SCOTTISH HOSPITALS INQUIRY

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Hearing Commencing
26 February 2024

Bundle 1 – Documents referred to in the expert report of Mr. Stephen Maddocks

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Re-Provision of RHSC and DCN at Little France
SECTION 4.23 SPECIFICATION – BUILDING SERVICES

JULY 2014 – 1st DRAFT – DOCUMENTS

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

NHS
Lothian

COMMERCIAL IN CONFIDENCE

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CONTENT

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.2 SMcK G1547**
Performance Specification Title	**Common Mechanical Clauses**	Date	**August 2014**
Prepared By	**BR**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Updated for Financial Closure	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
COMMON MECHANICAL CLAUSES

CONTENTS

1.0 GENERAL INTRODUCTION

Purpose of Document

This specification shall be read in conjunction with all other Mechanical and Public Health Specifications for the RHSC and DCN building and contains clauses common to all aspects of the mechanical and public health installation.

Fans & Pumps

All fan assemblies shall incorporate fan impeller and motors selected to provide the most energy efficient solution conforming to Section 6 regulations. All fans and pumps shall be fitted with IE2 efficiency motors to EN 60034-30:2009 as standard, and suitable for operation in ambient temperatures of 40 degrees C.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

Y10 PIPELINES

GENERAL

Project Co. shall supply all pipelines as new, undamaged, free from corrosion, not sub-standard and conform to the requirements of the specification.

Assist the manufacturer of any preformed or prefabricated pipework in the completion of their works.

Provide adequate and safe storage for all material in respect of their own works.

This shall include:

Purpose made racks for the storage of pipes and similar materials to prevent bending or distortion.

Purpose made cap ends to prevent dirt and rodent infestation.

Protect against frost, building works, or the operation of others.

Keeping clean, tidy, and free from waste and superfluous material all of their areas. For water services, pipe runs should not be excessively long and dead legs should be kept to an absolute minimum to avoid stagnation.

Where pipework joints are welded the procedure shall be carried out in accordance with Code of Practice TR/5.

Project Co. shall cut out the joints as selected and these will be examined for fault or excessive jointing material

110A STEEL PIPELINES FOR CHILLED WATER SYSTEMS and FOR LOW TEMPERATURE HOT WATER HEATING SYSTEMS FOR PIPE SIZES GREATER THAN 50mm and FOR PERMANENTLY CONCEALED SERVICES

- Thickness series for tubes to BS EN 10255: Heavy.
- Quality for tubes to BS EN 10216-1 or BS EN 10217-1: TR2.
- Finish: Varnish.
- Jointing method:
  - Permanently concealed: Welded class 1.
  - Accessible: Mechanical grooved joints 50-300 mm.

110B STEEL PIPELINES FOR NATURAL GAS SUPPLY SYSTEMS

- Thickness series for tubes to BS EN 10255: Above ground pipework to be heavy Duty welded throughout its length and painted yellow ochre.
- Quality for tubes to BS EN 10216-1 or BS EN 10217-1: Gas Pipework to be installed to BS EN 1775 & BS EN 15001.
- Finish: Varnish.
- Jointing method:
  - Permanently concealed: Welded class 1.
  - Accessible: welded.

110C STEEL PIPELINES FOR FUEL OIL SUPPLY SYSTEMS

- Thickness series for tubes to BS EN 10255: Medium . Quality for tubes to BS EN 10216-1 or BS EN 10217-1: TR1.
- Finish: Varnish.
- Jointing method:
  - Permanently concealed: Welded class 1.
  - Accessible: Screwed up to and including 50 mm or Welded and flanged 65 mm and Over.

110F STEEL PIPELINES FOR CHILLED WATER SYSTEMS and FOR LOW TEMPERATURE
HOT WATER HEATING SYSTEMS FOR PIPE SIZES LESS THAN 50mm

- Mapress carbon steel - unalloyed steel E 195 Quality for tubes.: Not applicable.
- Finish: Zinc plated.
- Jointing method:
  - Accessible: Mapress press fitting installed in accordance with manufacturer's instructions.

120B COPPER PIPELINES FOR REFRIGERENT PIPEWORK

- Standard: To BS EN 1057
  - Grade: R250 or Suitable for refrigerant gas used.
  Finish: Plain.
- Jointing method:
  - Permanently concealed: Brazed.
  - Accessible: Brazed.

130 PLASTICS WATER PIPELINES FOR UNDERGROUND POTABLE MAINS COLD WATER SUPPLY

- Manufacturer: Submit proposals.
  - Product reference: A water meter will be incorporated with direct reading and a BMS interface onto the incoming domestic mains supply at the entry to the site. A leak detection system will be linked to the BMS and difference in flows recorded to identify potential leaks. The site's domestic main water meter will be fitted with isolation valves and double check valves in accordance with the water byelaws.

- Pipe and fittings: PE 100 SDR 11. Site water mains will be installed in accordance with NJUG requirements. Where contaminated land is known use WRAS approved barrier pipe and backfill to be from a clean source.
  - Classification to BS 7291-1: Suitable for Mains water.
  - Classification to BS EN ISO 15874-1, BS EN ISO 15875-1, BS EN ISO 15876-1 or BS EN ISO 15877-1: BS EN 12201.
  - Classification to BS ISO 4427-1: Not applicable.
  - Colour: Blue.
- Jointing method: Electrofusion in accordance with manufacturer's instructions.

138 PLASTICS TREATED WATER PIPELINES FOR DEIONISED WATER

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Pipe and fittings: PVC-U. Cast iron must NOT be used in the construction of any pipes, fittings, valves, pumps or part thereof which may come into contact with the water.
  - Classification to BS 7291-1: Not applicable.
  - Classification to BS EN ISO 15874-1, BS EN ISO 15875-1, or BS EN ISO 15877-1: Not applicable.
  - Classification to BS ISO 4427-1: Not applicable.
  - Colour: Project Co. choice
- Jointing method: To suit tube.

140 STAINLESS STEEL PIPELINES FOR DOMESTIC HOT AND COLD WATER SERVICES

- Manufacturer: Submit proposals.
  - Product reference: Stainless Steel pipework shall be 316 S16 and comply with BS EN 10312, BS EN 10088-2, BS 3605 BS 864 part 2, DIN 2463, BS 4127, DIN 1988. Note that all these domestic supplies can only connect to outlets and equipment that are suitable for potable quality water supplies, i.e. Type A air gap protection. Cast iron may only be used in the construction of any pipes, fittings, valves, pumps or part thereof which may come into contact with the water if there is no other suitable alternative material available. The installation shall comply with HS (G) 70.
- Finish: Bright annealed
- Jointing method: Crimp in accordance with manufacturer's instructions.

140A STAINLESS STEEL PIPELINES FOR FILTERED WATER

- Manufacturer: Submit proposals.
  - Product reference: Stainless Steel pipework shall be 316 S16 and comply with BS EN 10312, BS EN 10088-2, BS 3605 BS 864 part 2, DIN 2463, BS 4127, DIN 1988. The installation shall comply with HS (G) 70. Cast iron must NOT be used in the construction of any pipes, fittings, valves, pumps or part thereof which may come into contact with the water.
- Finish: Bright annealed
- Jointing method: Board's proposals.

PRODUCTS

310 STEEL TUBES

- < 150 mm: To BS EN 10255.
- 150 mm and above: To BS EN 10216-1 and BS EN 10217-1.

320 JOINTING MATERIALS FOR STEEL TUBES

- Jointing compound: To BS 6956-5.
- PTFE tape: To BS EN 751-3.
- Flange jointing rings: To BS EN 1514-4.
- Elastomeric gaskets: To BS EN 681-1.
- Welding rods:
  - Gas welding: To BS EN 12536.
  - Arc welding: To BS EN ISO 636.

330 FITTINGS FOR STEEL TUBES

- Malleable: To BS 143 and BS 1256.
- Flanged: To BS EN 1092-1.
- Welded: To BS EN 10253-1 and BS EN 10253-2.
- Mechanical couplings: Manufacturer's standard.

340 COPPER TUBES

- Standard: To BS EN 1057.
  - Buried R220.
  - Above ground R250.

350 JOINTING MATERIALS FOR COPPER TUBES

- Solder for capillary fittings: To BS EN ISO 9453.
- Lead free solder for capillary fittings: To BS EN ISO 9453.
- Brazing filling: To BS EN 1044.
- Flange jointing rings: To BS EN 1514-4.

360 FITTINGS FOR COPPER TUBES

- Capillary: To BS EN 1254-1.
- Compression: To BS EN 1254-2.
- Flanges: To BS EN 1092-3.
- Press fittings: To manufacturer's standard.

373 POLYETHYLENE (PE) TUBES

- Standards:
  - Pipe:
    For gaseous fuels (PE): To BS EN 1555-2.
    For buried gaseous fuels (PE): To BS ISO 4437.
    For water supply (PE): BS EN 12201-2.
  - Fittings:
    For gaseous fuels: To BS EN 1555-3.
    For buried gaseous fuels (PE): To BS ISO 4437.
    For water supply: BS EN 12201-3.

385 JOINTING MATERIALS FOR PLASTICS TUBES

- Standards:
  - Compression: To BS EN 1254-3.
  - Electrofusion: To BS EN 12201-3.
  - Socket and spigot: To BS EN 12201-3.
  - Solvent cement: To BS EN 1452-3.
  - Elastomeric ring seal: To BS EN 1452-3.

390 STAINLESS STEEL TUBES

- Standards: To BS 4825-1 and BS EN 10312.

400 FITTINGS FOR STAINLESS STEEL TUBES

- Capillary: To BS 4825-2.
- Clamp type couplings: To BS 4825-3.
- Threaded (IDF type) couplings: To BS 4825-4.
- Recessed ring joint type (RJT) couplings: To BS 4825-5.
- Press fittings: To manufacturer's standard.

EXECUTION

Project Co. shall install services to building programme in a workman like manor and as specification. Due to the size of the water systems being installed all pressure testing and commissioning equipment shall be cleaned and chlorinated before each use. This is to prevent the systems from being contaminated with pseudomonas.

605 PIPELINES INSTALLATION GENERALLY

- Installation: In accordance with the latest edition of HVCA TR/20.
- Appearance: Install exposed pipe runs parallel with other pipe or service runs and building structure, taking account of gradients for draining or venting. Set vertical pipes plumb, or follow building line.
- Gradients: Install with gradients to allow drainage and air release.
- Air venting: Provide vents at high points.
- Draining: Provide drains at low points.
- Pipeline expansion and contraction: Arrange supports and fixings to accommodate pipeline movement caused by the thermal changes. Allow for movement at branch connections.
- Pipeline support: Arrange supports and accessories for equipment, appliances and ancillary fitments in pipelines, so that no undue strain is imposed upon pipes.
- Dirt, insects and rodents: Prevent ingress.

610 SPACING OF PIPELINES

- Minimum clearance between insulated pipelines and:
  - Wall finish: 25 mm.
  - Ceiling finish or soffit: 100 mm.
  - Floor finish: 150 mm.
  - Electrical services: 150 mm.
  - Adjacent services: 100 mm.
  - Uninsulated pipeline: 75 mm.
  - Another insulated pipeline: 25 mm.
- Minimum clearance between uninsulated pipelines and:
  - Wall finish: 25 mm.
  - Ceiling finish or soffit: 100 mm.
  - Floor finish: 150 mm.
  - Electrical services: 150 mm.
  - Adjacent services: 150 mm.
  - Another uninsulated pipeline: 25 mm.

620 PIPELINE SUPPORTS LTHW,CHW

- Type: Overstrap, washer and nuts.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
  - Material: Steel.

620A PIPELINE SUPPORTS COPPER PIPELINES

- Type: Pipe clip, sling rod, washer and nuts.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
  - Material: Brass.

620B PIPELINE SUPPORTS PVC PIPES

- Type: Pipe clip, sling rod, washer and nuts.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
  - Material: Brass or PVC

620C PIPELINE SUPPORTS ABOVE GROUND PRE-INSULATED PIPES

- Type: Overstrap, washer and nuts by manufacturer.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
  - Material: Steel.

620D PIPELINE SUPPORTS STAINLESS STEEL PIPEWORK

- Type: Pipe clip, sling rod, washer and nuts.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
  - Material: Stainless steel.

620E PIPELINE SUPPORTS NATURAL GAS AND FUEL OIL

- Type: Pipe clip, sling rod, washer and nuts.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
  - Material: Steel.

621 PIPELINE SUPPORT BRACKETS

- Type: Unistrut support for 50mm and below, submit proposals for pipe sizes above 50mm.
- Finish: Match pipeline supports.

625 PIPELINE FITTINGS

- Reductions and enlargements:
  - On horizontal pipeline runs: Eccentric.
  - On vertical pipeline runs: Concentric.
- Bushes: Use only at radiators.
- Square tees: Provide at vent and drain points.
- Square elbows: Do not use.
- Fabricated junctions and fittings: Same material as the main pipeline.
- Demountable joints: Regularly spaced along pipeline runs and at items of equipment.

630A PIPELINE SLEEVES

- Sleeves: Fit to pipes passing through building fabric.
- Material: Match pipeline.
- Size: One or two sizes larger than pipe to allow clearance. Continue insulation and vapour barrier through sleeve on chilled water services and agree fire break continuing detail with Building Control Officer.
- Finish: Install sleeves flush with building finish. In areas where floors are washed down, install protruding 100 mm above floor finish.
- Sealing: seal between building fabric and sleeve to maintain same fire or acoustic integrity as wall/floor shall be by Project Co.
- Masking plates: Fit at visible penetrations, including through false ceilings of occupied rooms.

635 DISSIMILAR METALS

- Electrolytic corrosion: Prevent.

640A ANCHORS GENERALLY

- Design: To resist axial stress transmitted by flexure of horizontal and vertical pipe runs, and loading on vertical pipes.
- Fixings: Provide associated backing plates, nuts, washers and bolts for attachment to, or building into building structure.
- Building structure: Suitable for transmitted stress. Board's Proposals to be submitted.

645A ANCHORS FOR STEEL PIPES

- Anchor: Two slip on flanges welded to pipes, bolted together through a mild steel channel section.
- Fixing: Bolted to building structure.
- Pipe restraints: Mild steel overstraps or heavy U-bolts welded to pipes.
- Board's Proposals to be submitted.

650 ANCHORS FOR COPPER PIPES

- Anchor: Two flanges fixed to copper female adaptors.
- Anchor fixing: Bolted to building structure.
- Pipe restraints: Saddle clamps.

660 SLIDE GUIDES

- Expansion and contraction: Direct movement from pipe anchor points towards loops, bellows or flexible inserts.
- Thrust: Linear relative to the axis of pipe.
- Friction: Apply a friction reducing material between metal faces subjected to movement.

665A WELDING STEEL PIPEWORK GENERALLY

- Standard: In accordance with HVCA TR/5.
- Welder identification: Mark each weld to identify operative.
- Non-destructive testing method: Ultrasonic examination and/or Board's proposals.
- Completed welds: Wire brush and protect from corrosion.

670 FLANGED JOINTS IN STEEL PIPES

- Preparation:
  - Flange mating faces: Parallel.
  - Flange peripheries: Flush with each other.
  - Bolt holes: Align correctly.
- Welded flanges: Weld neck and bore of 'slip on' flanges. Butt weld neck of welding neck flanges.
- Screwed flanges: Apply jointing materials. Screw on flange. Expand tube into flange.
- Making and sealing: Insert jointing between flange mating faces. Tighten joint equally all round.

675 SCREWED JOINTS IN STEEL PIPES

- Preparation of plain ends: Cut square. Ream out bore. Screw, taper thread.

- Making and sealing: Coat male pipe threads with jointing compound and hemp, or PTFE tape on small sizes. Immediately after connect with female end of socket or fitting, and tighten. Remove coating intruding into pipe. Leave joint clean.

680 MECHANICAL JOINTS IN GROOVED STEEL AND STAINLESS STEEL PIPES

- Preparation: Cut ends square, free of bumps, dents and score marks within manufacturer's tolerances. Form groove and assemble.
- Making and sealing: Thoroughly lubricate gasket, externally and internally. Stretch over pipe end and bring pipe ends together. Slide gasket into central position over both pipe ends. Position joint half housings over gasket and insert bolts, nuts and electrical continuity clip if required. Tighten bolts. Check alignment of joint and pipework.

680A MECHANICAL JOINTS IN MAPRESS CARBON STEEL AND STAINLESS STEEL PIPES

- Preparation: Cut ends square, free of bumps, dents and score marks within manufacturer's tolerances.
- Making and sealing: Use manufacturer's specialist tools to form joint. Check alignment of joint and pipework. Identify joint as being complete, e.g. spray paint.

700 CAPILLARY JOINTS IN COPPER PIPES

- Standard: To BS EN 1254-1.
- Preparation: Cut square and deburr. Clean plain ends using fine steel wool.
- Making and sealing: Do not use excess flux. Make joint. Clean off traces of flux when completed.

710 COMPRESSION JOINTS IN COPPER PIPES

- Standard: To BS EN 1254-2.
- Preparation: Cut square and deburr.
- Making and sealing:
  - Type A: Compress ring onto the wall of the tube.
  - Type B: Compress the formed portion of the tube against the formed end of the fitting.

730 COMPRESSION JOINTS IN STAINLESS STEEL PIPES

- Standard: To BS EN 1254-2.
- Preparation: Cut square and deburr.
- Making and sealing:
  - Type A: Compress ring onto the wall of the tube.
  - Type B: Compress the formed portion of the tube against the formed end of the fitting.

745 JOINTS IN PVC PIPES

- Type: Solvent welded generally, and ring seal at expansion joints.
- Preparation: Cut plain ends square and deburr. Clean plain ends using solvent cleaner.

750 FUSION JOINTS IN POLYETHYLENE PIPES

- Preparation: Cut plain ends square. Form pipe ends for socket type joints.

755 MECHANICAL FITTINGS FOR POLYETHYLENE PIPES

- Preparation: Cut plain ends square. Check wall thickness and pressure rating of fitting.

COMPLETION

910 GENERAL INSPECTION AND TESTING

- Inspection of joints: Cut out, cut open and inspect.
- Number of joints: Testing of gas pipework in accordance with BS EN 1775 & BS EN 15001. Testing of other pipework to be in accordance with TR/20. See also section Y50 mechanical commissioning.
- Safety precautions: In accordance with HSE GS4.

Y11 PIPELINE ANCILLARIES

GENERAL

Project Co. shall supply all pipeline ancillaries as new, undamaged, free from corrosion, not sub-standard and conform to the requirements of the specification. Provide adequate and safe storage for all material in respect of their own works.

This shall include:

Purpose made storage of pipeline ancillaries and similar materials to prevent damage. Protect against frost, building works, or the operation of others. Keeping clean, tidy, and free from waste and superfluous material all of their areas

110 PIPELINE ANCILLARIES FOR INCOMING MAINS WATER SUPPLY

- Water supply: PE 80 - Draw off taps and stop valves TO ISO 14885 electrofusion or compression. Suitable for pipe to BS EN 12201.
- Accessories: Backflow prevention devices.

120 PIPELINE ANCILLARIES FOR HOT AND COLD WATER SUPPLY

- Float valves: Fully variable delayed action.
- Isolating valves: Ball valves, stainless steel to BS ISO 7121I, complete with integral flow regulators/restrictors.
- Check valves: Stainless steel.
- Regulating valves: Stainless steel.
- Mixing valves: Thermostatic mixing valves for use in care establishments to SHTN 6.
- Draining devices: DOC at end of run stainless steel.
- Expansion devices: Expansion loops, stainless steel.
- Vibration isolation: Not required.
- Gauges: Temperature.
- Accessories: Not required.

120A PIPELINE ANCILLARIES FOR FILTERED WATER SYSTEMS

- Float valves: Piston type stainless steel.
- Isolating valves: Ball valves, stainless steel to BS ISO 7121I.
- Check valves: Stainless steel.
- Regulating valves: Not required.
- Mixing valves: Thermostatic mixing valves for use in care establishments to SHTN 6.
- Draining devices: DOC at end of run stainless steel.
- Expansion devices: Expansion loops, stainless steel.
- Vibration isolation: Not required.
- Gauges: Temperature.
- Accessories: Not required.

130 PIPELINE ANCILLARIES FOR HEATING SYSTEMS

- Isolating valves: Ball valves, cast iron or steel butterfly and gate valves, copper alloy to BS EN 7121, BS EN 12288, BS EN 13709.
- Check valves: Lift type to BS EN 12334, BS EN 12288, BS EN 13709.
- Regulating valves: Variable orifice valve (used for measuring, regulating and isolating). Brass double regulating to BS 7350. PICV control valves.
- Radiator valves: Radiator valves to BS 2767, fixed orifice valve (used for isolating only).
- Draining and venting devices: Brass automatic air vents and draining taps to BS EN 1982.
- Expansion devices: Expansion loops, steel to BS EN 898-1, BS EN 10255.
- Vibration isolation: Rubber bellows.
- De-aerators: As indicated on drawings.
- Separators: Combined air and dirt separators.
- Gauges: Pressure and altitude and Temperature to BS EN 837.
- Accessories: Pipeline strainers and Test points.

140 PIPELINE ANCILLARIES FOR CHILLED WATER AND CONDENSER WATER SYSTEMS

- Isolating valves: Ball valves, cast iron or steel butterfly and gate valves, copper alloy to BS EN 7121, BS EN 12288, BS EN 13709.
- Check valves: Lift type to BS EN 12334, BS EN 12288, BS EN 13709.
- Regulating valves: Variable orifice valve (used for measuring, regulating and isolating).Brass Double regulating to BS 7350. PICV control valves.
- Draining and venting devices: Brass automatic air vents and draining taps to BS EN 1982.
- Expansion devices: Not required.
- Vibration isolation: Rubber bellows.
- De-aerators: Pressure differential de-aerators.
- Separators: Dirt separators.
- Gauges: Pressure and altitude and Temperature to BS EN 837.
- Accessories: Pipeline strainers and test points.

PRODUCTS

302 CONNECTIONS FOR ANCILLARIES

- Capillary: To BS EN 1254-1.
- Compression for copper tubes: To BS EN 1254-2.
- Compression for plastics pipes: To BS EN 1254-3.
- Flanged for cast iron: To BS EN 1092-2.
- Flanged for copper alloy: To BS EN 1092-3.
- Threaded:
  - Where pressure-tight joints are made on the threads: To BS 21 or BS EN 10226-1.
  - Where pressure-tight joints are not made on the threads: To BS EN ISO 228-1

309 WATER SUPPLY - STOP VALVES FOR POTABLE WATER TO BE STAINLESS STEEL

- Standard: To BS EN 1213.
- Type: Straight.
- Manufacturer: submit proposals
  - Product reference: Project Co. choice
- Material: Copper alloy.
- Connections: Compression.

311 WATER SUPPLY - STOP VALVES, UNDERGROUND GENERAL

- Standard: To BS 5433.
- Type: To suit Pipe work.
- Manufacturer: To suit pipework.
  - Product reference: To suit pipework.
- Material: Bronze.
- Connections: Union ends.

321 FLOAT OPERATED VALVES, PISTON TYPE

- Valve to suit Stainless Steel pipework.
- Standard: To BS 1212-1.
- Type: Non-equilibrium.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Seat bore and body pattern designation: Submit proposals.
- Connections: To suit connection.

323 FLOATS FOR BALL VALVES GENERAL

- Standards:
  - Plastics: To BS 2456.
- Type: Spherical.
- Manufacturer: Project Co. choice
  - Product reference: Project Co. choice
- Diameter: To suit system.
- Grade: To suit system.

331 ISOLATING VALVES - BALL VALVES, CAST IRON OR STEEL GENERAL

- Standard: To BS ISO 7121.
- Type: Full bore.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Carbon steel.
- Connections: Threaded.
- Options: Wrench.

333 ISOLATING VALVES - BALL VALVES

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Not brass copper alloy.
- Connections: Threaded.
- Finish: Natural.

335 ISOLATING VALVES - BUTTERFLY VALVES GENERAL

- Standard: To BS EN 593.
- Type: Single flange wafer body.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Materials:
  - Body: Carbon steel.
  - Shaft: Nickel-copper alloy.
  - Disk: Aluminium bronze.
  - Seat: Ethylene propylene diene monomer (EPDM) .
- Operation: Gear.

353 CHECK VALVES, CAST IRON GENERAL

- Standard: To BS EN 12334.
- Type: Lift.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Body type: Flanged.
- Mounting: To suit system.
- Iron type: Grey.
- Connections: Flanged.

355 CHECK VALVES, LIFT TYPE GENERAL

- Standard: To BS 5154 or BS EN 12288.
- Type: Straight.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Series: A.
- Material: Not copper alloy.
- Connections: To suit pipework and standard.

365 REGULATING VALVES - DOUBLE GENERAL

- Standard: To BS 7350.
- Type: Globe.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Not copper alloy.
- Connections: Threaded.

367 REGULATING VALVES - FLOW MEASURING DEVICES GENERAL

- Standard: To BS 7350.
- Type: 4.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Copper alloy.
- Connections: Threaded.

367A DIFFERENTIAL PRESSURE CONTROL VALVES (DPCV)

- Standard: To BS 7350.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Type: self actuating
- Operating pressure range: 20 to 100kPa

- Operating temperature range: 6 to 120 deg C
- Material:
  - body Copper alloy or cast iron
  - Seat: stainless steel
  - plug: <50mm brass: >50mm stainless steel
- Connections: Threaded or flanged.

377 THERMOSTATIC MIXING VALVES FOR USE IN CARE ESTABLISHMENTS FOR DOMESTIC HOT WATER SERVICES

- Standard: To BS 7942.
- Type: To comply with SHTN 6.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Accessories: Flow rate regulators and Integral backflow devices.

385 RADIATOR VALVES GENERAL

- Standard: To BS 2767.
- Type: Angle pattern.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Bronze with chrome finish.
- Connections: Threaded.
- Finish: Chrome plated.
- Options: To suit system.

387 THERMOSTATIC RADIATOR VALVES

TRV's shall have the facility to allow the removal and replacement of the internal valve component while still under pressure from the main system in full operation. shall provide two no. specialist valve removal kits for use during the occupational period of the hospital. Project Co. shall ensure that the combination of thermostatic radiator valves and associated isolation/regulation valves do not have a greater pressure drop than 15kPa under maximum design flow rates.

- Standards: To BS 7478 and BS EN 215.
- Type: Integral sensor with multi position locking. Valves to be either occupant adjustable or remote sensor which are non adjustable.
- Pattern: To suite installation.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Connections: Internal pipe thread and cone seated union.

401 DRAINING AND VENTING DEVICES - AUTOMATIC AIR VENTS GENERAL

- Type: Vertical inlet with integral lockshield isolating valve (Valves to be Stainless Steel when used with H&CWS) non-corrodible needle valve and seats. Discharge pipe to be terminated in a conspicuous position.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Gunmetal.
- Connections: Threaded.

403 DRAINING AND VENTING DEVICES - DRAINING TAPS (Valves to be Stainless Steel when used with H&CWS)

- Standard: To BS 2879.
- Type: 1.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Bronze.
- Connections: Threaded.

415 EXPANSION DEVICES - EXPANSION COMPENSATORS, LATERAL GENERAL

- Standards: In accordance with BS 6129-1 and to BS ISO 15348.
- Type: Two tie bars.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material:
  - Bellows: Stainless steel 1.4571 (316 Ti), to BS EN 10088-1
  - Inner sleeve: Stainless steel 1.4541 (321), to BS EN 10088-1
  - Tie bars: Gr 8.8, to BS EN ISO 898-1, zinc plated
- Connections: Flanged

421 VIBRATION ISOLATION - FLEXIBLE HOSES General - SHALL NOT BE USED ON DOMESTIC WATER SERVICES

- Type: Rubber cored.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Ethylene propylene diene monomer (EPDM) rubber hose with stainless steel braid.
- Connections:
  - Rubber cored: To suit system.
  - Stainless steel: To suit system.

423 VIBRATION ISOLATION - RUBBER BELLOWS

Flexible connections shall be fitted to all pump suction and discharged connections, chillers and other centrifugal reciprocating or vibrating equipment and where anti-vibration mounts or inertia bases are fitted. Spacer pieces shall be installed during the construction phase with the flexible connection not being put in place until the system is complete. Flexible connections shall be suitable for the system type in which they are installed. Bellows shall be installed as close to the vibration source as possible. Rubber bellows shall be of reinforced EDPM rubber with wire-reinforced cuffs. Flanges shall be able to swivel and be removable. Tie bars with top hat washers shall be used where working pressure exceeds 1.5 bar. Where united bellows are used the manufactures recommendations for anchors and guides shall be followed. All flexible connections used on heating circuits shall have a design life of 120 months at the given conditions and after this time have a minimum burst pressure of 30 bar. For working temperatures between 70 and 100°C the bellows carcase shall be steel wire mesh reinforced throughout. For temperatures above 100°C bellows shall be of thick wall spirally wound multi -ply construction. For potable cold and hot water services the bellows liner shall be of a food grade butyl rubber.

- Type: Tied.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

- Material:
  - Liner: To suit system.
  - Reinforcement: Corrosion resistant steel wire.
  - Cover: Ethylene propylene diene monomer (EPDM) rubber.
- Connections: Flanged.

431 DE-AERATORS, PRESSURE: DIFFERENTIAL CHILLED WATER

- Type: Self circulating unit.
- Manufacturer: As schedule.
  - Product reference: As schedule.
- Material: Carbon steel.
- Connections: As schedule.

439 COMBINED AIR AND DIRT SEPARATORS: LTHW HEATING

The combined dirt and air separator shall be fitted to the main flow header of the primary heating water system.

The deaerator shall be capable of conditioning the water to make it highly absorptive at all points in the system by removing not only free but also dissolved gases released in the form of micro bubbles and also providing sludge removal.

The deaerator shall be at least line size and flanged to PN16 for sizes 50mm and above. The automatic air release system shall be installed complete with isolating valve to allow removal of automatic air vent and tamper proof air release valve. The valve shall be self closing and guaranteed against leakage.

The deaerator shall be mounted in a horizontal pipe at the hottest part of the system. The separator shall remove all dirt particles heavier than water down to 10 micron whilst keeping a constant pressure drop.

Velocity through the deaerator shall be no more than 1.5m/s.

- Type: Vertical housing with internal large surface area mechanism to remove microbubbles via coalescence effect.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Carbon steel.
- Connections: Flanged.

441 DIRT SEPARATORS: CHILLED WATER

- Type: Vertical mild steel housing with internal reservoir, sludge pipe, perforation plate and automatic air release mechanism.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Carbon steel.
- Connections: Flanged.

451 GAUGES, PRESSURE AND ALTITUDE GENERAL

- Standard:
  - Bourdon: To BS EN 837-1.
  - Diaphragm: To BS EN 837-3.
- Diameter: 100 mm.

- Manufacturer: Calibrated, to twice the working pressure complete with lever handle gauge cock and adjustable red dial pointer. White faced with black scale.
  - Product reference:.
- Case: To suit pipework and standard.
- Connections: To suit pipework.

453 GAUGES, TEMPERATURE GENERAL

- Standard: To BS EN 13190.
- Type: Bi-metallic.
- Manufacturer: Submit proposals.
  - Product reference: For LTHW 0 120 with divisions of 1 deg C all to be calibrated.
- Diameter: 100.
- Case: Brass.
- Connections: To suit pipework.
- Integral accessories: 100 mm immersion length pocket.

465 ACCESSORIES - BACKFLOW PREVENTION DEVICES GENERAL

- Standards:
  - Anti-pollution check valves: To BS EN 13959.
  - Check valves: To BS 6282-1.
  - Combined check and anti-vacuum valves: To BS 6282-4.
  - Hose union: To BS EN 14454.
  - In-line anti-vacuum valves: To BS EN 14451.
  - Terminal anti-vacuum valves: To BS 6282-2.
- Type: Submit proposals.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Copper alloy.

467 ACCESSORIES - PIPELINE STRAINERS

Strainers shall be install in location to ensure commissioning can be completed as per this specification.

- Type: Simplex basket.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: To suit pipework and standard.
- Connections: To suit pipework.
- Integral accessories: Plugged connections for drain, air vent and differential pressure monitoring.

469 ACCESSORIES - SAFETY VALVES GENERAL

- Standard: To BS EN ISO 4126-1.
- Type: Double.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: To suit pipework and standard.
- Connections: To terminate 150mm from floor level adjacent to gulley position.

471 ACCESSORIES - TEST POINTS GENERAL

- Type: Self sealing.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: To suit pipework and standard.
- Connections: To suit pipework.

FABRICATION

Project Co. shall assist the manufacturer of any preformed or prefabricated pipework in the completion of their works to ensure a correct and timely installation.

510 FABRICATED ANCILLARIES

- Proposals: Submit.
- Content: Include the following:
  - Overall dimensions.
  - Shop fabrication drawings.

520 EXPANSION LOOPS, STAINLESS STEEL for HWS

- Standard: To BS EN 1057.
- Type: Formed bends from single pipe length.

530 EXPANSION LOOPS, STEEL FOR LTHW SYSTEMS

- Standard: To BS EN 10255.
- Type: Jointed welded fittings.

540 AIR BOTTLES GENERAL.

- Construction: A vertical extension from pipe.
  - Size: Bore of pipe.
  - Length: Submit proposals.
- Extension pipe: Copper with a manual vent cock located in an easily accessible position.

EXECUTION

Project Co. shall install services to building programme in a workman like manner and as specification.

610 INSTALLATION OF VALVES GENERALLY

- Installation: In accordance with BS 6683.
- Location: As drawings, specification and standards.
- Isolation and regulation valves: Provide at equipment and on sub circuits.
- Access: Locate valves so they can be readily operated and maintained. Locate next to equipment which is to be isolated.
- Connection to pipework: Fit with joints that suit the pipe material.

620 INSTALLATION OF DOUBLE REGULATING VALVES

- Locations: Provide 10 diameters of straight pipe upstream of valve and 5 diameters downstream.

640 INSTALLATION OF FLOW MEASUREMENT DEVICES

- Locations: Provide straight length of pipe upstream and downstream.

655 INSTALLATION OF THERMOSTATIC RADIATOR VALVES

- Locations: In areas which represent the space temperature, e.g. not behind curtains or enclosed in heating or radiator panels.

660 INSTALLATION OF VENT COCKS

- Discharge pipes: Provide at outlets of vent cocks.

665 INSTALLATION OF DISCHARGE CONNECTIONS

- Safety and relief valves: Terminate at a safe discharge point.
- Vent cocks: Terminate 150 mm above floor level.
- Air bottles: Terminate with air cock or needle valve in a convenient position.
- Automatic air vents: Terminate over a suitable gully or drain line in a visible location.

685 INSTALLATION OF COMBINED AIR AND DIRT SEPARATORS

- Locations: Fit with dirt drain at lowest point for removing dirt that sinks.

690 INSTALLATION OF EXPANSION LOOPS

- Location: As drawings and specification.
- Stress: Minimize.

695 INSTALLATION OF CONTROL COMPONENTS

- Locations: Project Co. shall liaise with the controls specialist to ensure all controls are supplied and installed as specification and drawings. This shall include all controls that have been free issued to equipment manufactures. Control valve selection shall show figures for the valve authority.
- Insulation: Submit details of proposed insulation method where control components are on insulated pipelines.
- Supports: Do not strain components.
- Access: Adequate for operation and maintenance.

COMPLETION

910 VALVE TESTS

- Standard: To BS EN 12266-1.

920 KEYS

- Tee handled short shank keys: Supply for valve spindle shanks.
  - Number: 10.
- Lever pattern keys: Supply for drain cocks.
  - Number: 10.

930 HOSE UNIONS

- Spares: Supply for drain cocks.
  - Number: 10.

Y12 MECHANICAL CLEANING AND CHEMICAL TREATMENT

EXECUTION

Project Co. shall provide a Method statement for cleaning and chemical treatment.

610 GENERALLY

- Water analysis: Analyse water samples before treatment.
- Preliminary checks: Before cleaning or chemical treatment, complete pressure tests.
- Disposal of waste: Neutralize waste products and dispose to drain.

620A FLUSHING OF HOT AND COLD WATER SYSTEMS

Standard: To BS 8558 and SHTN 2.
Installation checks: Thoroughly inspect pipework.
Drainage: Provide adequate drainage, preferably direct to manhole.

The use of stainless steel, PVC-U, PVC-C, PB or PE-X piping requires a leachate flushing regime to reduce the level of contaminants leaching from the piping material into the water. Details of this regime are given in SHTN 2. All parts in contact with the water must be non-dezincifiable. It is recommended that a specialist firms are engaged for the disinfecting and water sampling process. NOTE chlorine should NOT be used for the disinfection of stainless steel piping or membrane filters manufactured from polypropylene. Disinfection and subsequent flushing should be carried out as a continuous and consecutive operation without any intermediate delays.

630 FLUSHING OF HEATING AND CHILLED WATER SYSTEMS

- Flushing: In accordance with BSRIA AG 1/2001.1.
- Installation checks: Thoroughly inspect pipework.
- Drainage: Provide adequate drainage, preferably direct to manhole.

640 PURGING GAS PIPEWORK

- Standards: To IGE/UP/1 and IGE/UP/1A.

650 WATER TREATMENT FOR HOT AND COLD WATER SYSTEMS

- Standard: To BS 8558.
- Samples for analysis: Provide after flushing.

660 WATER TREATMENT FOR HEATING SYSTEMS

- Treatment: In accordance with BSRIA AG 2/93.
- Chemicals:
  - Corrosion inhibitors: Project Co. shall ensure all chemicals used in the cleaning and flushing of systems do not damage the pipe work or associated valves.
  - pH control: Submit proposals.
  - Scale inhibitors: Submit proposals.

670 WATER TREATMENT FOR CHILLED WATER SYSTEMS

- Treatment: In accordance with BSRIA AG 2/93.
- Chemicals:
  - Corrosion inhibitors: Project Co. shall ensure all chemicals used in the cleaning and flushing of systems do not damage the pipe work or associated valves.
  - pH control: Submit proposals.
  - Scale inhibitors: Submit proposals.

COMPLETION

910 WATER QUALITY TESTS

- Standard: To BS 8558.
- Samples: Submit samples for bacteriological analysis.
- Water temperature: Record the temperature of the water at each sampling point, at the time of taking the sample.
- Test results: Submit.

Y20 PUMPS
PRODUCTS

310A PUMP SELECTION

- General: Select pump at or near the most efficient part of the performance curve for required duty. Project Co. shall ensure that all pumps are installed in the correct orientation. Complete with isolation and non-return valves.

320 PUMPS GENERALLY

General safety standard: To BS EN 809.

- Electrical safety: To BS EN 60335-2-51.
- Dynamic balance: To BS ISO 2953.
- Test standards: To BS EN ISO 9906 and in accordance with BS EN ISO 5198.
- Belts and pulleys: To BS 3790.
- Rotodynamic pumps: To BS EN 1151-1 and -2.
- Connections:
  - Flanged, copper alloy and composite: To BS EN 1092-3.
  - Flanged, cast iron: To BS EN 1092-2.
  - Threaded: To BS 21 or BS EN 10226-1.

340 CLOSE COUPLED END SUCTION PUMPS GENERAL

- Standard: To BS EN 22858.
- Arrangement: As pump schedule.
- Manufacturer: Project Co. choice
  - Product reference: Project Co. choice
- Flow rate: As pump schedule.
- System resistance: As pump schedule.
- Motor and impeller speed (maximum): Submit proposals.
- Motor efficiency: IE2
- Electrical supply: As pump schedule.
- Speed control: Variable.
- Discharge branch: As pump schedule.
- Casing material: Submit proposals.
- Accessories: Pumps to be fitted with isolation and non-return valves and strainer.
- Connections: Flanged, cast iron, pumps to be mounted with anti-vibration mounts.

360 CLOSE COUPLED IN LINE PUMPS FOR HEATING and CHILLED WATER SYSTEM

- Arrangement: As pump schedule.
- Manufacturer: Project Co. choice
  - Product reference: Project Co. choice
- Flow rate: As pump schedule.
- System resistance: As pump schedule.
- Motor and impeller speed (maximum): Submit proposals.
- Motor efficiency: IE2
- Electrical supply: As Pump schedule.
- Speed control: Variable.
- Casing material: Grey cast iron to BS EN 1561.

- Accessories: Pumps to be fitted with isolation and non-return valves and strainer. Pump and fittings to be made from Non- dezincifiable material.
- Connections: Flanged. Pumps to be mounted with anti-vibration mounts .

360A CLOSE COUPLED IN LINE PUMPS FOR HOT WATER SERVICE

- Arrangement: As pump schedule.
- Manufacturer: Project Co. choice
  - Product reference: Project Co. choice
- Flow rate: As pump schedule.
- System resistance: As pump schedule.
- Motor and impeller speed (maximum): Submit proposals.
- Motor efficiency: IE2
- Electrical supply: As Pump schedule.
- Speed control: None
- Casing material: Bronze.
- Impeller: Stainless steel.
- Accessories: Pumps to be fitted with isolation and non-return valves and strainer.
- Connections: Flanged, cast iron, Pumps to be mounted with anti-vibration mounts

370 SUBMERSIBLE PUMPS

- Manufacturer: As pump schedule.
  - Product reference: As pump schedule.
- Material: Plastic.
- Flow rate: As pump schedule.
- System resistance: As pump schedule.
- Motor and impeller speed (maximum): As pump schedule.
- Electrical supply: As pump schedule.
- Accessories: Pumps to be fitted with isolation and non-return valves and filter.
- Connections: Threaded.

380 FUEL OIL TRANSFER PUMPS

- Application: Duty and/ or standby.
- Manufacturer: Project Co. choice
  - Product reference: Project Co. choice
- Flow rate: As pump schedule, pump to be suitable for type of fuel being used.
- System resistance: As pump schedule.
- Motor efficiency: IE2
- Electrical supply: As pump schedule.
- Accessories: Pumps to be fitted with isolation and non-return valves and filters. Pumps to have auto-changeover.
- Connections: Threaded, pumps to be mounted with anti-vibration mounts and fusible link lever type fire valve.

410A PRESSURISATION UNITS FOR LTHW SYSTEMS

- Standards:
  - Generally: To BS EN 13831.
  - Low temperature hot water heating: In accordance with BS 7074-2.
- General: Fully automatic pre-wired packaged unit on common base plate.

- Arrangement: The units shall be of the fully automatic type, pre-piped and pre-wired, and mounted on a common base frame. The units shall include a fully automatic make-up, mounted on anti-vibration mounting. Expansion vessels shall be of the number and size to suit the requirements of installation, and shall incorporate replaceable diaphragms. Units shall have an electrical control system, complete with integrated alarm, which is fail safe and linked to the heat source.
- Manufacturer: Project Co. choice
  - Product reference: Project Co. choice
- Static head: As schedule.
- Plant rating: As schedule.
- System water content: As schedule.
- Operating temperatures: As schedule.
- Operating pressure: As schedule.
- Electrical supply type: As schedule.
- Components: Microprocessor control with digital display and volt free contacts and audible Alarm. Pumps to BS 1452 and suitable for system, expansion vessel shall be welded steel stamped and tested with a heavy duty duty/EDPM diaphragm. Mains water break tank to water byelaws having an air gap. The integrated control panel shall have a indicating lights for each pump condition or status, run, hand, off, auto and tripped/fault. Pumps shall have auto changeover. Unit must be suitable for system temperatures.
- Accessories: Pressurisation units to be fitted with isolation and non-return valves.

410B PRESSURISATION UNITS FOR CHILLED WATER SYSTEMS

- Standards:
  - Generally: To BS EN 13831.
  - Chilled water and condenser water: In accordance with BS 7074-3.
- General: Fully automatic pre-wired packaged unit on common base plate.
- Arrangement: As Scheduled.
- Manufacturer: As schedule.
  - Product reference: As schedule.
- Static head: As schedule.
- Plant rating: As schedule.
- System water content: As schedule.
- Operating temperatures:
  - As schedule.
- Operating pressure: As schedule.
- Electrical supply type: As schedule.
- Components: Microprocessor control with digital display and volt free contacts and audible Alarm. Pumps to BS 1452 and suitable for system, expansion vessel shall be welded steel stamped and tested with a heavy duty duty/EDPM diaphragm. Mains water break tank to water byelaws having an air gap. The integrated control panel shall have a indicating lights for each pump condition or status, run, hand, off, auto and tripped/fault. Pumps shall have auto-changeover unit must be suitable for system Temperatures.
- Accessories: Pressurisation units to be fitted with isolation and non-return valves.

420 PRESSURE BOOSTER SETS WHOLESOME WATER

- Manufacturer: Project Co. choice
  - Product reference: As schedule. The booster set must be suitable for the system type. All connections to be 316 stainless steel. Pump sets shall incorporate a minimum of three pumps for domestic water supply all mounted on a single bed plate with necessary flanged suction and delivery manifold arrangements, anti-vibration mountings and remote/control panel showing pump status.
- Flow rate: As schedule.
- Maximum draw: As schedule.
- Working head: As schedule.
- Electrical supply type: As schedule.
- Operation: As schedule. The set point adjusted via the control panel. The control shall take care of adjustments to maintain constant pressure and optimum efficiency.
- Pumps:
  - Type: As schedule. The pumps shall be of the in-line vertical multi-stage design mounted on a common base frame provided with all the necessary fittings. Pumps shall be selected for silent operation with Integrated variable frequency drive motors. All parts of the pumps and valves that are in contact with the water must be of stainless steel.
  - Number: As schedule. Motor efficiency: IE2
- Control panel mounting: As schedule. The base shall be cast iron (class 30). The control of the booster set shall build on the master and slave principal where one pump is the master pump and where the other pumps act as slaves.
- Accessories: Pressure booster sets to be fitted with isolation, non-return and be skid mounted.

420A PRESSURE BOOSTER SETS: CWS

- Manufacturer: As schedule.
  - Product reference: As schedule. The booster set must be suitable for the system type. All connection to be 316 stainless steel. Pump sets shall incorporate a minimum of three pumps for domestic water supply all mounted on a single bed plate with necessary flanged suction and delivery manifold arrangements, anti-vibration mountings and remote/control panel showing pump status.
- Flow rate: As schedule.
- Maximum draw: As schedule.
- Working head: As schedule.
- Electrical supply type: As schedule.
- Operation: As schedule The set point adjusted via the control panel. The control shall take care of adjustments to maintain constant pressure and optimum efficiency.
- Pumps:
  - Type: As schedule. The pumps shall be of the in-line vertical multi-stage design mounted on a common base frame provided with all the necessary fittings. Pumps shall be selected for silent operation. All parts of the pumps and valves that are in contact with the water must be of stainless steel.
    Motor efficiency: IE2
    Control panel mounting: As schedule. The control of the booster set shall build on the master and slave principal where one pump is the master pump and where the other pumps act as slaves.

- Accessories: Pressure booster sets to be fitted with isolation, non-return and be skid mounted.

EXECUTION

610 INSTALLATION OF PUMPS GENERALLY

- Pipeline connections: Arrange to prevent transmission of pipeline forces to pump casing.
- Pressure gauge tappings: Provide in flow and return pipeline connections and in common suction and delivery pipeline.
- Brackets: Support pipeline mounted pumps on purpose made brackets lined with vibration absorbent material.
- Alignment: Align and balance to minimize vibration.
- Belt tension: Correctly tension drive belts.
- Access: Provide adequate space for service and maintenance.
- Identification plate: Engrave showing
  - manufacturer's name and address;
  - serial number;
  - duty and maximum head;
  - speed; and
  - electrical loading.

620 VIBRATION ISOLATION

- Flexible connections: As section Y11.
- Anti-vibration mountings: Submit proposals.

630 INSTALLING PRESSURISATION UNITS

- Location of expansion vessel: In the system return pipeline close to the heat source or chilled water unit.

COMPLETION

Project Co. shall provide a method statement for cleaning and chemical treatment. System pumps are not to be used for flushing. Also see section Y50

920 COMMISSIONING

- In-line pumps: Change impeller & motor if necessary.
- Test certificates and performance curves: Submit.

Y21 TANKS AND CISTERNS

PRODUCTS

Sectional tanks shall be installed and tested by the manufacturer
Each cistern shall be divided into two separate compartments; a full height partition shall be constructed from standard panels. Each compartment shall be treated as a separate cistern and shall be capable of working normally with one compartment empty. Ball valve boxes shall be provided on each cistern compartment and shall incorporate access panels in the top of each.

320 GLASS FIBRE REINFORCED TANKS AND CISTERNS: DOMESTIC COLD WATER

Bulk wholesome quality sectional water storage tanks and break tanks will be located within the basement of the hospital building. The tanks will store 100% of the total main hospital water storage. The tanks will be insulated and complete with raised ball valve housings, middle partitions, self-draining bases, flushing drain, overflows and all necessary connections to comply with Water Authority requirements. Separate connections will be made from the break tank header to the filtration plants. Separate connections will be made from the cold water storage tank header to the booster sets.

- Standard: To BS EN 13280.
  - Type: For wholesome water, To Scottish Water Byelaws, SHTM 2040 and BS 6700.
  - Class: To comply with current Scottish Water Byelaws, Byelaw 30 and BS 6700.
- Application: Cold water storage for domestic.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Capacity:
  - Maximum: As tanks and cisterns schedule.
  - Minimum: As tanks and cisterns schedule.
- Future requirement: As tanks and cisterns schedule.
- Maximum rate of filling and emptying: Refer to specification.
- Head fluctuations: Refer to specification.
- Cycles per day: Refer to specification.
- Water:
  - Quality: Potable.
  - Temperature: Refer to specification.
- Type and weight of float operated valve: As tanks and cisterns schedule.
- Manholes: 600 x 600 mm.
- Division plates: As tanks and cisterns scheduled.
- Baffle plates: As tanks and cisterns schedule.
- Weir plates: As tanks and cisterns scheduled.
- Limiting conditions: As tanks and cisterns schedule.
- Connections: As tanks and cisterns schedule.
- Support: As tanks and cisterns schedule.
- Inspection at factory: Not required.
- On site erection: By manufacturer.

- Accessories:
  - External access ladder;
  - Internal access ladder;
  - Level switches; and
  - Temperature probes. Hi/ Lo level and temperature Sensors to be BMS addressable.

360 TANK CONTENTS GAUGES: General

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Type: Sight glass.
- Float level indicator: Hydrostatic dial type.

380 VENT PIPES

- Materials: Stainless Steel.
- Jointing: Compression or capillary.

EXECUTION

610 INSTALLING TANKS AND CISTERNS

- Moulded plastics: To BS 4213.
- Glass reinforced plastics: To BS EN 13280.
- Access: Allow for internal and external inspection and cleaning.

COMPLETION

910 CLEANING

- General: Clean out tanks and cisterns before site testing and commissioning.

Y24 TRACE HEATING TAPES

PRODUCTS

330 TRACE HEATING TAPE FOR PIPELINES ABOVE GROUND MAINS AND DOMESTIC WATER EXTERNAL TO BUILDING

- Manufacturer: Project Co. choice
  - Product reference: The heat tape shall automatically adjusts heat output in response to increasing or decreasing pipe temperature, controllers shall have a thermostat and a terminal block within a polycarbonate enclosure environmentally protected to IP66 and be suitable for wall or pipe mounting and have volt-free contacts for use with Building Management Systems.
- Application: Frost protection.
- Pipe material: Stainless steel/polyethylene.
- Tape: Self regulating.
- Electrical voltage: As schedule.
- Accessories: As schedule.

EXECUTION

Generally the trace heating tape shall be installed in such a way to prevent damage to the trace heating system or the services.

620 INSTALLING ELECTRIC SURFACE HEATING ON METAL SURFACES

- Installation: In accordance with BS 6351-3.

Y30 MECHANICAL THERMAL INSULATION
GENERAL

Project Co. shall ensure that the insulation does not interfere with fire sleeves and stopping. Project Co. shall co-ordinate the lagging with the trace heating installation to ensure correct operation of both.

110B INSULATION TO CONTROL HEAT LOSS FOR HOT WATER PIPELINES INTERNAL

- Standard: To BS 5422, section 8.
- Insulation materials: Phenolic foam, thermal conductivity 0.024 W/mK.
- Insulation thickness to BS 5422 (minimum): Copper and stainless steel pipelines, high emissivity, table 18 and increase thickness by one additional size.
  - Temperature of contents: 65°C.
- Protection: Not required.
- Accessories to be insulated: Insulation for valves and flanges.

110C INSULATION TO CONTROL HEAT LOSS FOR HOT WATER PIPELINES IN PLANTROOMS

- Standard: To BS 5422, section 8.
- Insulation materials: Mineral fibre pipe section, thermal conductivity 0.040 W/m·K.
- Insulation thickness to BS 5422 (minimum): Copper and Stainless steel pipelines, high emissivity, table 18.
  - Temperature of contents: 65°C.
- Protection: Sheet aluminium casing. The sheet aluminium casing shall be supplied and installed on pipework upto 2m above FFL in the plantroom.
- Accessories to be insulated: Insulation for valves and flanges.

120A INSULATION TO CONTROL CONDENSATION FOR COLD WATER PIPELINES EXTERNAL

- Standard: To BS 5422, section 7.
- Insulation materials: Phenolic foam, thermal conductivity 0.018 W/m·K.
- Insulation thickness to BS 5422 (minimum): Stainless Steel pipelines, high emissivity, table 6.
  - Temperature of contents: 10°C.
- Vapour barrier: Required.
- Protection: Polyisobutylene.
- Accessories to be insulated: Insulation for valves and flanges. See drawings for trace heating Requirements.

120B INSULATION TO CONTROL CONDENSATION FOR COLD WATER PIPELINES INTERNAL

- Standard: To BS 5422, section 7.
- Insulation materials: Phenolic foam, thermal conductivity 0.018 W/m·K. Insulation thickness to BS 5422 (minimum): Stainless Steel pipelines, high emissivity, table 6.
  - Temperature of contents: 10°C.
- Vapour barrier: Required.
- Protection: Not required.
- Accessories to be insulated: Insulation for valves and flanges.

120C INSULATION TO CONTROL CONDENSATION FOR COLD WATER PIPELINES IN PLANTROOMS

- Standard: To BS 5422, section 7.
- Insulation materials: Phenolic foam, thermal conductivity 0.018 W/m·K.
- Insulation thickness to BS 5422 (minimum): Stainless Steel pipelines, high emissivity, table 6.
  - Temperature of contents: 10°C.
- Vapour barrier: Required.
- Protection: Sheet aluminium casing.
- Accessories to be insulated: Insulation for valves and flanges.

130A INSULATION TO CONTROL HEAT LOSS FOR LOW TEMPERATURE HOT WATER HEATING PIPELINES EXTERNAL

- Standard: To BS 5422, section 8.
- Insulation materials: Mineral fibre pipe section, thermal conductivity 0.040 W/m·K.
- Insulation thickness to BS 5422 (minimum): Copper and steel pipes, high emissivity, table 16 and increase thickness by one additional size.
  - Temperature of contents: 80°C.
- Protection: Polyisobutylene.
- Accessories to be insulated: Insulation for valves and flanges.

130B INSULATION TO CONTROL HEAT LOSS FOR LOW TEMPERATURE HOT WATER HEATING PIPELINES INTERNAL

- Standard: To BS 5422, section 8.
- Insulation materials: Phenolic foam, thermal conductivity 0.025 W/m·K.
- Insulation thickness to BS 5422 (minimum): Copper and steel pipes, high emissivity, table 16 and increase thickness by one additional size.
  - Temperature of contents: 80°C.
- Protection: Not required.
- Accessories to be insulated: Insulation for valves and flanges.

130C INSULATION TO CONTROL HEAT LOSS FOR LOW TEMPERATURE HOT WATER HEATING PIPELINES IN PLANTROOMS

- Standard: To BS 5422, section 8.
- Insulation materials: Mineral fibre pipe section, thermal conductivity 0.040 W/m·K.
- Insulation thickness to BS 5422 (minimum): Copper and steel pipes, high emissivity, table 16 and increase thickness by one additional size.
  - Temperature of contents: 80°C.
- Protection: Sheet aluminium casing. The sheet aluminium casing shall be supplied and installed on pipework upto 2m above FFL in the plantroom.
- Accessories to be insulated: Insulation for valves and flanges.

140A INSULATION TO CONTROL CONDENSATION FOR RAIN WATER PIPELINES ENERGY CENTRE & PLANTROOMS

- Standard: To BS 5422, section 7.
- Insulation materials: Mineral fibre pipe sections, thermal conductivity 0.033 W/m K.
- Insulation thickness to BS 5422 (minimum): Steel pipelines, high emissivity, table 6.
  - Temperature of contents: 5°C.
- Vapour barrier: Required.

- Protection: Sheet aluminium casing. The sheet aluminium casing shall be supplied and installed on pipework upto 2m above FFL in the plantroom.
- Accessories to be insulated: Insulation for valves and flanges. All surfaces to maintain vapour seal.

140B INSULATION TO CONTROL CONDENSATION FOR RAIN WATER PIPELINES INTERNAL

- Standard: To BS 5422, section 7.
- Insulation materials: Phenolic foam, thermal conductivity 0.018 W/m·K.
- Insulation thickness to BS 5422 (minimum): Steel pipelines, high emissivity, table 6.
  - Temperature of contents: 5°C.
- Vapour barrier: Required.
- Protection: Not required.
- Accessories to be insulated: Insulation for valves and flanges, All surfaces to maintain vapour seal.

145A INSULATION TO CONTROL HEAT GAIN FOR CHILLED WATER PIPELINES EXTERNAL

- Standard: To BS 5422, section 7.
- Insulation materials: Phenolic foam, thermal conductivity 0.018 W/m·K.
- Insulation thickness to BS 5422 (minimum): High emissivity, table 11.
  - Temperature of contents: 6°C.
- Vapour barrier: Required.
- Protection: Polyisobutylene.
- Accessories to be insulated: Insulation for valves and flanges.

145B INSULATION TO CONTROL HEAT GAIN FOR CHILLED WATER PIPELINES INTERNAL

- Standard: To BS 5422, section 7.
- Insulation materials: Phenolic foam, thermal conductivity 0.018 W/m·K.
- Insulation thickness to BS 5422 (minimum): High emissivity, table 11.
  - Temperature of contents: 6°C.
- Vapour barrier: Required.
- Protection: Not required.
- Accessories to be insulated: Insulation for valves and flanges.

145C INSULATION TO CONTROL HEAT GAIN FOR CHILLED WATER PIPELINES IN PLANTROOMS

- Standard: To BS 5422, section 7.
- Insulation materials: Phenolic foam, thermal conductivity 0.018 W/m·K.
- Insulation thickness to BS 5422 (minimum): High emissivity, table 11.
  - Temperature of contents: 6°C.
- Vapour barrier: Required.
- Protection: Sheet aluminium casing. The sheet aluminium casing shall be supplied and installed on pipework upto 2m above FFL in the plantroom.
- Accessories to be insulated: Insulation for valves and flanges.

150 INSULATION TO PROTECT AGAINST FREEZING FOR PIPELINES FOR EXPOSED PIPEWORK

- Standard: To BS 5422, section 11. Insulation materials: Mineral fibre pipe sections, thermal conductivity 0.033 W/m K.
- Insulation thickness to BS 5422 (minimum): Selected commercial and institutional conditions, table 29.
  - Specified conditions: See Y24 for trace heating requirements.
- Protection: Sheet aluminium casing.
- Accessories to be insulated: Insulation for valves and flanges.

160 INSULATION FOR CONDENSATION CONTROL ON DUCTWORK CARRYING CHILLED AIR IN PLANT ROOMS & RISERS

- Standard: To BS 5422, section 8.
- Insulation materials: Mineral fibre slabs, thermal conductivity 0.032 W/m·K at 0°C.
- Insulation thickness to BS 5422 (minimum): Table 12 for 18°C & Table 14 for 13°C AHU's.
  - Minimum air temperature inside duct: 10°C.
  - Emissivity: Low.
- Vapour barrier: Required.
- Protection: Sheet aluminium casing for low level ductwork.
- Accessories to be insulated: All surfaces to maintain vapour seal.

160A INSULATION FOR CONDENSATION CONTROL ON DUCTWORK CARRYING CHILLED AIR EXTERNAL

- Standard: To BS 5422, section 8.
- Insulation materials: Mineral fibre slabs, thermal conductivity 0.032 W/m·K at 0°C.
- Insulation thickness to BS 5422 (minimum): Table 12 for 18°C & Table 14 for 13°C AHU's.
  - Minimum air temperature inside duct: 10°C.
  - Emissivity: Low.
- Vapour barrier: Required.
- Protection: Polyisobutylene.
- Accessories to be insulated: All surfaces to maintain vapour seal.

160B INSULATION FOR CONDENSATION CONTROL ON DUCTWORK CARRYING CHILLED AIR INTERNAL

- Standard: To BS 5422, section 8.
- Insulation materials: 13°C AHU's Phenolic foam, thermal conductivity 0.018 W/m·K and 18°C AHU's Mineral fibre slabs, thermal conductivity 0.035 W/m·K.
- Insulation thickness to BS 5422 (minimum): Table 12 for 18°C & Table 13 for 13°C AHU's.
  - Minimum air temperature inside duct: 10°C.
  - Emissivity: Low.
- Vapour barrier: Required.
- Protection: Not required.
- Accessories to be insulated: All surfaces to maintain vapour seal.

170 INSULATION TO CONTROL HEAT LOSS FOR DUCTWORK CARRYING WARM AIR PLANTROOMS & RISERS

- Standard: To BS 5422, section 8.
- Insulation materials: Mineral fibre slabs, thermal conductivity 0.035 W/m·K.
- Insulation thickness to BS 5422 (minimum): Table 12 for 18°C & Table 13 for 13°C AHU's.
  - Emissivity: Low.
- Protection: Sheet aluminium casing for Low level ductwork.
- Accessories to be insulated: Control and Fire dampers.

170A INSULATION TO CONTROL HEAT LOSS FOR DUCTWORK CARRYING WARM AIR EXTERNAL

- Standard: To BS 5422, section 8.
- Insulation materials: Mineral fibre slabs, thermal conductivity 0.035 W/m·K.
- Insulation thickness to BS 5422 (minimum): Table 12 for 18°C & Table 13 for 13°C AHU's.
  - Emissivity: Low.
- Protection: Polyisobutylene.
- Accessories to be insulated: Control and Fire dampers.

170B INSULATION TO CONTROL HEAT LOSS FOR DUCTWORK CARRYING WARM AIR INTERNAL

- Standard: To BS 5422, section 8.
- Insulation materials: 13°C AHU's Phenolic foam, thermal conductivity 0.020 W/m·K and 18°C AHU's Mineral fibre slabs, thermal conductivity 0.035 W/m·K.
- Insulation thickness to BS 5422 (minimum): Table 12 for 18°C & Table 13 for 13°C AHU's.
  - Emissivity: Low.
- Protection: Not required.
- Accessories to be insulated: Control and Fire dampers.

180 INSULATION TO CONTROL HEAT LOSS FOR LOW TEMPERATURE HOT WATER HEAT EXCHANGERS, CYLINDERS AND BUFFER VESSELS FOR NON - PRE LAGGED

- Standard: To BS 5422, clause 8.
- Insulation materials: Mineral fibre slabs, thermal conductivity 0.040 W/m·K.
- Insulation thickness to BS 5422 (min): Copper & steel vessels, low emissivity, table 15.
  - Temperature of contents: 80°C
- Protection: Sheet aluminium casing.
- Accessories to be insulated: Cover plates and Removable access covers.

190A INSULATION FOR FLUES BOILERS, GENERATORS & CHP UNITS

- Insulation materials: Boiler flues to be twin walled complete with insulation by the manufacturer.
- Protection: See boiler and flue specification for further information.
- Accessories to be insulated: See boiler and flue specification for further information.

PRODUCTS

330 MINERAL FIBRE PIPE SECTION INSULATION GENERALLY
- Standard: To BS 3958-4.
- Manufacturer: Submit proposals
  - Product reference: Submit proposals
- Recycled content: 50 % (minimum) to BS EN ISO 14021.
- Finish: Aluminium foil faced.

340 MINERAL FIBRE SLABS INSULATION GENERALLY
- Standard: To BS 3958-5.
- Manufacturer: Submit proposals
  - Product reference: Submit proposals
- Form: Rigid slabs.
- Recycled content: Submit proposals.
- Finish: Aluminium foil faced.

360 PHENOLIC FOAM INSULATION GENERALLY
- Standard: To BS EN 13166.
- Manufacturer: Submit proposals
  - Product reference: Submit proposals
- Form: Duct slab & pipe sections with zero ODP
- Finish: Aluminium.

380 VAPOUR BARRIER PERMEANCE
- Standard: To BS 5422, clause 5.6.

405 POLYISOBUTYLENE PROTECTION GENERALLY
- Manufacturer: Submit proposals
  - Product reference: Submit proposals
- Colour: Submit proposals.

425 SHEET ALUMINIUM CASING PROTECTION GENERALLY
- Manufacturer: Submit proposals
  - Product reference: Submit proposals
- Finish: Manufacturer's standard.

480 INSULATION FOR VALVES AND FLANGES GENERALLY
- Insulation materials: To match pipelines insulation.
  - Finish: To match pipelines finish.
  - Form: Removable and reusable preformed rigid covers.

495 INSULATION AT LOADBEARING PIPELINE SUPPORTS
- Hot pipelines up to 120°C: 300 mm length of high density phenolic foam.
- Hot pipelines above120°C: 300 mm length of calcium silicate.
- Cold pipelines: 300 mm length of high density phenolic foam.

EXECUTION

610 INSTALLATION GENERALLY

- Standard: In accordance with BS 5790.
- Timing: Insulate after installed system has been fully tested and joints proved sound.
- Insulation: Do not enclose adjacent units together.
- Clearance: Maintain between pipes.
- Finish: Neatly finish joints, corners, edges and overlaps.

625 INSTALLATION OF FOIL FACED MINERAL FIBRE INSULATION ON PIPELINES

- Joints: Close butt, seal with 50 mm wide class O tape on both longitudinal and circumferential joints.
- At fittings: Mitre. Secure with tape.
- Vapour seal: Tape exposed insulation membrane. Seal vapour barrier at pipe support with class O tape.

640 INSTALLATION OF PHENOLIC FOAM INSULATION ON PIPELINES

- Joints: Close butt, seal with 50 mm wide class '0' tape on both longitudinal and circumferential joints.
- At fittings: Mitre. Secure with tape.
- Vapour seal: Tape exposed insulation membrane. Seal vapour barrier at pipe support with class '0' tape.

660 INSTALLATION OF FOIL FACED MINERAL FIBRE INSULATION ON DUCTWORK

- Fixing to underside of ducting: Self adhesive stick pins. Further support with 0.7-1.0 x 50 mm mesh galvanized wire netting.
- Joints, pin penetrations, cut outs for test holes and supports: Seal with 100 mm wide class '0' foil tape.

690 INSTALLATION OF PHENOLIC FOAM INSULATION ON VESSELS

- Application: Install pre-formed segments or pre-slotted foil faced insulation around the diameter of the vessel. Lay with staggered joints.
- Joints: Seal joints and gaps around protrusions with jointing compound.
- Finish: Secure with aluminium banding.
- Access: Allow for removal of access covers.

710 INSTALLATION OF POLYISOBUTYLENE (PIB) PROTECTION

- Thickness (minimum): 0.8 mm.
- Application: Wrap sheeting with 50 mm overlap. Solvent weld joints.
- Finish: Secure with aluminium banding.

720 INSTALLATION OF SHEET ALUMINIUM PROTECTION

- Application: Form sheet to fit circumference of insulation with 50 mm longitudinal and circumferential overlaps. Secure overlaps with self tapping screws or rivets. Seal joints with grey sealant.
- Expansion: Make provision.

740 INSTALLATION AT VALVES AND FLANGES

- Application: Do not obstruct removal of nuts and bolts, or operation of valves.

750 INSTALLATION AT LOADBEARING PIPELINES SUPPORTS

- Application: Close butt to insulation.
- Joints: Seal with 100 mm wide class 'O' foil tape.
- Sleeve: Provide sheet metal protection sleeve.

755 INSTALLATION AT NON-LOADBEARING PIPELINES SUPPORTS

- Insulation: Carry through pipe support.

760 INSULATION NOT CARRIED THROUGH PIPELINES SUPPORTS

- Insulation at supports: Provide aluminium end caps.

770 INSULATION CARRIED THROUGH DUCTWORK SUPPORTS

- High density phenolic foam: Close butt to insulation.
- Sleeve: Provide sheet metal protective sleeve.

800 INSTALLING VAPOUR BARRIERS

- Integrity: Maintain throughout.

Y31 VIBRATION ISOLATING MOUNTINGS PRODUCTS

Project Co. shall ensure that building services plant and equipment are suitably isolated from the building structure in order to prevent the transmission of vibration. Reference shall be made to the specification and reports produced by the project Acoustic Consultant reports and specifications.

Project Co. shall comply with the guidance on the satisfactory magnitude of building vibration with respect to human response given in BS 6472. Project Co. shall comply with the following vibration limits detailed below:

a) Plant rooms on occupied floors 0.015 m/s2;
b) Plant rooms above and below occupied floor levels 0.050 m/s2; and
c) Remote plant rooms 0.100 m/s2

310 MOUNTINGS GENERALLY

- Criteria: Ensure that vibration generated by the engineering services is not transmitted to pipework, ductwork, the building and supporting structure.
- Overload capacity (minimum): 50%.
- Colour code: Identify for load and deflection rating.
- Marking: Label with load capacity.

320 SPRING ISOLATORS GENERALLY

- Type: Caged.
- Manufacturer: Project Co. choice
  - Product reference: Project Co. choice
- Colour code: Submit proposals.
- Load: Submit proposals.
- Deflection: Submit proposals.

330 COMPRESSION ISOLATORS GENERALLY

- Type: Spring.
- Manufacturer: Project Co. choice
  - Product reference: Project Co. choice
- Colour code: Submit proposals.
- Load: Submit proposals.
- Deflection: Submit proposals.

340 ISOLATION HANGERS GENERALLY

- Type: Spring and neoprene rubber.
- Manufacturer: Project Co. choice
  - Product reference: Project Co. choice
- Colour code: Submit proposals.
- Load: Submit proposals.
- Deflection: Submit proposals.
- Drop rod misalignment capability: 20%.

350 INERTIA BASES GENERALLY

- Type: External isolator mounting brackets.
- Manufacturer: Submit proposals
  - Product reference: Submit proposals
- Material: Welded steel channel perimeter frame.
- Reinforcing steelwork and mesh: Required.
- Thickness: To suit Equipment.

360 FLEXIBLE HOSES GENERALLY - NOT TO BE USED ON DOMESTIC WATER SERVICES

- Type: Generally flexible hoses shall not be used.
- Manufacturer: may submit an application for the use of flexible hoses in special circumstances.
  - Product reference: Submit proposals.
- Connections:
  - Rubber cored: Not required.
  - Stainless steel: Not required.

370 RUBBER BELLOWS GENERALLY

- Type: Tied.
- Manufacturer: Submit proposals
  - Product reference: Submit proposals
- Material:
  - Liner: To suit service.
  - Reinforcement: Synthetic fibre.
  - Cover: Ethylene propylene diene monomer (EPDM) rubber.
- Connections: To suit service.

EXECUTION

610 CAST IN SITU BASES

- Supported equipment: Arrange equipment on base to distribute load evenly.

COMPLETION

910 DOCUMENTATION

- Operation and maintenance instructions: Submit.

Y32 MECHANICAL PLANT AND EQUIPMENT IDENTIFICATION

PRODUCTS

310 PLANT AND EQUIPMENT IDENTIFICATION LABELS

- Standard: To BS 1710.
- Type: Metal plates for pumps, booster sets and pressurization units.
- Manufacturer: Submit proposals
  - Product reference: Plates shall show
    Manufactures Name and address
    Serial Number and allocated Plant number on the schedule
    duty and Maximum head
    Speed
    Electrical Load.
- Information: Purpose and reference number.

310A PLANT AND EQUIPMENT IDENTIFICATION LABELS

- Standard: To BS 1710.
- Type: Metal plates for boilers & heat exchangers.
- Manufacturer: Project Co. choice
  - Product reference: Plates shall show
    Manufactures Name and address
    Serial Number and allocated plant number on the schedule
    Maximum Output
    Design Pressure.
- Information: Purpose and reference number.

310B PLANT AND EQUIPMENT IDENTIFICATION LABELS

- Standard: To BS 1710.
- Type: Metal plates for AHU's.
- Manufacturer: Submit proposals
  - Product reference: Plates shall show
    Manufactures Name and address
    Serial Number and allocated Plant number on the schedule
    Fan duty and speed
    Output for Heating and cooling coil
    Filter type and dirty pressure drop.
- Information: Purpose and reference number.

310C PLANT AND EQUIPMENT IDENTIFICATION LABELS

- Standard: To BS 1710.
- Type: Metal plates for Fans.
- Manufacturer: Submit proposals
  - Product reference: Plates shall show
    Manufactures name and address
    Fan model, serial number and allocated plant number on the schedule
    Design duty
    Fan speed
    Electrical details
    Direction of rotation.
- Information: Purpose and reference number.

310D PLANT AND EQUIPMENT IDENTIFICATION LABELS

- Standard: To BS 1710.
- Type: Metal plates for calorifiers and plate heat exchangers.
- Manufacturer: Submit proposals
  - Product reference: Plates shall show Manufactures name and address
  - Serial Number and allocated plant number on the schedule
  - Duty Operating Temperature & Pressure.
- Information: Purpose and reference number.

310E PLANT AND EQUIPMENT IDENTIFICATION LABELS

- Standard: To BS 1710.
- Type: Metal plates for terminal heaters/coolers and fan coil units.
- Manufacturer: Submit proposals
  - Product reference: Plates shall show
    Manufactures Name and address
    Serial number and allocated plant number on the schedule
    Duty
    Operating temperature & pressure.
- Information: Purpose and reference number.

320 VALVE IDENTIFICATION LABELS

- Standard: To BS 1710.
- Type: Laminated plastics plates
- Manufacturer: Submit proposals
  - Product reference: Project Co. choice
- Information: Purpose and reference number.
- Colours: Basic and safety colour identification of associated system.

330 VALVE CHARTS AND SCHEMATICS

- Type: Plastic encapsulated.

EXECUTION

610 IDENTIFYING PIPEWORK

- Standards: To BS 1710.
- Identification type: Adhesive colour bands.
- Application of basic identification colour: To BS 1710 Or painted for gas and fuel lines.
- Safety colour identification: On or next to the colour bands.
- Information: Abbreviation of name and Colour bands as BS 1710 Appendix D.
- Direction of flow: Indication arrow and the word FLOW or the letter F and Indication arrow and the word RETURN or the letter R.

620 IDENTIFYING DUCTWORK

- Standard: To HVCA DW/144 Appendix B.
- Identification type: Self-adhesive plastics or transfers.
- Direction of flow: Equilateral triangle, 150 mm length of side, with one apex pointing in the direction of flow.
- Information: Space served by the duct and associated plant reference required.

630 INSTALLING PLANT AND EQUIPMENT IDENTIFICATION

- Fixing: Fix with adhesive to equipment.
- Location: On equipment.

640 INSTALLING VALVE IDENTIFICATION

- Fixing: Secure with tie wrap.

650 INSTALLING VALVE CHARTS AND SCHEMATICS

- Fixing: Plug and screw to wall.
- Location: Boiler house and plant rooms or Energy Centre as appropriate.

Y35 FLUES AND CHIMNEYS

PRODUCTS

310A METAL FLUES AND CHIMNEYS TWIN WALL STAINLESS STEEL FOR BOILERS, GENERATORS AND CHP UNITS.

- Standard: To BS 4076 or BS EN 1856-1.
- Manufacturer: Flue and chimneys to be erected by chimney/flue specialist. Adjoining sections shall be of a tight fit by means of a socket/bayonet type construction. All sections and joints shall have a fire rated seal throughout its construction including any sealant used. The flues, which will exit the Energy Centre and terminate at the appropriate height above ground level to comply with the requirements of the Clean Air Act. The flues will be supported by pre-fabricated steel structures which will incorporate all access platforms and ladders, etc, together with aircraft warning lights and lightning protection.
  - Product reference: Project Co. choice
- Construction: Twin wall flue with an outer band of stainless steel shall be provided at the joint of each section to aid the fire seal, structural integrity and continuous external appearance. All fastenings shall be stainless steel. The height of the flues shall comprise of the minimum amount of practical sections. Project Co's. flue specialist shall advise if draught stabilisers are required. Base connections to each flue shall be by easy swept bend into a tee piece. The tee piece shall be fitted with a removable end cap for cleaning and access to the flue. The flue shall be fitted with a drain point. The top of the flue shall have a tapered section to provide sufficient efflux velocity. A bird mesh guard shall also be fitted to each terminal. All supports/ structure for the flues shall be by the chimney specialist together with all necessary access platforms & ladders to install and maintain the flues. Submit calculations and details for the Structural Engineer's approval. The support structure shall be capable of being clad in accordance with the Architect's requirements.
- Insulation: Twin walled flues to be insulated with suitable grade of insulation material. Thickness to be calculated by the manufacture to give maximum flue performance.
- Material and finish: As Schedule. Stainless steel used in the construct of the flue shall be of a suitable grade to resist acid corrosion of the inner skin and provide suitable resistance to staining and weathering of the outer skin.
  - Colour: Stainless steel.
- Fittings: Suitable for Flue Specified. All flues shall be designed to provide lightning protection facilities in accordance with BS EN 62305. Lug connectors shall be provided on each flue for connection and to the requirements of the lightning specialist. .

EXECUTION

610 INSTALLING FLUES AND CHIMNEYS

- Joints and bends: Minimize number.
- Slope (maximum): 30° from the vertical.
- Joints: Install with sockets uppermost, fully supported and fixed securely with brackets supplied for the purpose. Do not locate joints within the depth of floors.
- Seals: Seal joints to provide a gas-tight installation.
- Expansion and contraction: Accommodate thermal movement.

- Fire safety: Locate a safe distance from combustible materials.
- Roof junction: Weatherproof. Fit terminal and flashings, collars, and the like.

COMPLETION

Flues shall have access doors, drain points and lightning protection.
The height of the flues shall be sufficient to avoid any interference with the hospital and not cause over cooling of the flue gases. Where flues are sited in close proximity to one another great care must be taken to avoid interference from other flue gases or back draught. Flues to be protected from damage during and following installation.

910 TESTING FLUES AND CHIMNEYS

- Standard: To BS EN 1859.
- Results: Submit.

920 ANALYSIS OF FLUE GASES

- Results: Submit.

Y50 MECHANICAL COMMISSIONING

EXECUTION

- Project Co. shall employ an independent commissioning engineer. The commissioning engineer shall be responsible for fully managing the commissioning process for the electrical and mechanical, public health, medical gases, life safety and communications Installations and shall carry out all necessary liaison with other Boards and specialist installers and compile the operation and maintenance manuals. Project Co. shall Pressure test all systems to this specification, TR/20 and the Institute of Hospital Engineers Guidance to Engineering Commissioning. The system shall not be insulated until pressure testing of the pipework is complete.

  Project Co. shall not use the system pumps for flushing any of the pipework systems. Project Co. shall ensure that the system has adequate connections to enable the correct flushing of the systems. Project Co. shall ensure the system is in a suitable condition for flushing to commence. e.g. removal of control valves. Strainers and stool pieces to be in place. The building services systems shall be commissioned by the commissioning engineer to meet the project objectives.

  Commissioning shall be completed in accordance with CIBSE commissioning Codes, and BSRIA guide 2/89.3. Remedial and defect work to the systems shall be completed and all polarity testing, phase sequence testing, loop impedance testing shall have been carried out before commissioning commences.

  The gas service shall be tested and commissioned to Scottish Gas Regulations and Institution of Gas Engineers publications. All work shall be carried out by a suitable qualified gas engineer. Copies of the engineer's registration certificate shall be attached to the test certificates. Project Co. shall issue a commissioning programme to all parties for review four weeks before the planed commencement of commissioning. this shall include a method statement. Progressive static testing will be witnessed by site engineer(s).

  Sufficient notice of testing shall be afforded to the site engineer to enable them to be present. Evidence will be required from the commissioning engineer that all services have been commissioned and are operating correctly.

  Room cooling capacities shall be tested on a department by department basis by introduction of temporary heat loads to prove the system design capabilities. This shall be carried out as part of the contract works. shall also carry out seasonal commissioning as detailed in BREEAM. Guidance, to ensure full system performance i.e. main cooling plant operation in the summer and heating plant in the winter. All checks and measurements of commissioning records shall be recorded in writing by the commissioning engineer as commissioning proceeds, together with appropriate comments.

610 COMMISSIONING PROGRAMME

- Generally: Submit before commissioning commences.
  - Notice (minimum): To be agreed with the Board.
- Commissioning manager: Submit details.

615 PERFORMANCE TESTING PROGRAMME

- Generally: Submit before performance testing commences.
  - Notice (minimum): 1 week.
- Performance testing manager: Submit details.

COMPLETION

O& M documentation shall be issued at least three months before completion of any part of the contract. The contents and format shall be agreed with the Board. The document shall be issued/uploaded on Aconex.
Project Co. shall provide instruction to the clients engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the manufactures' recommendations and best practice. Project Co. shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

910 COMMISSIONING OF HOT AND COLD WATER SUPPLY SYSTEMS

- Commissioning: In accordance with BS 8558, BSRIA AG 2/89 and CIBSE Commissioning code W.
- Notice (minimum): 1 week.
- Equipment: Check and adjust operation of equipment, controls and safety devices.
- Outlets: Check operation of outlets for satisfactory rate of flow and temperature.

930 COMMISSIONING OF WATER HEATING SYSTEMS

- Commissioning: In accordance with BSRIA AG 2/89 and CIBSE Commissioning code W.
- Variable flow systems: In accordance with CIBSE Knowledge Services Commissioning variable flow pipework systems.
- Notice (minimum): 1 week.

940 COMMISSIONING OF BOILER PLANT

- Commissioning: In accordance with CIBSE Commissioning code B.
- Notice (minimum): 1 week.

950 COMMISSIONING OF CHILLED WATER SYSTEMS

- Commissioning: In accordance with BSRIA AG 2/89 and CIBSE Commissioning code W.
- Variable flow systems: In accordance with CIBSE Knowledge Services Commissioning variable flow pipework systems.
- Notice (minimum): 1 week.

960 COMMISSIONING OF REFRIGERATING SYSTEMS

- Commissioning: In accordance with CIBSE Commissioning code R.
- Notice (minimum): 1 week.

970 COMMISSIONING OF AIR DISTRIBUTION SYSTEMS

- Commissioning: in accordance with BSRIA AG 3/89 and CIBSE Commissioning code A
- Notice (minimum): 1 week.

980 COMMISSIONING OF CENTRAL CONTROLS AND BUILDING MANAGEMENT SYSTEMS

- Commissioning: In accordance with CIBSE Commissioning code C.
- Notice (minimum): 1 week.

985A PERFORMANCE TESTING

- General: Demonstrate the performance of the installations.
  - Guaranteed efficiency: Tolerances defined in this specification and schedules.
- Environmental tests: Carry out environmental testing. If necessary, use artificial loads to simulate operating conditions.
- Recorders: Supply and maintain portable seven day space temperature and relative humidity recorders, complete with charts and/or Board's proposals.
  - Number of recorders: To be agreed with the Board.

Reports: Submit.

990 INSPECTION AND TEST RECORDS

- Records for water systems: In accordance with BSRIA AG 2/89.
- Records for air systems: In accordance with BSRIA AG 3/89.
- Record sheets: Submit.
  - Number of copies: 3

995 DEMONSTRATIONS

- Running of plant: Run, maintain and supervise the installations under normal working conditions.
  - Duration: 4 weeks.
- Instruction: Instruct and demonstrate the purpose, function and operation of the installations.

996 SEASONAL COMMISSIONING

Seasonal commissioning of plant and systems shall be undertaken over the first 24 month period in accordance with the requirements of the BREEAM Assessment. Measurement and recording of criteria for thermal comfort (temperature and humidity where applicable), ventilation rates and effectiveness, lighting levels and controls, etc shall be carried out at three monthly intervals. A representative from the Hospital shall also give subjective feedback for consideration in the monitoring process.

997 OPERATING THEATRES

In standard operating theatres provide validation report in accordance with the relevant NHS documentation including demonstration of air velocities at the operation table position.

In UCV operating theatres provide validation reports and terminal challenge test in accordance with the relevant NHS documentation of air velocities access the room in accordance with SHTM 03-01 figure 6.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.4 SMcK G1547**
Performance Specification Title	**Specification for Ventilation Systems**	Date	**August 2014**
Prepared By	**BR**	Checked By	**SMcK**

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RHSC and DCN EDINBURGH
VENTILATION SYSTEMS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by the Mechanical and Electrical Installer and is referred to in this document as “Project Co”.

To carry out the development of the design, The Specialist shall obtain the necessary supporting documentation.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

This specification relates to the Ventilation System serving the RHSC/DCN and associated Energy Centre.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include the following:-

- Ventilation System, including:-
    1. Kitchen extract equipment
    2. Fan coil units
    3. Local air conditioning systems
    4. Air ductwork and ancillaries
    5. Air handling units
    6. Fans
    7. Air filtration
    8. Heating and cooling coils

9. Heat recovery
10. Air treatment
11. Silencers and acoustic treatment
12. Air terminal devices

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Specification:-

- BMS and automatic control systems
- Insulation
- Louvres in external façade
- Kitchen canopies/hoods

4.0 INTERFACES AND DEMARCATIONS

The Ventilation Systems shall be provided as a complete working system serving the RHSC-DCH building.

Project Co. shall provide information to other parties for power supplies, controls and fire alarm system interfaces.

5.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

The Ventilation System shall accord with all appropriate Hospital Technical Memoranda, Codes of Practice and relevant British and European Standards.

The equipment supplied shall conform to all relevant standards and regulations in force. The equipment shall be supplied with relevant Declarations of Conformity to certify compliance with the EMC directive 89/336/EEC-92/31/EEC and the Machinery Safety Directive 89/392/EEC-91/368/EEC-93/44/EEC. Also the equipment and installation shall comply with all relevant statutory requirements in force at the time:

6.0 DESIGN CRITERIA

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

External Design Conditions	
Winter	-6oC sat
Summer	26oC db 19oC wb
Sizing for refrigeration plant	30oC
LTHW Flow Temperature	80°C

LTHW Return Temperature	60°C
Primary Chilled Water Flow Temp	6°C
Secondary Chilled Water Return Temperature	12°C

For ventilation/air change rates used in the design, Project Co. shall refer to the ADB sheets.

7.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety Regulations.

Specialist Installers. Project Co. shall liaise with other specialist parties as necessary to ensure that all interfaces and co-ordination between the Fire Detection and Alarm System and other systems are allowed for. This shall include but not be limited to:-

- Building Management System specialist
- Fire Alarm and Detection specialist
- Other disciplines for co-ordination
- Fire Protect Systems specialist
- Kitchen Specialist

Building Control. Project Co. shall liaise, with and adhere to, the requirements of the Building Control Officer.

Any other member of the Project and Board teams concerned with the planning and administration of the Ventilation System.

8.0 SYSTEM DESCRIPTION

The mechanical ventilation and air conditioning systems shall comply with HVAC DW144, 154, 172, TR19, BS 5726 (updated) SHTM 03-01, and descriptions and requirements set out below.

8.1 Background to Ventilation and Air Conditioning Installations

The building is largely sealed with limited openable windows in order to control the internal environment within the spaces.

The building ventilation is based on a mixed mode solution where it permits, utilising openable windows together with mechanical vent and a peak lop cooling solution.

The Hospital shall be mechanically ventilated:-

- Throughout all internal rooms that have no access to natural ventilation
- Perimeter areas where mechanical ventilation is required for clinical reasons
- Perimeter areas where mechanical ventilation is required for operational and environmental control reasons
- Deep plan perimeter areas where necessary to assist the natural ventilation
- Ward areas throughout

The various departments to match their function shall be served by a number of ventilation air handling systems.

In general, each air handling system shall be served by packaged air-handling units containing all components necessary (e.g. fans, coils, filters, etc.) to provide the correct environmental control of those spaces/rooms served.

Fan coil units shall also be provided for comfort cooling in areas where there is a need for separation or where high heat gains make these a more appropriate choice of systems.

Various types of room are included within this project and are described elsewhere. These are:-

- Wards
- Isolation rooms
- Outpatient type departments
- Operating theatres
- Critical care departments
- Comfort cooled areas (e.g. diagnostic imaging)
- Catering facilities
- Safety cabinet extracts
- Computer rooms and data hub rooms

Fan Motors

All fan assemblies shall incorporate fan impeller and motors selected to provide the most energy efficient solution conforming to Section 6 regulations and shall be fitted with IE2 efficiency motors to EN 60034-30:2009 as standard, and suitable for operation in ambient temperatures of 40 degrees C.

System Resistance

The carbon target of 80kg/m^2 per annum requires that, for example, system pressure loss is limited to reduce fan power.

The detailed design calculations for fan resistance have been based on assumed pressure drops through in-line components which are stated in the specification or equipment data sheets. ’s selection of components shall ensure that the pressure drop of a component does not exceed that assumed in the calculations. shall also take care in finally detailed the ductwork routes to avoid potential causes of high pressure drop that may have a detrimental effect on ultimate fan performance. Upon completion of ’s installation drawings shall recalculate the whole system pressure drop, including all components to verify that the design calculated pressure drop has not been exceeded. For the purposes of calculating the system resistances the following allowances have been made in the figures in the equipment schedules:

System performance

Project Co. shall supply and install services and equipment to perform as per specification.

Project Co. shall submit details of all mechanical equipment for comment and place orders in a timely fashion to ensure delivery as per programme.

Grille	25 Pa
Dampers	20 Pa
Heater Battery	20 Pa
Louvre	25 Pa
Plant Room Attenuator	50 Pa
Cross Talk Attenuator	25 Pa
Cowl	50 Pa
HEPA Filter	450 Pa

All rectangular radiused bends: r/w = 0.5
All circular radiused bends: r/d = 1

Where a particular manufacturer is specified, Project Co. shall include for that manufacturer.

Where considered appropriate, equivalent standard alternatives shall be offered for consideration.

This shall be done in a timely manner and Project Co. shall provide all details including but not limited to:

- Detailed description
- Cost comparison
- Technical comparison
- Thermal comfort comparison
- Carbon emission and energy usage comparison
- References to standards
- References to SHTM/HTMs

Completion

Project Co. shall protect the system from damage or interference during the works.

Project Co. shall test, and clean the system as per TR/19.

Project Co. shall submit O&M and record information via Zutec.

Project Co. defects and liability period shall be as the contract prelims.

940 OPERATING TOOLS

- Tools: Supply tools for operation, maintenance and cleaning purposes.
  - Quantity: 2 sets.

U10 VENTILATION SYSTEMS

ALL AIR SYSTEMS

These shall be low velocity systems with air being distributed throughout the building in galvanised sheet steel ductwork via ceiling voids and riser duct spaces terminating in ceiling or wall diffusers as appropriate.

On full fresh air systems, heat recovery devices shall be provided, to exchange heat between exhausted extract air and incoming fresh air wherever significant energy savings can be achieved.

Generally, temperature control shall be by means of room or duct-mounted sensors which shall operate, via the automatic control system software the control valves on the hot water and chilled water to the heating and cooling coils respectively.

Areas shall be controlled in zones or as individual rooms as necessary to achieve the conditions required by the ADB Sheets.

Supply plants shall incorporate panel type coarse pre-filters followed by high efficiency bag filters. Absolute HEPA (high efficiency particulate air) terminal filters shall be provided only for 'ultra clean' areas such as UCV Theatres for Orthopaedic and Neurosurgical and isolation rooms. Some isolation rooms shall incorporate HEPA filters on the extract system.

Within relevant air handling units, blank sections shall be included for future provision of full humidity control, including humidification and dehumidification in critical care clinical areas, such operating theatres, recovery, radiology and MRI Scanner or wherever close control of humidity is required for the successful operation of sensitive equipment, e.g. computers, as advised by the ADB Sheets.

Air pressure regimes for theatre suites shall be designed in accordance with the guidance provided in SHTM 03-1 employing wall mounted pressure stabilisers.

Air volumes have been established by consideration of heat gains or losses and also the air change rate necessary for comfort and safety as appropriate for the activity carried out in each area. Relative air pressures between rooms shall be maintained to suit the activity concerned, by design of the supply and extract air volumes, and use of pressure relief equipment where necessary to prevent cross infection or transfer of unpleasant odours between areas, as required by the ADB sheets.

Heat recovery shall be provided between the supply and extract systems. The hospital ventilation systems shall be in accordance with SHTM 03-01 Ventilation in health care premises, DW 144 and DW 143.

The ventilation system including all AHU's, fan's, diffusers, dampers and grilles shall meet the design noise and vibration criteria.

The ventilation and cooling system shall be zoned with each air handling system being served by packaged air-handling units containing all components necessary (e.g. fans, coils, filters, etc.) to provide the correct environmental control of those spaces/rooms served.

The philosophy of the system is to provide energy efficient operation with areas of the hospital operating on a similar time and clinical nature being served from the same system, and to maintain a sensible level of availability, such that in the event of plant breakdown or maintenance, limited areas of ventilation are lost. Air handling plants shall have availability reinforced by the provision of duplicate motors or fans, which shall automatically changeover to maintain the ventilation requirements.

Project Co. shall take care in finally co-ordinating the ductwork routes to avoid potential causes of high pressure drop that will have a detrimental effect on ultimate fan performance.

All ventilation controls shall be capable of being fully interrogated by the building management system through the independent network protocol.

WARDS

The ventilation systems serving ward areas shall provide treated air to internal spaces, clinical spaces and make-up air for sanitary accommodation.

Make up air for en suite WC accommodation shall be introduced directly into the associated bedroom at suitable temperature to maintain the required space temperatures.

Air shall be extracted from spaces by either the clean or dirty extract systems as appropriate. Heat recovery shall be provided between the supply and extract systems. The type of recovery system employed shall depend on the area being served. Refer to system drawings and schedules for details.

The ventilation plant shall use different facades of the plantroom for intake and exhaust air via vertical wall louvres. This strategy will avoid short circuiting or contamination of the supply air and also meet the BREEAM requirement for separation. Project Co. shall exercise caution when locating any other extracts or gas scavenging exhaust to ensure the supply intakes are not contaminated.

ISOLATION ROOMS

Each lobbied isolation room shall be provided with its own dedicated ventilation system in line with SHBN 04.

Each system ventilation plant shall filter, heat and cool the air and supply it to the room lobby at the required temperature, as dictated by a sensor in the bedroom.

Air shall be transferred to the room via a wall mounted pressure stabiliser and then extracted from the suite via the bedroom and en suite WC, and ducted by fire-clad ductwork to a dedicated extract fan in the plantroom.

Each extract fan unit shall comprise of an isolation damper and a centrifugal cased extract fan, with the motor located out of the air stream, and the exhaust duct shall discharge 3.0 metres above roof level. Were it is not possible to achieve a safe discharge height of 3.0 metres above roof level. The extract air shall be HEPA filtered through 'safe change' filter units in the plantroom before being discharged to atmosphere with all other ventilation exhausts.

Due to the small size of the plants, heat recovery is not considered viable and shall therefore not be provided.

Isolations rooms supply air terminals shall be capable of having terminal HEPA filters fitted at some future date. The air handling unit fan shall be capable of overcoming the additional resistance imposed by the HEPA filter by a simple speed change on the motor inverter.

OUTPATIENT TYPE DEPARTMENTS

The ventilation systems serving outpatient areas shall provide heated air to internal spaces, clinical spaces and make-up air for sanitary accommodation.

Radiant panels shall generally be installed to individual spaces to provide independent control of heating and comfort cooled fresh air for cooling requirements.

Air shall be extracted by clean and dirty extract systems.

Heat recovery shall be provided between the supply and extract systems.

OPERATING THEATRES

Each operating theatre shall be provided with a dedicated ventilation system.

Each system ventilation plant shall filter, heat and cool the air and supply it to the suite of rooms, and be arranged to allow individual temperature set point adjustment with this indicated on the associated surgeon's theatre panel.

The pressure regimes between the spaces in each theatre suite shall be maintained by a combination of supply and extract rates to each space, and pressure stabilisers located in the walls.

Heat recovery shall be provided between the supply and extract systems. Out of hours setback shall be provided by reducing the air volumes and temperature set points.

In theatres with a requirement for Ultra Clean Ventilation (UCV), a specialist shall be employed to undertake the provision of the UCV canopy in accordance with SHTM 03-01.

Ancillary areas associated with the Operating Theatre department shall be served from a dedicated plant.

CRITICAL CARE DEPARTMENTS

Critical care departments such as ITU/HDU shall be provided with dedicated ventilation systems.

The supply air ventilation plant shall heat and cool the air as required by the control system to provide the correct condition in the various rooms/zones.

Final temperature control to the spaces shall be achieved by terminal reheaters controlled from user adjustable sensors within each space. Heater batteries shall be located wherever possible in plant areas, but where heaters can only be provided in the ceiling void of the occupied space they shall be located away from patient occupied spaces, i.e. bed spaces.

Heat recovery shall be provided between the supply and extract systems.

COMFORT COOLED AREAS

Departments where space temperature control is required, such as the Emergency Centre, Diagnostic Imaging, etc. cooling shall be provided by treated air to clinical spaces and spaces with high equipment gains.

The department shall be arranged in a number of zones to suit the control requirements, varying heat gains and use of the spaces.

Particular areas that have high-density heat gains shall be provided with terminal cooling in the form of fan coil units to achieve the required space conditions.

The supply air ventilation plant shall heat or cool the air as required by the control system to provide the correct condition in the various rooms/zones.

All AHU's and fans shall be suitable for hospital application.

SAFETY CABINET EXTRACT SYSTEMS

The Laboratories shall be served by separate extract systems serving the general areas whilst extracts from safety cabinets shall be handled by individual contaminated extract systems.

The design of the general extract system shall be co-ordinated with the associated supply system and contaminated extracts to maintain suitable pressure levels.

QUENCH PIPES

The Quench pipes serving the MRI machines shall be installed by in accordance with a design and specification produced by the MRI supplier/installer. The route of the pipes shall be as shown on the drawings and they shall be insulated and terminate in accordance with the recommendations given by the MRI supplier/installer. The Quench pipes are required to be continuous and therefore the pipe structure and insulation shall maintain the required 2 hour fire integrity.

130 MECHANICAL SUPPLY VENTILATION SYSTEM

Supply air from central air handling plant shall be delivered through the ductwork systems to the areas served, and discharged via ceiling mounted diffusers.

Supply and extract air handling plants shall be of a packaged construction with a double skin casing complete with thermal/acoustic insulation material between the two skins. Units shall house filters, coils, fans and motorised inlet dampers, etc. Heat recovery devices and humidifiers shall also be incorporated where required. External fan motors shall be provided to all units with some units types having twin motors.

All AHU's and fans shall be suitable for hospital application.

- Location of plant: Various locations throughout the building.
- Type of system: Multizone, constant volume.
- External air intake terminals: Architectural louvres.
- Air filters: In air handling units, as section U81.
- Accessories: As schedule.
- Heat recovery: In air handling units, as section U81/U85.
- Air handling units: As section U81and schedules.
  - Fabrication: Construction, as section U81.
- Supply fans: As schedule.
- Acoustic treatment: Rectangular silencer, as section U87.
- Air ductwork and ancillaries: Ductwork, Fire rated and smoke extract ductwork and fittings as section U80.
  - Accessories: Dampers, fire and smoke, metal ductwork, as section U80.
- Thermal insulation on supply air ductwork: As section Y30.
- Vibration isolation mountings: Spring isolators, as section Y31.
- Reheat batteries: As schedules and drawings.
- Room supply air terminal devices: Grilles and diffusers as specified.
- Controls: All ventilation controls must be capable of being fully interrogated by the building management system through the independent network protocol.
- Completion:

  - Identification of ductwork and equipment: As section Y32.
  - Testing and commissioning:
  - Ductwork pressure testing, as section U80;
  - Air distribution system commissioning, as section Y50; and
  - Performance testing, as section Y50.

140 MECHANICAL EXTRACT VENTILATION SYSTEM

Extract air from the area concerned shall be drawn through a ductwork system to extract fans in the roof plantrooms for discharge to atmosphere, or returned to the air handling plant for recirculation.

- Room extract air terminal devices: As drawings.
- Air ductwork and ancillaries: Fire rated and smoke extract ductwork and fittings, as section U80 and Smoke extract ductwork, as section U80:
  - Accessories: Dampers, fire and smoke, metal ductwork, as section U80 and Flexible ductwork, as section U80.
- Thermal insulation on extract air ductwork: As specified.
- Vibration isolation mountings: Spring isolators, as section Y31.
- Heat recovery: Plate recuperator, as section U85 or thermal wheel, as section U85 depending on AHU type.
- Acoustic treatment: Rectangular silencer, as section U87.
- Extract fans: The extract fan shall have twin motors depending of fan type.
- External exhaust air terminals: Architectural louvres
- Controls: All ventilation controls must be capable of being fully interrogated by the building management system through the independent network protocol.
- Completion:

  - Identification of ductwork and equipment: As section Y32.
  - Testing and commissioning:
  - Ductwork pressure testing, as section U80;
  - Air distribution system commissioning, as section Y50; and
  - Performance testing, as section Y50.

150 TOILET EXTRACT VENTILATION SYSTEM

Potentially contaminated dirty air extract systems shall be discharged at, or above, roof level.

Dirty extract shall be provided to extract air from toilets, bathrooms, cleaners' rooms and dirty utility areas. Extract plants shall be separate extract fan units.

Air shall be extracted via grilles in the individual rooms and ducted by galvanised sheet steel ductwork similar to that provided for the general supply and extract systems to extract fans in the plantrooms. Make up air shall be via the main ventilation system.

Separate dirty extract units shall be manufactured heavy gauge aluzinc corrosion resistant steel. The general construction is to Class A leakage.

The fan unit shall be supplied complete with all manufacture control accessories to be fully integrated into the BMS.

The fan unit shall be provided with an integrated commissioning/speed control to accurately commission the system. The commissioning set up facility directly controls the integrated speed control/frequency inverter.

Heat recovery shall be used for the larger dirty extract systems.

Where toilets or bathrooms are in isolated positions, not convenient to central ducted systems, small units operated by light switch control shall be used

- Room extract air terminal devices: Air transfer grilles and diffusers, as specification.

- Air ductwork and ancillaries: Sheet metal ductwork and fittings, circular, as section U80 and Sheet metal ductwork and fittings, rectangular, as section U80:
  - Accessories: Dampers, fire and smoke, metal ductwork, as section U80 and Flexible ductwork, as section U80.
- Thermal insulation on extract air ductwork: Not required
- Vibration isolation mountings: Spring isolators, as section Y31.
- Acoustic treatment: Circular silencer, as section U87 and Rectangular silencer, as section U87.
- Extract fans: Twin Toilet extract fans run and standby, as section U82.
- External exhaust air terminals: Architectural louvres.
- Controls: All ventilation controls must be capable of being fully interrogated by the building management system through the independent network protocol.
- Completion:

  - Identification of ductwork and equipment: As section Y32.
  - Testing and commissioning:
  - Ductwork pressure testing, *as section U80;*
  - Air distribution system commissioning, as section Y50; and
  - Performance testing, as section Y50.

160 KITCHEN EXTRACT VENTILATION SYSTEM

Ventilation to the central catering areas shall be provided to deal with the requirements on the cooking equipment to reduce odours and limit temperatures within the space.
Contaminated air extract systems shall be discharged at, or above, the roof level at high velocity as appropriate.

Ventilation make-up air shall be provided to balance the extracted air.

There shall no recovery from kitchen hood extract due to the difficulties with grease laden air.

The kitchen canopies shall be supplied and installed by the kitchen specialist and do not form part of these works. Project Co. shall liaise with the kitchen specialist, so as to agree requirements. All the main kitchen extract hoods to be the capture/entrainment type. This type of canopy entrains the contaminant air by supplying fresh air over the kitchen island. This shall reduce extract air flow rates and hence save energy. The hoods and supply air shall also have a set back position when the kitchen is not in use. This shall reduce air flows when the kitchen is not in use and reduce energy consumption

- Air ductwork and ancillaries: Fire rated and smoke extract ductwork and fittings, as section U80. All kitchen extract systems to DW172:
  - Accessories: All kitchen hood extract ductwork to be fire rated.
- Thermal insulation on extract air ductwork: Not required.
- Vibration isolation mountings: Spring isolators, as section Y31.
- Acoustic treatment: Specialist to examine.

- Extract fans: Centrifugal belt driven, as section U82.
- Completion:

  - Identification of ductwork and equipment: As section Y32.
  - Testing and commissioning:
  - Ductwork pressure testing, as section U80;
  - Air distribution system commissioning, as section Y50; and
  - Performance testing, as section Y50.

EXECUTION

Project Co. shall ensure all works shall be done in a safe manner and comply with Health and Safety Regulations. This shall include clean and tidy working and working in confined spaces.

All supply and extract ventilation systems shall be clearly labelled. The label shall identify both the AHU and the area that it serves. The lettering shall be at least 50 mm high and be mounted in an easily visible place near the fan of the unit. Any sub-systems and the principal branch ducts shall be similarly labelled. The direction of air flow shall be clearly marked on all main and branch ducts.

630 INSTALLING DUCTWORK ON AIR HANDLING UNITS

- Air discharge: Connect ductwork to allow air to straighten as it leaves the air handling unit.

U41 FAN COIL UNITS

310 FAN COIL UNITS

Fan coil units shall be complete with dedicated controls enabling temperatures to be varied within each treated space. The units shall, where applicable, include heating. The controls shall comprise local room mounted temperature sensor/controller operating 2-port electrically operated valves in response to user inputs to raise or lower the room temperatures.

All Fan coil unit motors shall be fitted with built in Thermal overload protection.

- Performance: To BS 4856.
- Manufacturer: choice
  - Product reference: Project Co. to provide technical proposals.
- Project Co. shall examine all layout drawings, schematics and schedules, in order to ascertain duties and required temperatures.
- Fan speed: Low.
- Fan motors: EC type with a Specific Fan Power less than 0.8 watts per litre/second
- Noise levels: As fan coil schedule.
- Electrical supply type: As fan coil schedule.
- Casings: As manufacturer's standard for application.
- Mounting: As manufacturer's standard for application.
- Finish: As manufacturer's standard for application.
- Ductwork connections: Installer to provide proposals.
- Access: Provide access to filter, fan and motor, valves and controls.
- Drip tray:
  - Position: Under coil, and under control valve where fitted.
  - Material: Corrosion resistant.
  - Condensation: Insulate external faces to prevent.
- Controls: All ventilation controls must be capable of being fully interrogated by the building management system through the independent network protocol.
- Accessories: As Fan coil schedule.

EXECUTION

Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety Regulations. This shall include clean and tidy working and working in confined spaces.

610 FAN COIL UNIT DRAIN LINE

- Drain connections: Connect drain line flush with bottom of drip tray.
- Drain line: To discharge via a suitable dry type trap.

U60 LOCAL AND ROOM AIR CONDITIONING SYSTEMS

GENERAL

Generally ventilation and comfort cooling shall be from central systems. Where this is not possible because of the remoteness of the area from the main plant, the particular use of the space, or high cooling loads, local systems shall be used. Project Co. shall ensure that these systems are installed to the same high standard as the main system.

PRODUCTS

All elements of the work shall be in accordance with the requirements of current legislation, regulations and industry standards. The installation shall also comply with relevant British Standards. Project Co. shall provide working drawings for the installation and issue them for comment before work commences.

340 COMPUTER ROOM AIR CONDITIONING UNITS (CRAC)

The main core server room air-conditioning systems shall be feed from the main chilled water system. Computer rooms shall each be provided with independent system via dedicated secondary chilled water circuits having their own plate heat exchangers and circulating pumps.

CRACs shall be floor standing 'downflow' type and must be capable of being fully interrogated by the building management system through the independent network protocol.

To comply with these directives appropriate national & harmonised standards have been applied. These are listed on the Declaration of Conformity, supplied with each product.

Unit cabinets shall be manufactured from galvanised sheet steel coated with epoxy baked powder paint to provide a durable finish. Internal strength and rigidity shall be provided by a welded space frame constructed of channel profile folded steel. Cabinets shall be lined internally with fire resistant 20mm foam (UL94 V0) for thermal and acoustic insulation. Cabinets shall meet the Hospital acoustic and vibration requirements. The cabinet doors are full height, hinged and key lock secured. Door arrangement shall allow flexible door opening/removal for improved access. Doors shall have rubberised door seals reduce sound breakout and eradicate leakage.

The units shall have large surface area coil(s) to optimise airflow and heat transfer, manufactured from refrigeration quality copper tubes with mechanically bonded aluminium fins.

Fins shall be coated with a non-stick acrylic film to provide additional corrosion protection and efficient surface water removal for improved performance.

Coil headers shall be circuited to ensure low water pressure drops. The cooling coils shall be mounted over a full width stainless steel condensate tray. Chilled water flow shall be via a factory fitted 3 port modulating control valve.

All coils shall be Factory pressure tested to 20Bar.

Fans shall be backward curved impellers, direct drive centrifugal fan assemblies with integral rotor mounted motor which is statically and dynamically balanced for quiet operation. Designed for high corrosion resistance, the impellers are laser welded aluminium with galvanised rotor and die cast aluminium EC power module. An inbuilt EC fan control module shall allow the fan to modulate from 15-100%.

Filters shall be 97mm pleated disposable panel filters in a rigid frame. Conform to BS EN 779-G4.

Access and removal from unit front. An adjustable diaphragm pressure switch fitted across the filter assembly shall monitor pressure drop which shall initiate a filter dirty alarm.

The control panel shall have fan motor contactors and overloads, transformer, sub circuit protection, volt free contacts, mains and inter-connecting terminals. The panel shall be fitted within the cabinet and be hinged for easy access to other components within the unit. The electrical control panels shall be wired to the latest European standards and codes of practice.

To ensure complete unit isolation of the electrical panel during adjustment and maintenance a door interlocking isolator is provided as standard.

Units shall be fitted with the microprocessor controller which shall have a real time clock and a communication port plus networking and Bac Net BMS connections. A backlit LCD door mounted display keypad assembly shall be fitted to view the unit status and allow operator adjustment.

The condensate pump shall have a reservoir with a capacity of 5 l/m at a head of 10.8m.
Leak detection tape suitable for sensing water droplets shall be supplied loose for remote mounting on site.

- to provide technical proposals.
- Arrangement: Vertical.
- Casing: Steel frame with acoustically lined steel panels.
- Finish: Manufacturer's standard.
  - Colour: Manufacturer's standard.
- Controls: All controls must be capable of being fully interrogated by the building management system through the independent network protocol.

Each server room shall be provided with the following:

• Room sensible cooling capacity	32 kW
• Number of units (N+I)	3- No.
• Sensible cooling capacity per unit	16 kW
• Sensible Heat Ratio	1.0
• Chilled water temperatures at unit	Flow 6°C Return 12°C
• Chilled water flow rate per unit	0.635 litres/second

- Maximum coil/valve pressure drop 60 kPa
- Inlet air design conditions 22°C 50% RH
- Nominal air flow per unit 3.75 m³/s

EXECUTION

Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety Regulations. This shall include clean and tidy working and working in confined spaces.

U80 AIR DUCTWORK AND ANCILLARIES

During installation the ductwork shall be installed to a PDI (Protection, Delivery & Installation) as defined in the HVCA (2005) TR/19 – Guide to good practice: internal cleanliness of ventilation systems'.

A Specialist Cleaning Operation shall be performed on all ductwork systems installed serving Clinical Areas, in accordance with the guidelines of Section 9 – Verification of Cleanliness, HVCA TR/19.

The cleanliness of the ductwork installation shall be confirmed and documented by means of the post clean verification test procedure outlined in Section 9.5 of HVCA (2005 TR/19).

300 CLASSIFICATION

Ductwork shall be classified as described in Table 1 of DW/144, as follows:-

- Plantroom and main riser ductwork: Class B
- Distribution ductwork at each floor Class: A

The ductwork installer shall clearly indicate on the manufacturing and installation drawings the classification of the ductwork proposed.

All ductwork shall meet the leakage criteria given in the Building Regulations Section 6 which requires it to meet the requirements of HVCA DW/143.

10%, chosen at random, of Class B ductwork shall be selected by the Board for testing.

Ductwork branch connections shall be shoe type as fig 106 in DW144, spigot type branches shall not be acceptable.

Project Co. shall ensure that sufficient dampers are provided to regulate and balance the system. Dampers on grilles or diffusers shall be used only for balancing of external air distribution devices in a common branch. All dampers shall be sufficiently rigid to prevent vibration within the systems, when absorbing the additional available pressure of the system.

PRODUCTS

A specialist ductwork manufacturer/ installer shall be employed by to fabricate install and test a range of ductwork that shall be used for general ventilation, air conditioning or comfort cooling.

305 DAMPERS, FIRE AND SMOKE, METAL DUCTWORK

The ductwork system shall be provided with fire dampers in locations corresponding to the appropriate fire separation barriers. Actuation of the dampers shall be in accordance with SHTM81 Fire Code, and the Fire Consultants Strategy Report, subject to the separation performance of the barrier.

Where actuation of the damper is via the fire alarm system the damper shall be motorised to facilitate re-opening after testing of the fire alarm system. Dampers utilising fusible link operation only shall be provided with local mechanical indicator on the side of the fire damper. Dampers with motorised operation shall be monitored via a separate electronic remote monitoring system.

Fire dampers shall be fitted with the correct installation frame and supports.

Fire rated ductwork shall be utilised where the use of fire dampers is inappropriate.

The smoke damper control panel must be capable of being fully interrogated by the building management system through the independent network protocol.

Smoke control dampers shall be provided in the positions as indicated on the drawings and shall be suitable for mounting in the horizontal or vertical plane. They shall be certified by the manufacturer to have been tested to the temperature time curve of BS ISO 10294, for a period of 4 hours with a classification of ES 240 in the fully closed position with power off.

Smoke control dampers shall have factory fitted installation frames to HVCA 10.1.83 specification and shall allow for all additional framing, supports and bracing securing the damper to the structures, to the satisfaction of the Building Control Officer.

All smoke control dampers shall be supplied with a factory fitted actuator, complete with integral micro switches and controlled mechanical fail safe operation of not more than 20 seconds.

The totally enclosed precise movement with British Standard 5588: Part 9999: 1999 should be held in the open position by means of a thermally actuated device set to operate at approximately 74 °C. Automatic smoke and fire control dampers are fire rated dampers as they are held in the reset (Open) position by a thermally actuated device.

The totally enclosed precise movement opposed blade drive shall be positioned out of airstream for protection against damage, be hard wearing and free running.

The control mode/damper connection shall be by means of the drive interface mechanism, which shall be totally independent of the ductwork.

Automatic smoke release dampers with their appropriate control modes shall have spring fail-safe open operation.

Project Co. shall be responsible for allocating a unique reference number to each damper per system and produce a schedule for the purposes of carrying out the inspection and testing of all installed smoke/fire dampers. Upon completion of the tests, the certificates, with the schedule must be issued confirming that all dampers have been inspected and function correctly in accordance with the manufacturer's data sheets. The ductwork installer shall allow for subsequent demonstration of all fire/smoke dampers to a witnessing party. Access door requirements as DW144 Appendix M require unique numbers to be identified on the fire damper and also on installation / record drawings, damper control graphics and within a schedule to be included in the O& M instructions.

Project Co. shall be responsible for ensuring the mechanical inspection and testing of all smoke/fire dampers installed on the contract is carried out with the smoke damper control specialist testing and in attendance same time. Upon completion of the tests, the certificates must be issued for confirming that all the dampers have been inspected and that they function correctly in accordance with the manufacturer's data sheets.

The dampers shall comply to Class A and B of Eurovent Document 2/2 and Test Procedures for Classes A, B and C of HVCA Ductwork Specification DW144.

305A DAMPERS, FIRE AND SMOKE, METAL DUCTWORK

The slam shut curtain fire dampers shall have a stainless steel folding curtain having unbroken movable joints, stainless steel constant tension closure springs for positive closure and stainless steel peripheral gasketing.

The self resettable, latching removable release mechanism cassette, shall ensure the closure of the stainless steel curtain under full fire conditions. The housing shall be galvanised steel fully welded spigotted type casing suitable for square, rectangular, circular or flat oval connections.

The spigotted casing with continuously welded corners and spigot connections makes these dampers suitable for inclusion into air distribution systems to the test methods of
Eurovent Class A, B & C and HVCA Ductwork specification DW144.

- Standard: To BS EN 1366-2.
- Type: Multi-blade.
- Manufacturer: to submit proposals.
  - Product reference: to submit proposals.
- Material: Stainless steel.
- Accessories: External visual indication of fire damper blade position.
- Fusible links fusing temperature: 72°C.

310 DAMPERS, NON-RETURN

Non return dampers shall be installed as shown on the drawings. They shall automatically shut of individual sections of an air conditioning system.

The damper shall be selected for the type of system (constant or variable volume).

- Standard: To BS EN 1751.
- Manufacturer: to submit proposals.
  - Product reference: to submit proposals.
- Leakage through closed blades: Class 0.
- Casing leakage: Project Co. to submit proposals.
- Pressure: Project Co. to submit proposals.
- Material: Galvanized sheet steel frame and aluminium blades.

330 DAMPERS, SHUT OFF

Shut of dampers shall be suitable for air conditioning and ventilation systems requiring air control and low closed blade leakage characteristics. For standard low/medium pressure and velocity systems.

Air control and system balancing shut-off dampers shall comprising of stainless steel aerodynamic blades with synthetic trailing edge blade seals, synthetic blade end bearings and stainless steel top and side spring tempered flexible gasketing. Dampers to have a maximum closed blade leakage of 27 l/s at 1000 Pa when measured on a 1000mm wide x 1000mm high damper. Housed in a galvanised mild steel frame having integral peripheral flanges.

- Standard: To BS EN 1751.
- Manufacturer: to submit proposals.
  - Product reference: to submit proposals.
- Leakage through closed blades: to submit proposals.
- Casing leakage: to submit proposals.
- Pressure: to submit proposals.
- Setting: to submit proposals.
- Material: Galvanized sheet steel.
- Control method: Electric and electronic.

340 FLEXIBLE DUCTWORK

Flexible ductwork shall not be used in runs that are more than 1.0m. Fixed ductwork shall terminate not less than 450mm from terminal equipment. Actual lengths of flexible ductwork when fully extended shall not exceed 125% of the connection distance.

Where the flexible ductwork is to be insulated, this shall be factory applied of a type approved for the application and to the thermal conductivity equivalent to the adjacent thermal insulation, and shall be Class O fire rated.

- Standard: To HVCA DW/144.
- Manufacturer: to submit proposals.
  - Product reference: to submit proposals.
- Material: As specification U10.

370 PRESSURE STABILISERS

Pressure control flaps/pressure stabilisers are to be installed as shown on drawings. The flap/stabiliser shall accurately control the differential air pressure between adjacent rooms, and the blades close fully as soon as the pressure differential drops below the required level. This diverts the airflow to pass through an open door forcing back airborne contamination.

The damper shall come with a Standard Finish: RAL9010 powder coated white with antimicrobial protection as standard.

Bearings shall be stainless steel ball roller type sealed for life ball bearings. Pressure Control Range shall be 3 - 50 Pa with a setting accuracy of +/- 1 Pa. Where required the flap/pressure stabilisers shall come complete with fire/fire smoke damper.

The fire/smoke damper shall be standard smoke/fire damper integrity tested to BS EN 1366 for 245 minutes - ES classification (ES245).The fire/smoke damper shall be enclose in a case with the flap/stabiliser as one unit and the entire case shall be powder coated white with antimicrobial protection as standard. The fire damper must be compatible and be capable of being controlled by the fire damper control panel/system.

- Manufacturer: to submit proposals.
  - Product reference: to submit proposals.
- Material: Stainless steel flap and adjustable balance weight assembly.
- Wall mounting casings material: to submit proposals.
- Control pressure of balance weight: to submit proposals.

380 ACCESS DOORS

An access panel shall be provided adjacent to all items of in-line equipment that require either regular servicing or intermittent access.

Access doors shall not generally be less than 450 mm long by the full width of the duct on sizes up to 450 mm wide. For ductwork sizes up to 600 mm wide, access door shall not be less than 450 mm x 450mm clear opening. Ductwork sizes for 600 mm-900 mm shall have not less than 600 mm x 450 mm access doors. For ducts with longest dimensions below 300 mm Level 2 access doors DW/144 Table 25 shall apply. For ductwork with sides longer than 900mm access door sizes shall be agreed with . Where man access into ductwork is possible then the supports and fixing shall be suitable to support the weight of an occupant and tools. Access doors shall be installed adjacent to all coils and batteries for inspection and cleaning.

Access and inspection opening locations shall be in accordance with Part 7 of DW/144 and suitable to comply with the requirements of TR/19 with the exception of above and the following.

All doors shall be fitted with rust-resistant quick release fasteners and those in the riser shafts shall be supplied with an approved retaining device fixed to door and frame. Access doors shall be capable of withstanding the respective system test pressures referred to in Table 1 of DW/144.

All access doors are to be pre-insulated and shall be constructed and installed in such a manner that the internal face of the duct and door is maintained when fixed. On insulated services all access doors shall be fitted with raised stools which shall be equal to the depth of the insulation. For tender purposes assume insulation thickness of 38 mm. All insulation finishes shall be extended to the neck size of the access door with the access doorframe returns exposed on the surface of the insulation finish.

Ductwork test holes shall be required to be drilled in the locations recommended in SHTM 2025/03-01 (Commissioning) and identified by the commissioning engineer. Test holes shall be drilled and located in accordance with the requirements of BSRIA Application Guide 3/89 Section C3.2 at the positions confirmed by in situ marking or marked up ductwork drawings. Each test hole to be sealed with a top hat grommet. Locations shall not be limited to those described.

Access doors, panels and covers other than those regarded as standard practice (see DW/144) shall be marked on the manufacturers drawings issued for comment or noted below or in other sections of this specification, including type to be used.

Details of large access openings shall be agreed and shall be:-

Fitted in readily accessible locations and suitable for the purpose.

Provided to the sizes, requirements and positions recommended in DW/144 and this specification and on the drawings, utilising suitable proprietary products, which meet the relevant pressure classifications. Provided adjacent to duct mounted filters, cooling coils, fans, heating coils, humidifiers, and all dampers including hand fire and smoke dampers to facilitate easy cleaning and maintenance.

For air-conditioning (A.C) systems access doors provided for Level 3 access and for other ventilation systems Level 2 access is provided all as indicated on DW/144 Table 25.

Access doors shall be sealed, to ensure an airtight seal with a soft EDPM full-face gasket secured to the ductwork with an approved adhesive. Fire rated to match the standard of ductwork in which they are installed. Insulated in all thermally insulated ductwork to match the insulation value of the associated lagging and maintain the vapour barrier.

FABRICATION

Ductwork used for general ventilation system (including air-conditioning and comfort cooling) shall be manufactured from sheet steel and may be rectangular, circular or flat oval as indicated on the scheme design drawings. Ductwork constructed from an alternative material shall be agreed with and clearly indicated on the scheme drawings. Ductwork, shall generally be constructed from zinc coated Steel as described in DW/144.

The specialist ductwork manufacturer/installer shall be responsible for:-

Reviewing associated Architects and Structural Engineers drawings to confirm routes, availability of supports etc. Site measuring built structures to confirm suitability of routes, co-ordination (with the structure).

Provision of manufacturing/installation and builderswork drawings associated with the ductwork system.

Provision of support details and proposed locations. This shall be via manufacturing drawings and mark-ups on Architectural/Structural engineers' scheme drawings.
Co-ordination and installation of all ductwork components not directly supplied by the ductwork manufacturer/ installer.

Manufacture and supply of all ductwork, and associated components. Installation, air leakage testing, and component operation testing of the ductwork systems and their associated equipment. Preparation of as-fitted ductwork drawings - issued as electronic copy and hard copy at a scale of 1:50 or 1:25.

All the forgoing responsibilities shall be co-ordinated and integrated within the agreed programme of installation.

520 FIRE RATED AND SMOKE EXTRACT DUCTWORK AND FITTINGS

Where indicated on the scheme drawings or where passing through fire rated rooms/enclosures, ductwork shall be of fire rated construction equal to the room/enclosure through which it passes, in accordance with the Fire Consultant's Strategy Report and NHS Fire Code SHTM 81. Project Co. shall review the fire strategy and architects drawings.

The location of the fire enclosing structures and their value (in hours) are indicated on the Architects drawings.

The ductwork shall be constructed as a complete system to provide the rated protection for stability, integrity and insulation when tested in accordance with SHTM 81 and BS. Any components within the system shall maintain the overall integrity in accordance with the test procedures.

Where ductwork services penetrate fire rated walls and cavity barriers, the penetrations shall be sealed after installation by using a proprietary fire sleeve/sealant as manufactured by specialists.

The ductwork systems shall be fire stopped where appropriate. Where plastic ductwork is specified the ductwork manufacturer/installer shall supply and fit to ductwork intumescent sleeves for to finish too.

The ductwork shall be constructed as a complete system to provide the rated protection for stability, integrity and insulation when tested in accordance with BS476 Part 24. Any components within the system shall maintain the overall integrity in accordance with the test procedures.

All fire rated ductwork shall be constructed and installed by a specialist supplier who shall certificate the complete system to the approval of the Local Authority Building Control Officer.

The standard of fire stopping shall give greater or equal fire resistance as the construction through which the service penetrates. Where sheet steel or rolled steel section sealing flanges are required the ductwork manufacturer/installater shall provide them.
Cleanliness and leak tests shall be as main ductwork section.

- Standard: To HVCA DW/144.
- Fire resistance to BS 476-24: As this specification.
  - Stability: To meet room requirements.
  - Integrity: To meet room requirements.
  - Insulation: To meet room requirements.
- Accessories:
  - Materials: Compatible with ductwork.
  - Finish: Match ductwork.

530 PLASTICS DUCTWORK AND FITTINGS, CIRCULAR (No plastic ductwork shall be used without prior written agreement of)

- Standard: To HVCA DW/154.
- Environmental conditions for plastics ductwork: As drawings.
- Material: As drawings.
- Regulating dampers: As drawings.
- Flexible joint connections: Fit on fan inlets and outlets and at building expansion joints.
- Hangers and supports
  - Strength requirements: To BS EN 12236.
- Access openings: As required.

550 SHEET METAL DUCTWORK AND FITTINGS, CIRCULAR

Standard components shall be used wherever practical. Circular ductwork supports shall be as Figures 65 (drop rod studding only) or 66(DW/144).

- Standards: To HVCA DW/144, BS EN 1506 and BS EN 12237.
- Air leakage testing: As classification requirement.
- Special installations: Not applicable.
- Material: Suitable for system and as drawings.
- Construction: Spirally wound.
- Regulating dampers:
  - Balancing type: Suitable for system and as drawings.
  - Operation: Suitable for system.
  - Material: Suitable for system.
- Flexible joint connections: Fit on fan inlets and outlets and at building expansion joints.
- Hangers and supports
  - Strength requirements: To BS EN 12236.
- Access openings:
  - Function:
  - Inspection;
  - Cleaning; and
  - Maintenance.
  - Sizes: As DW 144 and Part U10.

560 SHEET METAL DUCTWORK AND FITTINGS, RECTANGULAR

Any duct with an aspect ratio greater than 4:1 shall be supplied with a central splitter. For all slide-on flange systems ventilation with bolted corners, joints on all systems to be further secured with intermediary fastenings to the Manufacturer's recommendations. Only full girth stiffeners shall be used. Dimpling, self-tapping screws and piercing screws shall not be used as fasteners on ductwork. Turning vanes shall be double skinned as (DW/144) and attached to ductwork using guide rails as indicated in DW/144. Access doors are required in accordance with HVCA guide TR/19 Tables 2 and 3.

The ductwork manufacturer/installer may use radius bends as Figure 29 (DW/144) as an alternative, enabling turning vanes to be omitted.

- Standards: To HVCA DW/144 and BS EN 1505.
- Air leakage testing: As classification requirement.
- Special installations: Not applicable.
- Material: Suitable for system and as drawing.
- Regulating dampers:
  - Balancing type: Suitable for system and as drawing.
  - Operation: Suitable for system.
  - Material: Suitable for system.
- Flexible joint connections: Fit on fan inlets and outlets and at building expansion joints.
- Hangers and supports
  - Strength requirements: To BS EN 12236.
- Access openings:
  - Function:
  - Inspection;
  - Cleaning; and
  - Maintenance.
  - Sizes: As DW 144 and Part U10.

EXECUTION

Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety Regulations. This shall include clean and tidy working and working in confined spaces.

610 GENERAL

- Cut edges on ductwork, flanges and supports: Smooth and burr free.

630 INSTALLATION OF PLASTICS DUCTWORK

- Standard: To HVCA DW/154.
  - Other requirements: Generally no plastic ductwork shall be used.
- Installing flexible joint connections: Minimize pressure drop.

640 INSTALLATION OF SHEET METAL DUCTWORK

- Standard: To HVCA DW/144.
  - Other requirements: Hangers and supports shall be generally as Table 15 of DW/144 or with manufacturer's proprietary devices with the following qualifications.
- Installing flexible joint connections: Minimize pressure drop.

650 SUPPORT OF AIR TERMINALS UNITS IN CEILING GRIDS

- Standard: To HVCA DW/144.
- Special supports: Supply and extract grille/ diffuser supports shall be as manufacturers detail.
- Position: is responsible for the co-ordination of the reflected ceiling
- layout.

670 DUCTWORK SUPPORT FOR VAPOUR SEAL CONTINUITY

- Method of support:

The horizontal bearers shall be steel profiled section such as Uni-strut or equal and approved proprietary support system. The horizontal bearers shall have a galvanised finish, and plastic end-caps. A medium density Class O rubber or EDPM gasket shall be provided between the ductwork and the support bearer horizontal surface. The gasket shall not fully deform under load. The ductwork shall calculate the support system selected. Horizontal supports shall not be used as secondary supports for additional services without prior approval. Calculations shall include the additional loads imposed by the agreed additional services. Multi-tier ductwork runs shall all be supported on individual horizontal bearers with single length common support rods sized for the combined load of all ducts being supported. Multiple section drop rods shall not be accepted. Insulated ducts with vapour sealing shall be provided with a timber or composite material isolating member between ductwork and the support bearer, either horizontally (rectangular ductwork) or circumferential (circular/flat oval ductwork).

The isolating member shall be the full depth of the insulation and shall have the insulation finish/vapour seal and where applicable encasement extended without a break at least 1 duct width or diameter either side of the support channel. The isolation rubber gasket shall also be included. The ductwork Project Co. shall include an allowance for insulation on all faces of ductwork when setting out in horizontal and vertical planes. Supports or bearers, that interrupt or penetrate the insulation or vapour seal, shall not be accepted.

The ductwork manufacturer/installer shall provide a standard sheet of support details cross referenced with the manufacturing and installation drawings. Where cantilever brackets or other special forms of support are indicated, they shall be structurally strong enough to take the load and to transfer the imposed load to the building structure. The Board may require design and supporting calculations for comment prior to manufacture.

690 DRAINAGE OF DUCTWORK

- Ductwork: Install to drain entrained moisture
- Joints: Lap to minimize moisture leakage.

700 TEST HOLES

- Location: In accordance with CIBSE Commissioning Code Series A and HVCA DW/144.

710 CONTROLS AND SENSING EQUIPMENT

- Install sensors and test points to suit specialist control and sensing equipment.

720 WEATHERPROOFING

- All duct work penetrations to the external shall be weathered by

740 INSTALLING CONTROL EQUIPMENT

- General: Fit sensors, damper motors and other control equipment.

760 ACCESS TO DAMPERS FOR RESETTING AND MAINTENANCE

- Location: Provide access to damper mechanisms on fire dampers; smoke dampers; combined smoke and fire dampers; and volume control dampers through access doors, false ceilings etc. Where more than one fire damper is installed in a frame provide access to all fire dampers.
- Fire links: Provide access so that they can be replaced.

790 DUCTWORK CLEANLINESS & VERIFICATION

Refer to section U80 above.

915 CLEANING OF KITCHEN EXTRACT SYSTEMS

- Cleaning: In accordance with HVCA TR/19.
- Method of test: Deposit thickness test.
- Method of cleaning: As section 7 TR/19.
- Post clean verification of cleanliness report: Submit.

940 AIR LEAKAGE TESTING OF MEDIUM PRESSURE DUCTWORK

- Standard: To HVCA DW/144.
- Procedure: Carry out tests. Submit report.
- Extent: Random testing of 10% maximum of the ductwork system.
- Test pressure: To HVCA DW/144.
- Documentation: Submit calculations used to arrive at the allowable loss for the section to be tested.

950 AIR LEAKAGE TESTING OF PLANT ITEMS

- Standard: To HVCA DW/144.
- Procedure: Include in-line plant with certificate of conformity for pressure class and air leakage classification for system under test.

960 FIRE DAMPER SPARES

- Fusible links: Supply spares.
  - Quantity: 4 no full set of spares.

U81 AIR HANDLING UNITS

PRODUCTS

Packaged supply and extract air handling plants shall be provided as defined in the schedules of equipment and as indicated on the drawings, or as defined further in this specification.

The air handling unit and fan supplier shall select the internal components of the plants, such that the overall system resistance does not result in system fan power being excessive.

Project Co. shall obtain from his proposed supplier calculations to demonstrate that the Building Regulation requirements for Specific Fan Power, etc are being met along with his technical submission.

All items of the AHU plant and system controls must be capable of being fully interrogated by the building management system through the independent network protocol.

310 AIR HANDLING UNITS

The supply and extract air handling plant shall in all respects comply and align with the requirements and recommendation detailed within the Health Technical Memoranda, in particular SHTM03-01 and 08-01, except where specifically noted within this specification.

The AHU shall be arranged so that the majority of items are under positive pressure. Any item of plant requiring a drain shall be on the positive pressure side of the fan.

AHU Plants shall be of a rigid, air tight, assembly and constructed in unitary form or consist of standard modular components, assembled to ensure even airflow throughout plant with no by-passing of active components. Sealing strips shall be provided between all component parts. Factory joints shall be fully tightened and all necessary sealing strips, nuts, bolts and washers etc. being provided for site made joints. The units shall be suitable for operating against closed dampers, i.e.no flow conditions during normal and fire operation. Panels penetrated by service pipes, electrical cables etc. shall be sealed together with all joints having an air leakage integrity at design pressure which is not less than the integrity of the associated ductwork systems.

The units shall incorporate gradual change section pieces between sections to minimise pressure drops, with spacing of components to manufacturer's recommendations to ensure satisfactory operation at each stage and allow access for inspection, cleaning and maintenance. The inside surfaces shall have smooth and easy clean finishes free from structural projection. The location of fan motor, fan belts, filters etc. shall be as detailed in the schedules and on the drawings.

All modular constructed plants shall be provided with purpose made base frames. Bases shall be of sufficient height to accommodate drainage traps from dehumidifiers, humidifiers etc. All plants shall be provided with sufficient access panels/doors and viewing windows to allow maintenance and repairs to be carried out. Coils used in air-handling units shall be rated in accordance with EN 1216. On larger plants, split/multiple coils shall be used.

Construction shall be such as to withstand maximum fan static pressure without deformation and with panel deflection of not more than 1/120 of maximum panel dimension under operating conditions.

Energy recovery shall be via a plate heat exchanger or thermal wheel (fitted with a purge sector), depending on the type of unit. Cleaning access shall be required to both sides of any energy-recovery device.

Where units incorporate recuperators or cooling coils, the internal surfaces of the units liable to be affected by any free water produced shall be protected by anti-corrosion paint (white). Such units shall have adequate drain trays to collect water; the drain trays shall be extended, or other means of collection shall be provided to ensure the removal of any water deposited or condensed in adjacent sections.

Trays collecting cooled water shall be insulated to prevent condensation on the outer surface. All the surfaces/features shall be suitable to withstand regular cleaning with a water solution containing 5ppm chlorine, such as 316 stainless steel. Internal sloping surfaces for humidifier and cooling coil sections to fall to drain. All drains shall be provided with glass U-traps suitable to withstand twice the negative/positive pressure produced by the fan and have a screwed access for cleaning and filling as indicated in TM13 (Minimising the risk of Legionnaire's disease) and as further defined in Department of Health Guidance Notes. Certified type test performance certificates shall be issued on completion of plant testing for fans, coils, filters and electric motors etc. Fire rating type test certificates shall be provided for filters. Individual pressure testing certificates shall be provided for coils. Specific fan performance curves shall be provided and these are to relate to the unit ESP with clean filters.

All wiring from fans is to be taken through the unit casing and a 2 metre tail left for connecting to inverters supplied by the controls specialist

Viewing ports and internal illumination shall be fitted to facilitate routine inspection of the AHU. Viewing ports should be at a convenient height so that temporary ladders are not required. Internal illumination should be provided by fittings to at least IP55 rating. Fittings shall be positioned so that they provide both illumination for inspection and task lighting. All of the lights in a unit shall be operated by a single switch.

320 AIR CONTROL DAMPERS

Motorised low leakage shut off dampers shall be located immediately behind the intake and discharge of each supply and extract system respectively. They shall be of the opposed blade type, opening through a full 90^{o} and must close automatically in the event of power failure or plant shutdown to prevent any reversal of the system airflow.
A manually operated isolating damper should be installed between the main AHU and its distribution system to enable the unit to be isolated when cleaning is in progress.

- Function: Shut off.
  - Damper position: Dampers are to be rigid, with square connections fitted with end and edge seals of a flexible material and with minimal play in linkages. The leakage on shut-off should be less than 2%.
- Damper control: Motorized.
- Type: Multi-blade damper, opposed blade.
- Material: Manufacturer's standard.
- Ancillaries Locking device and Position indicator.

330 FILTERS

Filters shall be securely housed and sealed in well-fitting frames that minimise air by pass.

Mounting frames shall be designed so that the air flow pushes the filter into its housing to help minimise air bypass. Mounting frames shall be capable of being withdrawn so that the filter can be changed without having to reach into the unit.

Neither the filter media, nor any material used in the construction of the filters, shall be capable of sustaining combustion

All filters sections shall be provided with direct reading dial type gauges marked with clean and dirty sectors to visually show filter status.

A complete spare set of filters shall be provided at handover. Filter grades to be as schedule.

Refer to section U83.

340 HEAT RECOVERY

Heat recovery shall be provided to air handling units and be of the type as indicated on the schedules.
Refer to section U85.

350 HUMIDIFIERS

Space for future installation of packaged steam humidifiers shall be provided to air handling units as indicated on the schedules.

Space shall be included within Operating Theatre air handling units for the provision of humidification in the future.

Refer to section U86.

360 PREHEATERS

Duties as schedule.

Frost coils shall be plain tube without fins, where practical. Where this is not practical coils with fins at 6mm spacing shall be used.

Refer to section U84.

370 COOLING COILS

Duties as schedule.

Refer to section U84.

380 REHEATER

Duties as schedule.

Refer to Section U84.

390 FANS

Fans shall be selected to limit the total system (supply and extract fans) specific fan power, as described in the 'Non-Domestic Heating, Cooling and Ventilation Compliance Guide – Section 10. External system resistances for air handling units and fans are given in the schedule.

Fans shall be centrifugal fans with backward curved aerofoil blades, and give an efficiency of not less than 78%.

Fans shall be positioned to 'blow through' the central plant so that the cooling coil and humidifier drains shall be under positive pressure.

Where a centrifugal fan is located with an open intake, the clear distance between the suction opening and the nearest wall should be not less than half the diameter of the inlet. If two fans with free inlets are positioned within the same chamber, their adjacent suction openings should be at least 1 diameter apart.

Fan/s and drive/s shall be provided with mounting frames and isolation mountings.

Motors shall be located externally. On externally driven fans, drive connection or belts shall be provided with airtight seals to prevent leakage. Externally driven fans shall have suitable anti-vibration mountings and frame with flexible connections to the fan sections of the unit. Fan-drive trains, whether supply or extract, should be easily visible without the need to remove access covers.

Fan drives shall be protected by a mesh guard.

All fans shall be controlled by inverter speed control drives supplied by the controls specialist.

Fans shall be capable of being direct start with fixed speed and manual operation in the event of a computer control system failure or software fault.

Particularly attention shall be given to critical care systems serving operating suites, high dependency care units of any type, isolation facilities, laboratories and pharmaceutical production suites in this regard.

- Performance: In accordance with BS 6583.
- Type of fan: Centrifugal.
- Motor mounting: The fan motor shall be external to the air stream.
- Blow through units: Arrange section to allow uniform velocity profile downstream.

Refer to Section U82.

405 ATTENUATOR

Where attenuators are located within the air handling unit they shall be the same cross sectional area as the AHU and have diffusion plenums as necessary.

Cleaning access should be provided at both ends of any attenuator unit.

Attenuators shall meet SHTM03-01 and this specification.

The splitters shall be fitted with 0.8mm mild steel galvanised bull nosed entries and exits to reduce pressure drop.

Normally the attenuators shall be installed with the splitters in the vertical plane. However in some circumstances, i.e. close to a vertical bend it may be necessary to install with splitters horizontally. In those circumstances the splitters shall be suitably stiffened to prevent flexing and restriction of the airway.

Refer to section U87.

FABRICATION

Project Co. shall submit details of all mechanical equipment for comment and place orders in a timely fashion to ensure delivery as per programme

Project Co. shall protect the AHU's from damage or interference during the works.

The AHU's shall be blanked off when delivered to site to prevent dust entering the AHU.

Project Co. shall include for the services of the manufacturer's skilled services engineers to start up, test and check all the AHU's and controls. This shall include all tests to prove that all the AHU equipment is working with and responding to the clients BMS network and head end. The units when commissioned shall be "Set Up" to give maximum efficiency. The AHU's shall be witnessed by the Board before the plant shall be accepted from . Project Co. shall allow for instruction of the clients representative on the working of the equipment.

510 AIR HANDLING UNIT CASING CONSTRUCTION

Supply air handling plants shall be of a packaged construction with a double skin casing, complete with thermal/acoustic insulation material between the two skins. Units shall house filters, coils, fans and motorised inlet dampers, etc. Heat recovery devices shall also be incorporated as detailed in the AHU schedule.

Vibration isolation shall be provided in the form of spring anti-vibration mountings located under fan and motor bases with flexible connections from the fan discharge and the adjoining ductwork.

- Standard: To BS EN 1886.
- Details: is to submit shop drawings and details of dimensions and weight for review.
- Thermal performance of casing, to form part of the technical submission.
- Acoustic insulation of casing: To form part of the technical submission.
- Fire protection: To form part of the technical submission.
- Material: To form part of the technical submission.
  - Finish: To form part of the technical submission.
- Air handling unit feet: Base to suit AHU and depth of drain and pipe fall.
- is to allow space to integrate the BMS controls into each air handling unit, to serve that respective AHU, and liase with the BMS Specialist to integrate this.

520 AIR HANDLING UNIT ACCESS

- General: Provide access openings and covers complete, including opening devices.
- Seal: To prevent excessive air leakage.
- Seal durability: For normal maintenance operations over at least 10 years.
- Access type: Access doors/hatches as appropriate and where indicated on the drawings or called for in SHTMs, shall be provided complete with handles, locks, keys and latches to the same standards of construction and finish of unit.

Where the unit is large enough for a maintenance engineer to enter the unit, facilities for local maintenance isolation of equipment and opening the doors from the inside shall be provided.

The doors should be large enough e.g. 500mm minimum to allow easy access. Items requiring infrequent access such as attenuators may be via bolted on, lift off panels All doors/panels shall be provided with seals to prevent air leakage.

Access shall be provided as a minimum to fan chamber, dampers, filters, humidifiers and both sides of heating and cooling coils.

Internal lights and double glazed viewing windows shall be provided into fan chambers,
either sides of coils, humidifier sections and where indicated on the drawings. Fittings within the unit shall be to IP55 standard and be operated from a single switch. Additionally, the cladding shall be capable of being easily removed as is necessary to obtain access for necessary inspection and maintenance and also for removal of large items of equipment.

All necessary items shall be assembled by means of nuts, bolts, anti-vibration lock washers equal and approved quick release fastenings. Access doors on isolation suite extract shall have biohazard label affixed.

EXECUTION

610 COMPONENT ASSEMBLY

- Sealing: Provide gaskets between air handling unit sections to prevent air leakage from casing.
- Site drilling of air handling unit: Not permitted.

620A ACCESS

- Access space: Position air handling units to allow space for maintenance and access.

Access for servicing shall be as manufacture recommendations and drawings.

As a minimum Project Co. shall allow the width of the AHU for withdrawing the coils.

630 COIL INSTALLATION GENERALLY

- Venting and draining: Set out pipeline to and from the coils to allow venting and draining of the coils and piping.
- Support: Do not support pipeline and valves on coil connections.
- Access: Allow space to inspect and maintain the coils on both sides.

640 HOT WATER COILS INSTALLATION

- Expansion: Connect pipeline to allow free expansion of headers and tubes.

650A DRAIN LINES INSTALLATION

- All items of plant that could produce moisture must be provided with a drainage system.

The system shall comprise a drip tray, glass trap, air break and associated drainage pipework. All parts of the drainage system must comply with SHTM 03-01.

The drip-tray should be constructed of stainless steel, and be so arranged that it shall completely drain. To prevent 'pooling', it is essential that the drain connection should not have an up-stand; and that a slope of 1 in 20 in all directions should be incorporated to the drain outlet position. The tray must be completely accessible or, for smaller units, easily removable for inspection and cleaning.

Where traps are fitted to plant located outside or in unheated plant rooms trace heating shall be required. The trace heating must not raise the temperature of the water in the trap above 5^{o}C.

660 SERVICES CONNECTIONS

- Entry points: Seal around electrical cable and pipeline entry points to prevent air leakage.
- Flexible cables: Provide between fan motor and local isolator.

670 ISOLATION OF AIR HANDLING UNITS

- Electrical connections: Provide means of isolating air handling units electrically.
- Pipe connections: Provide means of isolating pipelines to air handling units.
- Steam: Provide means of isolating steam to humidifier when access door is opened.

680 SUPPORT FOR AIR HANDLING UNITS

- Method: Purpose made raised frame, with sufficient clearance for drains and traps.

COMPLETION

During the flushing of the pipework system the AHU coil must be by passed or disconnected.

Under no circumstances shall flush though the coils

The units shall be supplied initially with one complete set of spare filters and a further set is to be offered for handover to the client at the end of the contract. This set should be carefully packed and labelled for each plant and filter type.

Alongside each filter gauge a permanent label is required with the following information:-

- Type (pre, bag, final etc.)
- Grade
- Size
- Clean PD (at full speed)
- Dirty PD (at full speed)

910 PRE-COMMISSIONING OF COILS

- Preparation:
  - Remove protective covering.
  - Check frost protection and drain if heat is not available in freezing conditions.
  - Straighten fins.
- Cleaning and chemical treatment: Use chemicals compatible with the materials in the coils.

920 AIR LEAKAGE TESTING

- Testing: In accordance with HEVAC Guide to air handling unit leakage testing.

930 TESTING

- Test location: On site before incorporation in works. (Selected factory testing/inspection may be carried out)
- Test results: Submit.

U82 FANS

PRODUCTS

All fans shall be type tested to BS.848 and a type test certificate shall be provided for each type of fan supplied. All fan duties shall be at an air density of 1.2 kg/m³ at 1.01325 bar and 15°C. Fan outlet velocities shall not exceed 10.00 m/s. Each fan shall be provided with dedicated fan performance curves, with the duty selection, absorbed power requirements, motor selection and sound power levels clearly indicated.

All fans shall be selected for low noise.

All fans shall be low energy type.

All fan's and system controls must be capable of being fully interrogated by the building
management system through the independent network protocol.

All fans shall be inverter driven.

310 AXIAL FLOW FANS

Axial flow fans shall be of the long case pattern with a heavy gauge mild steel casing
galvanised after fabrication, flanged and drilled at each end.

The impeller shall be of multi-blade aerofoil section constructed from die cast aluminium or heavy-duty steel. The hub design shall allow for manual adjustment of the blade pitch angle. Multi-stage axial fans shall be arranged with contra-rotating stages.

The impellers shall be directly driven through a totally enclosed motor with ball or roller bearing to suit the application. The fan motor shall be sized so that a blade pitch angle adjustment of the impeller of up to 2° shall be possible without a change of motor. During assembly of each fan the fan impeller shall be statically balanced to a level of 4.5 mm/s RMS at the fan feet. All bearing lubrication shall be extended to the outside of the casing. Axial fans shall be complete with anti-vibration mounts, flexible connections and matching flanges for duct connection and bellmouths and guards where fans are in free air. Motor terminal boxes shall be external to the casing and provide protection to IP55 as defined in BSEN.60529.

- Performance: To BS 848-1.
- to provide technical proposals for review.
- Mechanical safety: To BS 848-5.
- Electrical safety: To BS EN 60335-2-80.
- Dimensions: To BS 848-4.
- Operating conditions:
  - Environment: Existing hospital and residential housing
  - Air density: 1.20 kg/m3.
- Operation: As schedule and drawings.

- Inspection doors: Fit airtight inspection doors giving access to drive motors and other components requiring regular servicing and maintenance.
- Motor and drive: Match fan.
- Material:
  - Casing: Manufacturer's standard. to submit proposals.
  - Impeller: Manufacturer's standard.
- Anti-vibration mountings: Manufacturer's standard. to submit proposals.
- Flexible duct connections: Manufacturer's standard. to submit proposals.
- Accessories: As schedule and drawings.

320 CENTRIFUGAL FANS

Fan units shall be installed as detailed on drawings and fan schedules. External fans shall be weatherproofed and suitable for conditions.

The assembly is dynamically balanced to DIN ISO 1940. Motors shall be constructed from aluminium and be suitable for speed control.

Fans shall be suitable for horizontal through to vertical shaft operation. Supplied IP55, with removable drain plugs.

Sealed for life bearings lubricated with wide temperature range grease. Motors shall be fitted with thermostat overheat protection as standard. Three phase motors shall be suitable for inverter speed control down to 20% of full speed where specified.

Fans shall be fully cased, complete with an externally mounted pre-wired electrical terminal box. Casings shall be from sheet steel with integral pre-drilled inlet flanges.

Casings shall have a galvanised finish to provide a high corrosion resistance

- Performance: To BS 848-1.
- to provide technical proposals for review.
- Mechanical safety: To BS 848-5.
- Electrical safety: To BS EN 60335-2-80.
- Dimensions: To BS 848-4.
- Operating conditions:
  - Environment: Existing hospital and residential housing.
  - Air density: 1.20 kg/m3.
- Operation: As Fan schedule.
- Motor and drive: Match fan.
- Casing: Manufacturer's standard. to submit proposals.
- Inspection doors: Fit airtight doors in scroll and cover.
- Mounting: As Fan schedule and drawings.
- Material Galvanized sheet steel.
- Anti-vibration mountings: Manufacturer's standard. to submit proposals.
- Flexible duct connections: Manufacturer's standard. to submit proposals.
- Accessories: As Fan schedule.

350 ROOF MOUNTED FANS

The roof mounted extract/supply fans shall be located in the positions indicated on the drawings and in accordance with the relevant fan schedule. They shall have a low profile cowl manufactured in flame retardant GRP.

The roof fan shall suit the roof profile.

The fan shall be supplied complete with backdraught shutters, bird guard, purlin box curb, hand guard, specific details of the curb and purlin shall be confirmed by

Project Co. shall make due allowance for supporting the fan via the provision of purpose made trimmers between purlins. The trimmers shall be sized to adequately support the weight of the fans.

The fan shall be supplied with all the control interfaces to integrate with the clients BMS system.

- Performance: To BS 848-1.
  - Inlet and outlet arrangement: to provide technical proposals for review.
- to provide technical proposals for review.
- Mechanical safety: To BS 848-5.
- Electrical safety: To BS EN 60335-2-80.
- Dimensions: To BS 848-4.
- Operating conditions:
  - Environment: Normal
  - Air density: 1.20 kg/m3.
- Operation: As Fan schedule and drawings.
- Motor and drive: Match fan.
- Anti-vibration mountings: Manufacturer's standard. to submit proposals.
- Flexible duct connections: Required.
- Flexible electrical connection: Fans electrical power shall be rated for outdoor use.
- Accessories: As Fan schedule.

355 SMOKE EXTRACT FANS.

Fans shall be the bifurcated type as indicated or required, the motor shall be outside the airstream. Motors may be placed between the two halves of the casing using ambient air for motor cooling. Where hot gases, vapours or corrosive fumes are being handled, the motor bearings shall be suitable for operation at the temperatures resulting for the processes involved.

Fans shall be specially constructed for the temperature and the running duration specified during Fire/smoke condition.

- Standard: To BS EN 12101-3.
- to provide technical proposals for review.
- Electrical safety: To BS EN 60335-2-80.

- Accessories:
  - Flexible connections: Required.
  - Vibration isolators: Manufacturer's standard. to submit proposals.
- Control: As schedule.
- Starting device: As schedule.

360 TOILET EXTRACT FANS

Dirty extract systems shall be provided with dedicated extract fans. The fans shall be arranged for duplicate operation in a run and stand-by configuration.

The fans shall be of the centrifugal type with forward curved blades. The impellers shall be belt driven.

Each fan shall have its own dedicated motor and drive assembly mounted on a common base frame with spring anti-vibration mounts between the frame and the unit case/framework.

The fans shall be arranged for auto changeover achieved via the BMS. On failure of the duty fan the stand-by shall start and run. The changeover shall also include the automatic activation of backdraught dampers. The fan enclosure shall be configured to allow continuous operation of the stand-by fan while the failed unit is removed for repair or replacement. The fan and motor shall be removed as a common assembly.

The fans shall be housed in a common heavy gauge aluminium casing arranged for ducted inlet and outlets.

The units shall be provided with airflow and failure monitors suitable for interfacing with the BMS. Auto changeover shall be undertaken by the BMS.

- Performance: To BS 848-1.
  - Inlet and outlet arrangement: As drawings.
- Manufacturer: to provide technical proposals.
  - Product reference: to provide technical proposals.
- to provide technical proposals for review.
- Electrical safety: To BS EN 60335-2-80.
- Operation: As schedule
- Electrical supply type: As schedule.
- Accessories:
  - Access panel: Removable panel
  - Controls: Speed controller to match fan, refer to BMS for further details.
  - Silencer.
  - Backdraught damper.
  - Anti-vibration mount.
  - Guards.

370 CONSTRUCTION AND HANDLING

- Casings: Rigid, so there is no drumming under operating conditions.
- Lifting: Provide lifting eyebolts facilities on fans or sections heavier than 20 kg.

EXECUTION

610 INSTALLATION

- Fixing: Use fixing points provided. Do not strain the fan structure when bolts are tightened.
- Orientation: Mount impeller shaft horizontally.
- Alignment: Install fan to allow optimum air flow path.

U83 AIR FILTRATION

PRODUCTS

Filters shall be provided in a separate plant section of the air handling unit or, if specified, as part of a common section. Filter banks shall be provided with mounting frames to suit standard commercially available filter cells, arranged for side or front withdrawal as per schedules.

Air filters shall be constructed not to be capable of supporting combustion.

Gauges shall be provided across each filter. Tees and branch tubing should be fitted to allow the controls specialist to fit a separate dirty filter warning pressure switch. All filters shall include a filter dirty alarm to the BMS.

Alongside each filter gauge a permanent label is required with the following information:-

- Type (pre, bag, final etc.)
- Grade
- Size
- Clean PD (at full speed)
- Dirty PD (at full speed)

One complete spare set of filter media for each plant shall be provided at handover, being carefully packed for storage and labelled for respective plant and filter types.

Project Co. shall supply and install services and equipment to perform as per specification. Project Co. shall submit details of all mechanical equipment for comment and place orders in a timely fashion to ensure delivery as per programme.

Where a particular manufacture is specified, Project Co. shall include for that manufacturer.

Where considered appropriate, provide for equivalent standard alternatives to be offered for consideration.

This must be done in a timely manner and Project Co. shall provide all details including but not limited to.

- Detailed description
- Cost comparison
- Technical comparison
- References to standards

310 PRIMARY FILTERS

Filter media shall be manufactured from 100% recycled materials. Filter media shall be a cotton and synthetic blend, lofted to a uniform depth, and formed into a uniform radial pleats.

A welded wire grid, treated for corrosion resistance, shall be bonded to the downstream side of the media to maintain the radial pleat and prevent media oscillation.

An enclosing frame, of biodegradable board shall provide a rigid and durable enclosure.

The frame shall be bonded to the media to prevent air bypass.

The manufacturer shall provide evidence of facility certification to ISO standard.

- Performance: To BS EN 779.
- Filter type: to submit proposals.
- Manufacturer: to submit proposals.
  - Product reference: to submit proposals.
- Duty:
  - Air flow rate: to submit proposals.
  - Air velocity: to submit proposals.
  - Initial filter pressure drop: to submit proposals.
  - Final filter pressure drop: 150 Pa.
  - Filter class: As schedules.
  - Filter height, width and limiting depth: As schedule and drawings.
  - Conditions: Sewerage works nearby.
- Flammability: Non-flammable for duration of recommended working life.
- Casing: Manufacturer's standard.
- Access: As specification.
- Filter mounting frames: Purpose made, rigid, with building-in ties where filter is mounted in walls or partitions.

320 SECONDARY FILTERS

Bag or extended surface type filters shall be provided to the required grade or better as specified, in the Equipment Schedules with maximum air velocity at face not exceeding 2.5 m/s. Filter media shall be manufactured from 100% recycled media.

Filters shall be fully self-supporting without external ties or stiffening frames. Filters shall inflate fully, shall not sag or flutter, nor have effective medium area reduced by obstruction due to contact with other filter faces or housing surfaces when operating between 60% and 110% of design air volume for constant volume systems or between the specified minimum and maximum air volume rates for multi-speed systems. Bag shall be short or normal length as noted in the Schedule of design criteria.

- Performance: To BS EN 779.
- Filter type: Bag.

- Manufacturer: to submit proposals.
  - Product reference: to submit proposals.
- Duty:
  - Air flow rate: to submit proposals.
  - Air velocity: to submit proposals.
  - Initial filter pressure drop: to submit proposals.
  - Final filter pressure drop: 250 Pa.
  - Filter class: to submit proposals.
  - Filter height, width and limiting depth: to submit proposals.
- Flammability: Non-flammable for duration of recommended working life.
- Casing: Rigid.
- Access: to submit proposals.
- Filter mounting frames: Purpose made, rigid, with building-in ties where filter is mounted in walls or partitions.
  - Material: to submit proposals.

330 HIGH EFFICIENCY PARTICLE ARRESTOR (HEPA) FILTERS

High efficiency particulate air filters (HEPA/absolute) shall remove virtually all particles from air.

HEPA filters shall be H14 (EU 14) (unless otherwise Specified) with an efficiency of 99.995% @ MPPS.

HEPA filters shall be of the replaceable panel type with leak proof seals. They shall be installed in a manner that permits on site validation of the filter and its housing. This shall involve the release of a Dispersed Oil Particle (DOP) challenge smoke through an injection point upstream of the filter and a measurement of the DOP penetration across the downstream face.

A photometer shall be used to detect leaks.

The Method of testing/Validation with DOP shall be as set out in SHTM 03-01.

Filter housing and seal (generally Housing shall be Electro zinced steel painted white RAL 9010, seal shall be Silicone or Polyurethane gel) shall be suitable for application.

- Standard: To BS EN 1822.
- Manufacturer: to submit proposals.
  - Product reference: to submit proposals.
- Use of conditioned space: to submit proposals.
- Duty:
  - Maximum air flow rate: to submit proposals.
  - Air velocity: to submit proposals.
  - Filter height, width and limiting depth: to submit proposals.
- Filter media: HEPA filter media - Group H.
- Filter class: H14.
- Filter casing: Provide with gasket fitted to casing.
- Filter material: As above.
- Flammability: Non-flammable for duration of recommended working life.
- Access: Access shall be provided for filter change and DOP test.
- Filter frame material: To suit application, as schedule.

370 EDGE SEALS

- Function: Prevent air by-passing filters. Seals must remain effective after removal and replacement of cells.

380 PRESSURE GAUGES

Each filter shall have a filter dirty alarm filter status and filter dirty alarm. This shall be compatible with the client BMS system:

- Type: Dial.
- Manufacturer: to provide technical proposals.
  - Product reference: to provide technical proposals.
- Gauge markings: Positions equivalent to 'Filter Dirty' and 'Filter Clean' conditions.
- Pressure differential switch: Provide for visual or audio warning of 'Filter Blocked Condition'.

390 TERMINAL FILTER HOUSINGS

- Terminal filter housing shall be easy to maintain, clean housing, able to accept a range of standard diffusers and grilles. The diffuser and colour shall match the other supply and extract diffusers. Before any HEPA filters are installed the ductwork system shall be suitably clean.
  The terminal housings shall have:
  Polyester power coat finish
  Limited travel filter clamps
  DOP/Pd sample port
  Installation hanging brackets
  Fully welded flange
  Top or side circular inlet
  Damaged filters must not be installed in the system.

- Filters housed: HEPA and ULPA.
- Housing seals: Gaskets between holding frames on banks of filters. Seal filters into steel casing.

395 FILTER SAFE-CHANGE UNITS

Where indicated on the drawings supply and install safe change housings complete with all pre and main filters. All housings to be manufactured from seam welded carbon steel with 2 pack epoxy coat finish.

Each filter assembly shall have the following features:-

- Inlet and outlet ductwork connections and support feet.
- Inlet and outlet tight shut off dampers.

Tight shut off dampers shall have seals to KTA 3601 or DIN 25414 (maximum leakage 0.01m³/hr x m² with a pressure differential of 2000Pa). The dampers shall be pressure tight to 5000Pa. The damper mechanism shall be designed such that after closure no energy is required to keep the damper in a closed position. The case and blades of the unit shall be constructed of sheet stainless steel to BS 1449 – Grade 304 – S11 Finish 2B. Bearing assemblies shall be stainless steel or brass. Damper blade sealed shall be neoprene foam rubber material, temperature resistant up to 80°C.

- Manometer points across each filter housing with manometer fitted across the hepa filter. Tappings to be configured to allow for BEMS monitoring of hepa filter condition. Manometer to be mounted on the assembly framework.
- 2 No. stainless steel cam bars for filter location.
- Aerosol sampling point in bottom spigot.
- All necessary safe change bag and retaining ring sets.
- All filter assemblies shall be factory pressure tested to a pressure of 2500Pa for minimum 1 hour and a test certificate provided.
- Leak test devices to DIN 1946 shall also be provided to allow maintenance staff to ensure replacement filters are properly seated prior to operation.
- Each unit shall have:
- Minipleat high capacity absolute filters, 610 x 610 x 292mm deep with MDF case, efficiency to BS EN 1822 grade H14, 99.995%. All filters throughout the development shall be a common grade.
- Hardened case pre-filters 610 x 610 x 60mm to BN 779 grade G7.
- Upon completion of installation, a site validation test shall be carried out to achieve a maximum of 0.005% penetration and certificate provided.

EXECUTION

610 INSTALLING FILTER FRAMES

- Fixing: Securely fasten frames to ductwork walls.
- Gaps around the frames: Seal with mastic sealant.

620 INSTALLING FILTERS

- Mounting: Clamp securely against sealing gasket to prevent leaks.

630 INSTALLING PRESSURE GAUGES

- General: Fix external to unit to allow easy observation, within 3 m of filter.

U84 HEATING AND COOLING COILS
PRODUCTS

To facilitate maintenance access, auxiliary wet batteries should be located above corridors or other non-critical areas and not above patient occupied spaces. Access doors shall met the requirements in section U80.

310 LOW TEMPERATURE HOT WATER HEATING COILS

Hot water coils shall be installed as shown on drawings.

Tubes are arranged in a staggered pattern with respect to adjacent rows to provide maximum heat transfer efficiency.

Return bends are the full thickness and diameter of the coil tubes to provide unrestricted flow and undiminished strength Access for cleaning shall be provided to both sides of all coils and batteries.

All water batteries shall be designed to ensure equal flow through all circuits. The water flow and return connections together with the airflow direction shall be permanently marked on the casing. All coils shall be supplied complete with vents and drains. Provision shall be made for expansion of the tubes and for effective venting of the coils.

Coils shall be arranged so as to facilitate removal of the coils without draining local pipework

On large coils, multiple or split coils shall be used to ease installation, repair and maintenance operations.

Heat exchanger finned surfaces shall extend the full width of the coil casing. Coils shall be suitably protected against corrosion with due regard to the geographical location of the coil and local atmospheric conditions. Sealing devices shall be provided around the casing to prevent air by-pass

Casings shall be galvanised sheet steel with angle framing at each end drilled ready to receive the counter flanges on the connecting ductwork. Coils shall be supported so that their weight is not transmitted to ductwork and so they can be removed without disturbing adjacent ductwork. Inspection doors shall be provided on both the upstream and the downstream sides of the coils.

All coils shall be tested at the manufacturer's works or an approved testing laboratory and rated for thermal performance to BS EN 13053 and certificates provided. These tests shall also include confirmation of water pressure drops at the design flow rates. These pressure drops shall be from pipework pressure tapping on the flow and return connections external to the unit.

The maximum water system pressure drop shall be *25* kPa. The maximum air pressure drop across the coil shall be *20* Pa. Any site tests that show either pressure drops above this level shall require the replacement of the coil.

Where auxiliary/re - heater-batteries are located in false ceilings, they should be fitted with a catch tray and leak detection alarm. The catch tray shall be installed under both the battery and the control valve assembly to protect the ceiling from leaks. The moisture sensor and alarm shall be fitted in the tray and shall alarm the clients BMS in the event of a leak.

- Performance: To BS 5141-2 and BS EN 1216.
- Project Co. shall submit proposals for review.
- Materials: Solid drawn copper tubes with copper fins.
- Tube wall thickness: At least 0.7 mm.
- Fin thickness (minimum):
  - Aluminium: 0.4 mm.
  - Copper: 0.3 mm.
- Fin spacing (maximum): As schedule.
- Thermal expansion: Allow for movement.
- Casing finish: Galvanized mild steel.
- Access doors: Hinged, airtight and watertight for maintenance.
- Draining and venting: As specification.
- Water test pressure: Up to 2.1 MPa or 1.5 times the working pressure, whichever is greater.
- Packaging: Fit protection for fins before despatch.
- Protection: Fit blank flanges or caps to pipe connections after manufacture.
- Accessories: As schedule.

320 CHILLED WATER COOLING COILS

Access for cleaning must be provided to both sides of all cooling coils. The coil shall have electro tinned fins.

Coils frames and casings shall be manufactured from stainless steel.

Pipe Connections shall be screwed up to 50mm, flanged above. Maximum velocity over the coils shall be 2m/s.

The coil shall have an eliminator.

All cooling coils shall be fitted with their own independent drainage system. The system shall comprise of a stainless steel drip-tray, glass trap, air break and associated drainage pipework.

The drip tray shall be arranged to drain completely and prevent pooling.

The drain connection shall not have an up-stand. A slope of 1 in 20 in all directions shall be incorporated to the drain outlet position.

Where coils are greater than one metre high intermediate drain trays shall be provided.

The AHU base shall be high enough to accommodate the trap and pipe work fall.

The tray shall be completely accessible or for inspection and cleaning.

Each drip-tray shall be provided with its own drain trap. The drain trap shall be of the clear (borosilicate) glass type.

The trap shall have a means for filling and shall incorporate couplings to facilitate removal for cleaning. It shall be located in an easily visible position where it shall not be subject to casual knocks. The pipework connecting it to the drainage tray should have a continuous fall of not less than 1 in 20.

Water from each trap shall discharge via a clear air gap of at least 15 mm above the unrestricted spill-over level of either an open tundish connected to a drainage stack via a second trap, or a floor gully. A support shall be provided to ensure that the air gap cannot be reduced. Drainage pipework shall be copper.

A baffle device shall be provided in the drip-tray to prevent air bypassing the coil, and the tray shall be large enough to capture the moisture from the eliminator, bends and headers.

The cooling-coil control valve shall close upon selection of low speed, system shut-down, low airflow or fan failure.

The maximum water pressure drops across the coils shall be *30* kPa. The maximum air pressure drops across the coils shall be 80 Pa. Any site tests that show pressures above either of these levels shall require the replacement of the coil.

- Performance: To BS 5141-1 and BS EN 1216.
- Duty: Refer to drawings and schedules.
- Materials: Solid drawn copper tubes with copper fins, all electro-tinned.
- Tube wall thickness: At least 0.7 mm.
- Fin thickness (minimum):
  - Aluminium: 0.4 mm.
  - Copper: 0.3 mm.
- Casing:
  - Finish: Stainless steel
  - Return bends: Provide removable covers. Lag and vapour seal the bends.
- Eliminator plates: Install downstream of all coils.
- Draining and venting: As specification.
- Access doors: Hinged, airtight and watertight for maintenance.
- Water test pressure: Up to 2.1 MPa or 1.5 times the working pressure, whichever is greater.
- Packaging: Fit protection for fins before despatch.
- Protection: Fit blank flanges or caps to pipe connections after manufacture.
- Accessories As schedule.

- Airflow: Evenly distributed over face area of coil (to be verified at commissioning)
- Air velocity: Ensure it is below level at which moisture carryover occurs.

340 ELECTRIC HEATER BATTERIES

Generally electric heating batteries are to be avoided. Their use should be restricted to low power use (for example trimming control).

Where used, electric heaters shall be provided with high temperature cut out protection with automatic reset.

is to provide technical submissions for review.

- Casing material: Aluminium.
  - Casing finish: Natural.
- Access doors: Hinged, airtight and watertight for maintenance.
- Heating elements: Mount on removable terminal plate.
  - Type: As schedule.
- Terminal boxes: Welded steel.
- Safety cut-out switch: Automatic reset, wired in series or via contactor with heating elements.
- Controls:
  - Fan interlock to prevent heater operating without fan running.
  - Run-on timer to allow airflow to cool heater before switching off fan.
- Air flow detector switch: Wired in series with other safety devices.
  - Type: Differential pressure.
- Accessories: Heater batteries to be thyrister controlled.

610 INSTALLATION

- Equipment, controls and instruments positioned next to heating coils: Protect from thermal radiation.
- Fixings: Support coils independently of ductwork.

620 ELIMINATOR PLATES INSTALLATION

- General: Fit to allow removal from coil casing.

U85 HEAT RECOVERY

Thermal wheel heat exchangers shall be incorporated within extract air plants handling uncontaminated air (non hygro-scopic type). These plants shall also include main dirty air extract plants. The heat exchangers shall transfer heat energy within the extract air to a pumped circulation water heat recovery system. Heat exchangers within the fresh air plants shall utilise the recovered heat to pre-heat incoming fresh air.

Where the use of thermal wheel heat recovery units have been found to be inappropriate plate recuperator systems shall be employed.

The heat recovery systems shall be configured to operate at all times when useful energy can be recovered and used by the various air plants.

PRODUCTS

310 PLATE RECUPERATORS

- is to submit proposals for review based upon details shown on drawings, schematics and schedules.
- Efficiency: minimum 55%.
- Heat transfer plates: Manufacturer's standard for application. to provide technical submission.
- Coating: Manufacturer's standard for application.
- Access doors: Hinged, airtight and watertight for maintenance.
- Accessories:
  - Face and bypass dampers;

330 THERMAL WHEELS

- is to submit proposals for review based upon details shown on drawings, schematics and schedules.
- Efficiency: minimum 65%.
- Rotor: Non-hygroscopic.
- Access doors: Hinged, airtight and watertight for maintenance.
- Accessories:
  - Adjustable purging sector;
  - By-pass damper;
  - Matching ductwork flanges;
  - Return air damper; and
  - Speed controller.

EXECUTION

630 INSTALLING DRAIN TRAPS

- Air break: Locate between trap outlet and drainage system.
- Traps under suction: Install the outlet below the inlet by a depth equivalent to at least one and a half times working pressure.
- Traps under positive pressure: Install inlet and outlet at same level.

U86 AIR TREATMENT

Space within air handling units to accommodate future installation of humidification shall be provided only in Operating Theatres, HDU and Critical Care. Close control of humidity is required for the successful operation of sensitive equipment, e.g. computers.

U87 SILENCERS AND ACOUSTIC TREATMENT

PRODUCTS

The attenuators including cross talks, shall be selected and installed by . Project Co. shall appoint a specialist to select these, using the noise criteria detailed elsewhere. The permissible pressure drop on cross talk attenuators is *25* Pa and *50* Pa on other attenuators. is to provide technical submissions for the silencers and acoustic treatment.

310 CIRCULAR SILENCERS

Silencers shall be installed generally as indicated on the drawings.

Silencers shall be of the size, configuration, capacity and acoustic performance required to meet the specified acoustic criteria.

All circular silencers shall be constructed with a galvanized steel casing. All casing seams and joints shall be lock formed and sealed. All fixings to the casing to be with blind rivets to eliminate leakage.

The silencer infill to be covered in ICI Melinex to prevent particle migration. The membrane shall have a 25 year service life.

- Performance requirements: To BS EN ISO 7235 and BS EN ISO 11691.
- Casing: galvanised sheet steel minimum thickness 0.8mm
- Splitters: galvanised perforated sheet screen minimum thickness 0.8mm with an open area of at least 23%.
- Lining material: Inert, fire proof, inorganic and non- hygroscopic minimum density 48kg/m^3.
- Markings: Show direction of air flow on silencer.

320 RECTANGULAR SILENCERS

Silencers shall be installed as indicated on the drawings.

Silencers shall be of the size, configuration, capacity and acoustic performance required to meet the specified acoustic criteria.

All Rectangular silencers shall be constructed with a galvanized steel casing. All casing seams and joints shall be lock formed and sealed. All fixings to the casing to be with blind rivets to eliminate leakage.

The silencer infill to be covered in ICI Melinex to prevent particle migration. The membrane shall have a 25 year service life.

- Performance requirements: To BS EN ISO 7235 and BS EN ISO 11691.
- Casing: galvanised sheet steel minimum thickness 0.8mm
- Splitters: galvanised perforated sheet screen minimum thickness 0.8mm with an open area of at least 23%.
- Lining material: Inert, fire proof, inorganic and non- hygroscopic minimum density 48kg/m^3.
- Markings: Show direction of air flow on silencer.

330 AIR TRANSFER AND CROSS TALK ATTENUATORS

Cross Talk attenuators shall be installed in the ductwork in locations shown in the plans.

The performance of the attenuators shall be such that the privacy shall be maintained between adjacent spaces.

The attenuator shall control noise transfer, in particular speech via the ductwork.

Project Co. shall submit calculations for examination *by the acoustic consultant*.

All cross talk silencers shall be constructed with a galvanized steel casing. All casing seams and joints shall be lock formed and sealed. All fixings to the casing to be with blind rivets to eliminate leakage.

The silencer infill to be covered in ICI Melinex to prevent particle migration. The membrane shall have a 25 year service life.

- Performance requirements: To BS EN ISO 7235 and BS EN ISO 11691.
- Casing: galvanised sheet steel minimum thickness 0.8mm
- Splitters: galvanised perforated sheet screen minimum thickness 0.8mm with an open area of at least 23%.
- Lining material: Inert, fire proof, inorganic and non- hygroscopic minimum density 48kg/m^3.
- Markings: Show direction of air flow on silencer.

The cross talk attenuator shall be installed / located to avoid flanking ideally placed in the ductwork as it passes through the wall separating rooms.

350 ACOUSTIC INSULATION

’s acoustic specialist shall examine the need for acoustic lagging. Acoustic lagging shall be provided and fitted where necessary to the outside of the ductwork to achieve an enhanced Sound Reduction Index (SRI) of ductwork and hence reduce noise break in or break out.

The lagging shall consist of mineral wool density not less than 48kg/m3 and not less than 50mm thick.

The mineral wool shall be covered with an outer skin typically lead weighed PVC material or 0.8mm thick galvanised mild steel. All joints shall be suitably sealed to maintain acoustic integrity.

The lagging shall be securely fixed to the pipework / ductwork using mechanical fixings.

- Material: Lightweight mineral wool.
- Outer covering: As specification.

EXECUTION

610 ACOUSTIC LININGS

- Access: Where personnel access is provided, protect acoustic linings to prevent damage.

U88 AIR TERMINAL DEVICES

PRODUCTS

Air terminals shall be provided as indicated on the drawings, or as defined further in this specification.

shall co-ordinate the reflected ceiling plan.

Project Co. shall appoint a specialist supplier to provide the selections and schedules for the air terminal devices. ’s specialist shall select the grilles and diffusers using the locations and air volumes shown on the drawing. Project Co. shall submit these for review.

All diffusers and grilles shall be selected for quiet operation, using the noise criteria specified.

Project Co. shall provide samples of each type of air terminal device for review.

Neck velocity shall not exceed 2.5 m/s on any terminal device (diffusers/grilles etc).

310 AIR TERMINAL DEVICES, SPECIALIST UCV HOODS

The UCV shall be a Vertical-flow type system and meet all requirement of SHTM03-01 including figure 6.

The return air grilles/diffusers shall be sited so as not to cause short circuiting. Project Co. shall comply with SHTM03-01 to this regard.

Project Co. shall ensure that each face or each corner of the theatre shall have an air path to provide good air circulation and to prevent entrainment in the clean zone. Air velocities for and over the UCV shall be as SHTM/HTM 2025/03-01 as a minimum. UCV systems shall come complete with HEPA filters. A set of new filters shall be issued to the client following commissioning of the unit.

The final filters shall be installed in a leak-proof housing in a manner that allows the terminal unit, filters and their seals to be validated. A challenge test shall be carried out during commissioning to prove the effectiveness of the complete installation. Challenge test shall be as manufactures recommendations and the Method of testing/Validation with DOP shall be as set out in SHTM03-01.

The UCV shall have direct-reading pressure gauges for each final filter and a return-air filter to capture the relatively coarse particles that would otherwise significantly reduce the life of the final filter. The return air filter shall be G3 grade to BS EN 779 as a minimum.
The UCV shall not exceed NR 50. Any in line attenuation shall non-particle-shedding and fire-resistant.

The functions of the canopy circulation fans shall be continuously monitored by a BMS control unit.

Additional to this the UCV system shall have

- a set-back facility that shall reduce the air supplied through the UCV terminal to a volume that equates to an amount not less than 25 air changes per hour of the operating room's gross volume whilst still leaving the supply AHU operating at full speed;
- a facility to turn off the entire system, the supply AHU and the UCV terminal (an emergency stop is not required);
- a read-out sufficiently large to be clearly visible from the operating table that shows the temperature of the air being supplied by the UCV terminal;
- a read-out sufficiently large to be clearly visible from the operating table that shows the relative humidity of the air being supplied by the UCV terminal;
- a red indicator light that shall illuminate when either the supply AHU or the UCV terminal fails; either or both are switched off or the AHU and UCV terminal are at set-back;
- an amber indicator light that shall illuminate when the UCV terminal is at set-back and the supply AHU is running;
- a green indicator light that shall illuminate when both the supply AHU and UCV terminals are operating at full speed;
- a blue indicator light that shall illuminate when the UCV terminal's HEPA-filter resistance causes the air delivered to fall below 80% of the design flow rate.
- Performance:
  - Mixed flow applications: To BS EN 12238.
  - Sound power levels: To BS EN ISO 5135.
- Performance requirement to SHTM.
- Material: Stainless steel.

325 AIR TRANSFER GRILLES

Transfer grilles shall be non-vision type and sized for a maximum face velocity of 1.5 m/s.

- Grille type: Non-vision.
- Accessories: Transfer grilles shall not be installed in a fire rated door/wall. Transfer grilles in operating theatres shall incorporate a volume control damper to allow adjustment to room pressure

330 DIFFUSERS

Ceiling diffusers shall be installed as shown on the drawings. The diffuser shall be a square ceiling diffuser for flush mounting, comprising diffuser face with mitred perimeter border.

Louvre face diffusers shall be of the four way pattern and shall have adjustable cores to provide horizontal or vertical distribution. The air pattern shall be achieved via the use of directional blanking plates within the body of the diffuser and shall not be visible from the diffuser face. The diffuser shall be suitable for incorporation in a standard ceiling tile grid without overlapping the tile-supporting bar. Diffusers shall be complete with a security chain between the diffuser body and the core and an earth bonding tag.

Ceiling diffusers shall be suitable for direct replacement of 600 x 600 ceiling tiles or an overall size relative to the selected neck size for fitting within a cut tile.

Branches serving individual diffusers shall be provided with a manual volume control damper supplied and fitted by the ductwork installer, in addition to the grille damper where supplied. The duct mounted volume control damper shall be located as close as possible (within 1 duct diameter) of the take-off with the main branch duct.

Where extract is required via ceiling mounted devices louvre face diffusers shall be used. The diffusers shall be similar in construction and appearance to the supply diffusers.

The diffuser shall have fixed air control blades, central fixing screw with decorative cap and an opposed blade damper adjustable from the front face.

The plenum box shall be galvanised sheet metal with a rubber lip seal.

The plenum box shall have fixings for suspending the assembly from the ceiling slab.

The plenum boxes shall be suitable for side or top entry as required.

The diffuser face shall be extruded aluminium sections, natural anodised rear ancillaries in formed sheet steel, surfaces phosphate treated and stove-enamelled.

Supply and extract diffusers shall be at a distance from one another to prevent short circuiting. Supply diffusers shall be located away from one another to prevent two opposing air streams meeting and causing drafts, the individual velocities shall not be greater than 0.25 m/s.

- Performance:
  - Mixed flow applications: To BS EN 12238.
  - Sound power levels: To BS EN ISO 5135.

340 LAMINAR FLOW PANELS

Laminar flow panel diffusers shall be provided in operating theatres with a footprint that encompasses the operating site to produce a downward-displacement parallel-flow air distribution.

Diffusers, of all patterns, to operating theatres shall achieve the required velocity at the operating table position of between 0.2 and 0.3 metres per second, and achieve good air distribution throughout the remainder of the room. Particular care shall be taken to ensure that in a heating mode air discharge velocity overcomes the buoyancy of the air to achieve the required velocity at the operating table position.

The ventilation distribution arrangement must take priority over the layout of luminaires and pendants, etc.

350 TOILET SUPPLY AND EXTRACT VALVES

Extract from toilets, bathrooms and showers shall be via exhaust air disc valves. Each valve shall be constructed from sheet steel and provided with a stove-enamelled finish. The centre disc valve core shall be mounted on a threaded adjustable centre spindle complete with locking nut to provide air volume flow rate adjustment.

The centre disc assembly shall be mounted in a profiled outer ring complete with an edge seal and tamperproof sub-frame.

Generally each valve shall be installed within a cut tile. Each valve shall not require a plenum but shall be connected into a section of rigid ductwork before any flexible is used.

Each branch connecting to individual valves shall be provided with a manual volume control damper fitted as close to the upstream branch connection as possible.

360 DIFFUSERS, LINEAR

Linear diffusers shall be installed as shown on drawings.

They shall be made from aluminium extrusion, natural anodised.

Diffusers shall come complete with end caps and air control blades.

The diffusers shall have a rear mounted plenum box fitted with a side entry spigot and suspension brackets to hang the complete assembly from the ceiling.

The plenum box shall be fitted with a volume control damper adjustable from the diffuser face and be made from galvanised sheet steel.

- Performance:
  - Mixed flow applications: To BS EN 12238.
  - Sound power levels: To BS EN ISO 5135.
- Diffuser: Slot.
- Material: Aluminium.
  - Finish: Anodized.

370 DIFFUSERS, SWIRL

The swirl diffusers shall be adjustable in square or circular face plates with swirling horizontal discharge of supply air with high induction.

Diffusers shall consist of a pressed front face with radially angled air discharge sections incorporating adjustable directional air control blades.

Diffusers shall be complete with a plenum box with circular top or side entry spigots and volume control damper. The Plenum box shall be supplied with fixed hanging brackets.

The face plate shall be galvanised sheet steel with the surfaces pre-treated and powder coated white (RAL 9010).

The control blades shall be made from Polystyrol coloured black or white as required.

The plenum box is made from galvanised sheet steel with a rubber lip seal.

The plenum box shall be galvanised sheet metal with a rubber lip seal.

The plenum box shall have fixings for suspending the assembly from the ceiling slab.

The plenum boxes shall be suitable for side or top entry.
Supply and extract diffusers shall be at a distance from one another to prevent short circuiting. Supply diffusers shall be located away from one another to prevent two opposing air streams meeting and causing drafts, the individual velocities shall not be greater than 0.25 m/s.

- Performance:
  - Mixed flow applications: To BS EN 12238.
  - Sound power levels: To BS EN ISO 5135.
- Material: Galvanized steel.
  - Finish: Epoxy resin powder/ hardener coating.

390 GRILLES

Grilles shall be installed as shown on the drawings.

The grilles shall be made from extruded aluminium sections. The finish shall be as RAL number. Grilles shall be selected for quiet operation.

Grilles, shall have corner mitres and rear perimeter sealing strip with profiled front blades.

Sub frames shall be used where required.

- Performance:
  - Mixed flow applications: To BS EN 12238.
  - Displacement flow applications: To BS EN 12239.
  - Sound power levels: To BS EN ISO 5135.

400 CEILING VENTING GRILLES (CVG)

Ceiling venting grilles shall be provided along the main distribution routes for medical gas and natural gas pipework.

Ceiling venting grilles shall be of similar construction and arrangement to the supply diffusers. The diffuser body only shall be provided for these items.

The minimum size of CVGs shall be 150 x 150mm.

410 PLENUM BOXES, CEILING OR WALL MOUNTED

Plenum boxes shall be made of 0.7mm Galvanised steel plenum.

Spigot construction shall be a top or side entry plenum option robustly fabricated plenums shall come complete with all necessary fixing angles for drop rod support.

- Duty: To match grille and diffuser.
- Configuration: Single plenum box or a series of plenum boxes butted together to form a continuous length.
- Construction: Sturdy and rigid with circular inlet spigots of 65 mm minimum length.
- Fixing: Incorporate means for fixing to, or suspending from, building or other construction.

EXECUTION

610 INSTALLATION

- General: Do not distort air terminal devices. Fix securely.
- Air leakage: Prevent. Seal joints with self adhesive foam strip or equivalent.
- Appearance: Finish visible edge joints neatly. Do not leave sharp edges and protruding screws.

620 FIXING CIRCULAR AND RECTANGULAR DIFFUSERS

- Method: As per manufacturer's instructions and specification.

640 FIXING LINEAR AND SLOT DIFFUSERS

- Method: As per manufacturer's instructions and specification.

650 FIXING FLOOR MOUNTED SWIRL DIFFUSERS

- General: Fit flush with finished floor.
- Method: As per manufacturer's instructions and specification.

660 FIXING GRILLES

- Method: As per manufacturer's instructions and specification.

670 OPERATION

- General: Fit so that moving parts operate correctly and removable cores can be taken out and replaced.
- High level and ceiling applications: On removable cores, provide safety wires with quick release ends.

680 BLANKING PLATES

- Location: Where needed to restrict projection of air flow from section of grille or diffuser.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical**	Sheet	**WW AP.1.2.18 SMcK G1547**
Performance Specification Title	**CHP Systems**	Date	**August 2014**
Prepared By	**BR**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Updated for Financial Closure	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
COMBINED HEAT & POWER SYSTEM

CONTENTS

1.0 GENERAL INTRODUCTION

Purpose of Document

The development of the scheme, manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by

Project Co. shall obtain the necessary supporting documentation.

This specification relates to the CHP installation to be provided as part of the Energy Centre works. It shall be read in conjunction with the other specifications issued as part of the overall works.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2,

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

Drawings

As part of the development of the scheme Project Co. shall prepare co-ordinated working drawings which shall include general arrangement drawing sections, elevations and schematics, of the works to be provided. These shall be based on the Architect's base drawings and coordinated with other services and building elements.

2.0 SCOPE

The scope of work covered by this specification is for single CHP generating system including but not limited to the following:-

- Gas fired reciprocating engine
- 11000V alternator/generator
- The provision of Low Temperature Hot Water
- Controls with computer supervision backed up by UPS c/w standby
- Full communication interface with the on-site Building Management System and Electric Network Management System
- Metering equipment to assess heat and electricity output
- Metering equipment to assess heat dumped
- Metering equipment to assess gas intake
- Metering software in the controls strategy to determine the CHP quality index as defined by Inland Revenue and carry out energy efficiency evaluations
- Mains synchronising equipment
- Operation and protection to MV system in accordance with G 59.2
- Electric motor starting system
- Power isolator
- Fuel handling system
- Fuel cut-out system
- Neutral Earthing Resistors and associated controls
- Acoustic enclosure
- Acoustic equipment
- Forced air ventilation system for the enclosure
- Flue exhaust system with support structure
- Acoustic measures including inlet and outlet attenuation
- Lighting, emergency lighting and small power in the enclosure to facilitate maintenance operations
- Fire and gas detection activated safety fuel shut-off valves
- Site mechanical and electrical installations including all connections between the components in the scope of this contract and interfaces to the site systems
- Testing
- Setting to work
- Commissioning
- Demonstration that the system meets good quality CHP, either making sufficient heat demand available at the Buffer Vessel or via use of the heat dump unit as a simulating facility. This shall include the provision of all necessary meters, including:
  - Heat
  - Power
  - Gas

3.0 SPECIFIC EXCLUSIONS

Fire alarm systems, and telecommunications systems requirements that do not form part of the CHP installation are generally covered in separate documentation, for the provision by others.

4.0 APPLICABLE STANDARDS

All elements of the works shall be designed and installed in accordance with the requirements of SHTM 06-01, IEE Wiring Regulations BS 7671 (17th Ed.), current legislation, regulations and industry standards, including British Standards unless otherwise stated.

The complete installation shall comply with the requirements of CHPQA (Department of Energy and Climate Change Quality Assurance Programme).

5.0 DESIGN CRITERIA

Under normal conditions the CHP unit is to run to assist the LTHW demands of the heating system. The electrical power generated from the production of the Low Temperature Hot Water demand shall be used to serve the Hospital's electrical power system. With this in mind, the switching on, off and stepping up/down of the CHP units shall be matched to the requirements of the LTHW system.

The CHP unit shall however be controlled so it does not export power above any agreed limit from the RHSC & DCN electrical systems to the SPEN supply network.

6.0 LIAISON

Project Co. shall include for liaison with:-

SPEN. Project Co. shall include for liaison with SPEN to ensure the requirements for parallel operation of the CHP units and the mains incoming supplies are met.

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety Regulations.

Project Co. shall satisfy themselves of the suitability of the products and installation details being provided by other specialists.

Building Control. Project Co. shall liaise, with and adhere to, the requirements of the Building Control Officer.

Any other member of the Project and Board teams concerned with the planning and administration of the installations.

7.0 MECHANICAL

7.1 Air for Combustion & Cooling

A fan assisted ventilation system shall be provided for combustion, to dissipate heat build up within the CHP enclosure and the rejection of waste heat (e.g. from any low grade water).

Incoming ventilation air shall be ducted from louvres located on the external elevation to inside the CHP enclosure. The exhaust from the CHP enclosure shall be fan assisted ducted to the external louvres on the north wall.

Automatic multi-bladed dampers shall be provided on the inlet and discharge. The dampers shall be arranged to open on the start signal for the appropriate CHP and to close once that engine has stopped running and residual heat dispersed.

In addition a radiator coil shall be located in the ductwork, to reject low grade waste heat. This is in addition to the CHP Heat Dump facility from the Low Temperature Hot Water.

The ventilation system shall be designed, installed and set to work within the following criteria:-

a) Taking into consideration the louvre sizing and types provided, considering noise, vibration, velocity and pressure drop.

b) The intake air temperature to be used in calculating the air requirements shall be 30°C.

c) The maximum *summertime* air temperature exhausted from the louvres shall be based upon the heat dissipated from the unit and shall be no more than 50°C.

d) The maximum air volume *for combustion and cooling shall be advised by the supplier.*

e) The ductwork design and installation shall meet the requirements of Heating and Ventilation Boards Association Document DW144.

f) *The ventilation system shall* keep the CHP enclosure close to the optimum temperature for the effective operation of the CHP units. Therefore in winter, the heat from the CHP can be used to keep the enclosure warm, but *this should* not *be* above 30°C or *shall be* as required by the CHP manufacturer.

g) Acoustic details mentioned in later sections.

7.2 Sound Attenuation

Acoustic Enclosure

An acoustic enclosure shall be provided to the CHP unit. The acoustic enclosure shall include:-

- Acoustic lining
- Access doors to enable full maintenance of the CHP unit
- Air inlet and air discharge ducts connecting the enclosures to the external louvres
- Air inlet and discharge attenuators with automatically opening and closing dampers on the internal faces of the units

The discharge air paths shall be sealed against the building fabric to prevent leakage back into the CHP room.

The Tender shall be inclusive of the design, supply and installations of the acoustic enclosure to house the CHP engine plant, and confine ventilation of the CHP plant to within the enclosure.

The CHP acoustic enclosure shall form part of the route for ventilation air to avoid the need for ventilation of the entire plant area. Project Co. shall provide all necessary intake and discharge attenuation to achieve noise levels stated.

The acoustic enclosure size shall be developed to ensure that it:

- Co-ordinates with other services in the room
- Co-ordinates with the building fabric and structure
- Allows maintenance to all plant and distribution systems as detailed within the SHTMs

Project Co. shall give due consideration to the need to maintain maintenance access around the entire CHP enclosure and allow for ducting ventilation air accordingly. Internal access and spatial arrangements shall be adequate to allow all maintenance functions and repairs.

The acoustic enclosure shall achieve maximum breakout noise levels within the CHP room of 65 dBA at 1 m from the enclosure.

The enclosure shall be provided with adequate access doors for plant servicing and replacement of major components. Access doors shall have emergency escape panic facilities in the event that personnel become trapped.

Inlet and Discharge Attenuators

The necessary attenuators for the CHP room are to form part of the Sub-Contract works and Project Co. shall take account of the pressure drop across/through them when selecting/sizing the air attenuators and fans for the CHP acoustic enclosures.

Attenuators shall be of the dissipative type and constructed of specially selected high quality materials.

Outer casings shall be made of galvanised sheet steel.
Each unit shall be constructed to prevent air leakage. Internal splitter units shall have aerodynamic leading and trailing edges to reduce pressure drop across them.

The acoustic infill shall be of inorganic high density bonded long stranded rock wool sufficient to obtain the specified acoustic performance and packed under compression to eliminate voids due to vibration and settling. Infill material shall be insect, vermin and moisture proof.

The attenuators shall be manufactured in modules to enable them to be removed and replaced so that major maintenance works can be carried out, and to enable initial installations to be achieved.

The module shall have a rolled steel angle frame and shall be capable of free standing without distortion, sagging or mechanical damage.

Provision shall be made to allow fixing of mechanical and acoustic seals. The module shall be located firmly in the builders work opening.

All attenuators to have double skin casings on all four sides to prevent flanking.

CHP Flue Exhaust Attenuators

Provide attenuation within the exhaust flue system to reduce noise, at source, to the acceptable level of 60 dBA at 3 m from the flue. The CHP flue and exhaust attenuator to outside the acoustic enclosure, for connection shall be extended by the flue Installer.

Locate attenuation within the CHP Room.

Louvres

Project Co. shall liaise with the louvre manufacturer/supplier to ensure that their scheme takes full consideration of the louvres being provided. Project Co. Project Co. shall ensure that the fans provided with the CHP package are able to overcome the pressure drop through the louvres. Project Co. shall ensure that the CHP system, including noise generated velocity, pressure drop and noise, by or through the louvres, meets the design criteria.

7.3 Heating

The CHP units shall be used to generate low temperature hot water.

The CHP unit shall be connected in parallel and be piped to serve the Energy Centre.

The CHP units shall act as the lead boiler and feed the LTHW into the Primary Return header.

Circulation/shunt pumps shall be provided for the CHP unit to suit the flow rate and pressure drop into the LTHW system. The pumps shall be part of the CHP package and located within the Acoustic Enclosure.

The primary purpose of the CHP is to provide low Temperature Hot Water. In instances where there is insufficient LTHW demand for the boiler systems, then a CHP unit shall switch off and any residual heat shall be dumped via dry air coolers on the roof/wall of the Energy Centre. The dry air coolers are to be provided within the CHP package.

The BMS shall provide the CHP control system with the required LTHW load. The CHP controls system, shall modulate to ensure that the required load is provided.

The CHP Unit shall be controlled by their own controls system to provide a constant 85 °C flow.

Whilst the output from the CHP unit shall be modulated by the CHP controls system varying the speed of the unit's engine, the CHP pumps shall also be inverter driven. This is to allow the output from the unit to be modulated between 50 and 100%.

The CHP Unit shall be provided with a duplicate *variable flow* circulating pump set to circulate water through its associated CHP Unit and to the Primary LTHW header. A motorised valve on the inlet to the CHP Unit shall close when the CHP Unit is not enabled to run. Upon receiving an enable signal the valve shall open and auxiliary contact on the valve shall then enable the CHP Unit pump to run. Upon CHP Unit shut down the duty pump shall be run only when the CHP Unit is signalled to run by the sequence controller. The CHP Unit pump set shall be monitored by differential pressure switches.

The CHP unit shall be interlocked with the CHP pumps.

The design return temperature for the return to the CHP is 75 °C. Should the temperature rise above 80 °C then a three port heat dump control valve shall open to divert some of the water around the roof/wall mounted dry air coolers, until the return water temperature to the CHP units has been reduced back to 75 °C. The control of the dry air units themselves shall be by the CHP control system. The fans on the dry air coolers shall modulate to reject the unwanted heat.

The CHP *tenderer shall advise of any limitations with regards the maximum number of 'starts' over a 24 hour period.*

Each CHP unit shall have its own integral safety controls and high temperature lock out thermostats.

The temperature differences shall be adjustable to permit flexibility of operation during commissioning and general use.

The operational sequence shall allow all the control set points to be adjusted in line with the common boiler system flow temperature, as it is modulated relative to the building loads. *The operational sequence set points shall be interlocked with the CHP set points so that the performance of the CHP is not inhibited.*

When a CHP is shut down by the control system, water shall continue to pass through the CHP unit for a period of time (variable) to dissipate stored heat, at which point the CHP pump shall shut down and the motorised valve close.

Any fault that prevents the CHP from operating shall be raised as a high priority alarm.

The CHP controls shall also monitor the gas safety valve circuit.

The CHP, boilers and primary heating system shall all operate on a 24-hour continuous basis and therefore shall not be time clock controlled.

The CHP controls shall monitor the time operation of the CHP and the software shall include pump sequencing on an hours run basis.

In the event of a mains power failure, the controls shall arrange for the CHP system to restart immediately on power restoration. The CHP controls shall, by communicating with the ENMS and by monitoring of the electrical power supply and standby generators, be aware that the original shut down was not a plant fault and be ready for a sequence re-start.

In maintenance mode only the CHP shall operate on their own integral thermostats, under manual switches, but with all safety features in place to provide emergency usage in case of a BMS or controls fault.

The CHP controls shall monitor the inlet gas pressure and/or a failure of pressure, raise alarm and shut down the CHP.

The Specialist shall supply and install a common gas pressure sensor within the circuit serving the CHP units to detect loss of gas supply.

In the event of the CHP controls system monitoring a gas fault on the unit and the common gas pressure sensor signalling the required pressure, the CHP system shall automatically shut down the CHP unit.

The Specialist shall provide flue temperature sensors to monitor the temperature of flue gases within the CHP flue.

The following shall be provided by the CHP Controls system, for monitoring by the BMS:

- Grid voltage.
- CHP generator voltage.
- Grid frequency.
- CHP generator frequency.
- Synchroscope.
- Ammeter
- KWH meter.
- Engine tachometer.
- LTHW Flow Temperature
- LTHW Return Temperature
- kWhrs being dumped via the Dry Air Cooler heat rejection system
- Heat Rejection Flow Temperature
- Heat Rejection Return Temperature

7.4 Base Frames

The base frame of the CHP units shall be fabricated from mild steel sections and designed to carry and distribute the weight of all the components, without undue distortion or deflection, both when in use or in transit. The base shall be complete with all necessary holding down points, jacking points and lifting points. A suitable paint finish shall be applied at works to the whole of base frame.

All dynamic components mounted on the base frame, i.e. engine, shall be complete with anti-vibration mountings.

The engine shall be fitted with torsional damping to minimise dynamic vibration.

The complete unit shall be mounted on an inertia base designed, supplied and installed by .

Project Co. shall also identify the floor loadings required for the replacement of major plant items, e.g. alternator.

7.5 Engines

The packaged CHP set engine shall be of proven design specifically intended for static industrial power generation, with low operating stresses and an anticipated life in excess of 20 years. All wearing components such as bearings, valves, seats, pistons etc. shall be replaceable and readily available.

The engine shall be suitable for use with natural gas and shall be supplied complete with all necessary control valves, safety valves, low pressure cut off valves, and safety valve test and gas purge points as required by the design and shall not be less than those required to comply with all aspects of British Gas Publications including IGE/UP/3. All connections to the engine shall have flexible connections to stop vibration being transmitted to other equipment. The engine shall be complete with a pressurised oil lubrication system, cooling system complete with pump and all necessary controls to avoid damage due to overheating or oil pressure failure.

The engine fuel control system shall maintain the air fuel rates to the engine within the flammability level of natural gas under all load conditions.

The units shall be low Nox type to achieve Nox emissions of less than 500mg/m^3 (at 5% oxygen).

7.6 Primary Fuel Supply

The fuel supply to the CHP unit will be natural gas at a pressure of approx. 65 mbar.

Facility shall be provided on the engine for the connection of the gas supply.

The fuel supply pipework shall be brought within the CHP plant room by others. Final pipework runs and connection shall be by . This shall include flexible connections to prevent damage due to engine set vibration.

Flexible connections shall be in accordance with the Code of Practice for Natural Gas Fueled Engines, British Gas IGE/UP/3:

1. A length of flexible pipe shall be incorporated in the gas supply to the engine to isolate any vibration, whilst being as short as is practicable.

2. The flexible pipe shall be sited downstream of at least one of the safety shut-off valves.

3. The flexible pipe shall be of metal reinforced and preferably armoured construction, suitable for continuous use at 3.5 Bar (50 psi) or three times the working pressure, whichever is the greater.

4. The flexible pipe shall be able to withstand engine suction without sustaining damage.

5. The flexible pipe shall be installed in a position where it shall not be weakened by heat from the engine system.

6. The flexible pipe shall be installed so that it is not subjected to tension, torque or other forces likely to cause damage.

7. Adequate means shall be provided for sensitive test for gas tightness of the flexible pipe and its connections. Full consideration shall be given so as to ensure that leakage tests can be performed frequently as part of the scheduled maintenance procedure of the plant.

7.7 Heat Recovery

Heat recovery from the CHP set is to provide low temperature hot water.

The packaged CHP set shall be complete with on-set heat exchangers for heat recovery from the various circuits. The exchangers will be complete with all associated pumps, pipework, controls, sensors, etc to provide a complete fully functioning system, suitable for connection to the external heat recovery/rejection systems detailed elsewhere in this specification.

7.8 Exhaust Systems

The Tender shall be inclusive of the design of the exhaust system from the CHP set. This shall include exhaust gas heat exchanger, attenuation and exhaust. shall work with the specialist providing the flue exhaust. Project Co. shall provide the exhaust system, including silencers to the centre core wall. The flue specialist shall provide the flue from the centre core wall (on the side within the plantroom) to the termination point on the external flue/chimney arrangement.

Project Co. shall be responsible for the design of the whole exhaust systems installation. This shall include ensuring that the back pressure of the total exhaust system, exhaust gas heat exchanger, silencers, exhaust ductwork/pipework are within acceptable limits for the CHP engine.

The internal exhaust shall be run using thermally insulated and metal-clad mild steel tube exhaust system.

Project Co. shall include for the supply and installation of all associated exhaust system components including silencers, hanger supports, expansion compensators, drain points, explosion relief panels, flame quenching devices etc.

The number and type of silencers shall be determined from the noise criteria stated for the plant both internally and at relevant site boundaries as noted below.

It shall also be ’s responsibility to ensure that the whole of the exhaust installation is suitable for the range of temperatures and conditions applicable to the operation of their plant.

The whole of the engine exhaust system silencers and any flexible exhaust connections fitted to absorb engine vibrations shall be of sufficient strength to withstand the effects of sudden internal pressure rises such as those caused by back firing.

To reduce heat loss from the exhaust, excessive heat gain into the plant area and provide safe surface temperatures, the exhaust system is to be insulated throughout.

Project Co. shall therefore include in the Tender for insulating the engine exhaust system, including silencer(s) provided with the CHP unit.

The insulation including the silencer to be clad with plain finish Aluzinc sheet and the surface temperature of this cladding shall be below 50°C in accordance with BS.3316.

7.9 CHP Heat Dump Facilities

At some site part load conditions, it may be necessary to dump heat from the CHP plant in order to eject residual unwanted heat from the system. To allow this to take place a heat dump facility shall be provided by via a roof/ wall mounted dry air cooler.

The allowance is for a total of 300 kW of heat to be rejected via a dry air cooler, which accounts for 50% of the CHP unit heat.

Auxiliary cooling circuits shall include all fans, pumps, pipework and controls etc. to enable continuous plant operation. Where the pipework is external, it is to be fitted with trace heating.

Project Co. shall verify that this is sufficient for their needs, prior to finalising their design and/or starting manufacture.

7.10 Lifting Facilities

Project Co. shall include for the provision of lifting facilities, as required for the maintenance of the plant. Lifting beams shall be certified with maximum safe working loadings in accordance with statutory regulations will be provided by others.

7.11 Access Platforms and Ladders

Project Co. shall provide platforms and ladders to enable safe working access to all parts of the plant and particularly high level equipment. All platforms and ladders shall comply with the requirements of:-

BS.4592
BS.5395
BS.5950
BS.3049
BS.4211
and all other relevant codes of practices.

7.12 Oil Tanks

Project Co. shall provide an appropriately sized clean lubrication oil tank and similar dirty oil tank. This shall include automatic pumping facilities and all interconnecting pipework and controls. Each tank shall be double skinned, so as to have its own bund, in order to meet the latest requirements of the Scottish Environmental Protection Agency Oil Storage Regulations.

8.0 ELECTRICAL

8.1 Outline for Electrical System

The CHP unit shall normally run in parallel with main incoming MV supply to the Hospital. If either side (A or B) of the Hospital's 11000V systems are being supplied from the Hospitals standby generators then the CHP unit will normally be disconnected from the 11000V distribution systems and shut-down. The CHP unit shall not operate when the standby generators are in operation.

If the electrical load of the hospital is reduced to the level where the CHP unit is in danger of exporting power above the agreed threshold to the SPEN network the CHP, will be automatically ramped down and if necessary isolated. To achieve this it will be necessary to link the CHP controls to the BMS energy metering of the incoming supplies and set a level which individual CHP's are isolated.

The control of the MV circuit breaker through which the CHP unit connects to the MV site distribution systems shall be controlled by both the CHP control systems and the Electrical Network Managements Systems (ENMS). These controls/interfaces shall:-

- Ensure the CHP's neutral earthing resistor is in circuit while the CHP run up to speed and synchronise with the busbar voltage is then switched out of circuit as the CHP is paralleled onto the bus bar.
- The CHP MV circuit breaker (on the Energy Centre MV panels) cannot be closed unless both:-
    - The CHP controls signal the CHP is synchronised with the bus-bar voltage

The low voltage connections required for the CHP enclosure lighting and small power, battery chargers etc will be derived from the 400V 50z Three phase, Neutral and Earth systems serving the Energy Centre.

8.2 Wiring on Engine/Generator Unit

All wiring shall be:-

Carried out with LSF cable suitably bushed and having stranded copper conductors of adequate mechanical strength and current carrying capacity, with a minimum of 1.5mm² csa.

Adequately supported and protected from accidental damage, properly installed and terminated in suitable terminal boxes with flexible connections. Special arrangements are to be made where wiring is subject to movement and vibration.

Segregated for different voltages and where necessary to avoid `pick-up' from adjacent wiring.

8.3 Power Cabling and Terminations

All power connections between the CHP set and the switchboard shall be undertaken by . The connections shall be sized to carry all normal operating currents and safely withstand all potential fault currents at their point of installation.

Specification of 11 kV Cables

MV cables from the CHP to the 11000V switchpanel shall be XLPE insulated, copper conductors, steel wire armoured with pvc outer sheath to IEC502 and rated at 11000 volts.

The cores of all MV cables shall be permanently marked to indicate phases.

Cable Installation

01. General

New cables shall be installed joint-free.

02. Single Core Cables

Single core cables shall be provided c/w wire armour and copper tape screen.

Single core cables shall be laid in trefoil to reduce magnetic field induced interface.

03. Cable Termination

MV cable glands shall be rated above the prospective fault current of the system to which they are assembled. Glands shall have integral earth lugs to which equibonding copper strip shall connect to the main earth bar.

MV cable boxes shall be made of fabricated steel and air insulated termination up to 11kV. Spacing between terminals shall conform to BS 4999/145 and IEC standards for the rated voltage.

All MV terminations and terminating cable tails shall be encapsulated in heat shrinkable insulation rated at the cable voltage. Heat shrinkable insulation shall be guaranteed by a reputable manufacturer.

Terminations shall be permanently marked to indicate phasing. The far and near ends of cables shall be tested by continuity meter to confirm correct phase rotation.

04. Single Core Cables

Single core cables shall be glanded at non-magentic gland plates.

On long runs of single core cables insulated terminating glands shall be used.

The open circuit induced voltage between cable armour and earth shall not exceed 25 volts when full load current flows in the cable.

8.4 Earthing Systems

The whole of the electrical systems shall be earthed and bonded to accord with the requirements of BS 7430, BS 7671 and Scottish Power Energy Networks (SPEN). The requirements for this are interpreted onto the drawings accompanying this specification.

Under mains supply conditions the systems shall rely on SPEN's earth.

Under standby generator only conditions when all standby generators are operating in parallel the systems shall be earthed to one generator's neutral via the appropriate neutral earthing panel and its MV resister.

When the standby generator systems are operating as two 'unparalleled groups, each group shall be earthed to separate standby generators via each groups neutral earthing panel.

The CHP unit shall, however be provided with suitable Neutral Earthing facilities to enable it to be run to speed and tested off line.

The neutral earthing panels shall be equipped with a spare/paralleled circuit earth resister in a separate compartment such that one can be removed while the other is in use.

The CHP's neutral earthing shall be controlled by the CHP.

Two sets of earthing rods shall be provided to form a connection for the MV system to the general mass of earth. These shall each comprise a minimum of 4 No parallel earth electrodes driven to depth of 4.8m and contained in concrete inspection chambers. The minimum resistance to earth of each set of earth electrodes is 1 Ohm. Where this is not achieved then either additional earth rods shall be installed or the installed units shall be driven deeper.

The CHP unit shall not operate in isolation of the mains or the generators, except for testing purposes. For clarification the CHP unit shall not operate in island mode.

9.0 CONTROLS

9.1 Automatic Controls

The Controls for the CHP shall comply with the BMS specifications.

The complete electrical controls system for the CHP set shall be designed, supplied and installed by . The Controls for the CHP shall interface seamlessly with the Building Management System in all areas of monitoring and Control. The controls shall be open protocol.

A control panels shall be provided, at the end of the CHP unit to control the CHP, with a further panel to both co-ordinate the operation of the CHP unit and to communicate with the BMS. Selected information, set points, controls strategies, *maintenance mode* etc. that can be viewed and changed at the CHP panels shall also be viewed and changed at the BMS end.

All panels shall be manufactured and finished to the same specification to form a uniform suite.

The CHP set control panel suite shall comprise separately identifiable sections to provide the following functions:-

(a) Mains circuit breaker section.
(b) MCC section.

(c) Controls section.
(d) Battery panel.

Note: The MV circuit breaker will be located in the MV switchboard.

Synchronisation with site operating from REC supply.

The site shall be connected with the local REC grid through the CHP supplier automatic circuit breaker. Circuit breakers connecting CHP generators with the site medium voltage system will be open. Generators will not be running.

The CHP set is started and run up to speed set point. Automatic synchronising equipment shall govern the generator voltage, frequency, and phase until they match the grid parameters. All conditions shall be ensured prior to automatic synchronising equipment closing the generator circuit breaker.

Sequence of events when the set is running in synchronisation with grid

The CHP is planned to provide supply to a base load and operate only in parallel with the local public network. The unit shall shut off in the event of loss of mains, and shall not normally operate while the emergency generators are running. It is intended, however that the CHP shall operate when the generators are being tested.

Protection relays in compliance with the requirements of G59.2 shall be provided on the 11000Volt circuit breakers.

Excess electricity shall not be exported to the grid above the agreed limit. The CHP Controls shall adjust the electrical power output to avoid export above the agreed limit of power to the REC grid.

9.2 11000V Isolator

Voltage	11,000 V
Bus Bar Rating	630 A
Rated Short-Time Withstand Current	25 kA for _ seconds
Maximum Ambient	40°C

9.3 Motor Control Centre

The CHP unit shall be provided with an MCC panel located on the outside of the unit.

All major motor loads shall be controlled and protected through a Motor Control Centre (MCC). The MCC shall be dedicated to control motors and LV electrical loads associated with the CHP set only.

All motor gear shall be grouped into a Motor Control Centre which shall comprise of form 3b type 2 of enclosure to BS EN 60439-1&2.

The MCC shall be capable of withstanding short circuit currents of 50kA - (35MVA at 400V for one second) ASTA certified to BS.EN 60439-1&2.

Where an Installer cannot comply with this Standard, he must clearly state his intended deviation at the tendering stage.

The electrical symbols used in the circuit diagrams are to be to British Standards.
Final reproducible copies of circuit diagrams and layout drawings shall be submitted after satisfactory commissioning.

Busbars

The busbar system shall be manufactured from hard or medium hard drawn high conductivity copper, including the auxiliary busbars.

The bars shall be rigidly supported by insulators of a high electrical and mechanical strength suitable for the withstand values specified.

Any access plates to the busbar chamber should be suitably marked with appropriate warning labels and when any such access plate is removed, it should reveal busbars suitably marked with phase colours and labels “L1”, “L2” and “L3”.

The busbar system shall not contain any internal interconnecting or outgoing cabling.

Main Isolator

A main isolator shall be provided in the MCC. The isolator shall be capable of interrupting the total stalled motor current from the MCC without deterioration.

The isolator shall be interlocked with the panel door and shall have facilities to padlock it in the `off' position.

The incoming supply shall terminate directly onto the main isolating device. Termination points shall be fully shrouded and suitably labelled.

Separate ammeter and voltmeters shall be fitted to the door of the incoming isolator. Both meters shall be operated through phase selector switches.

Enclosure

Enclosures shall be of the floor mounting, free standing, flush- fronted, cubicle type.

The enclosure shall comply with a minimum degree of protection, IP54 and be suitably designed to exclude vermin.

Enclosures shall be constructed from mild steel plate (unless conditions/environments dictate otherwise) with a minimum thickness of 2mm (14 SWG).

All metalwork to be degreased, rust-proofed and stoved to match all other control panels.
Access to the enclosure interior is to be via hinged front opening doors.

All gland plates to be provided.

Components and Wiring

Components mounted on baseplates must be removable from the front of the compartments. Baseplates also must be removable.

The minimum flexible wire inside the compartment shall be 1.5mm^2.

All wires to be numbered at both terminal and contactor/relay/ fuse, etc. ends.

Ring type of markers only shall be used.

All conductors shall be identified by colours as follows:-

Earth Conductors	-	Green/Yellow	
Power Circuits	-	400 Volt	
		Phase:	Brown / Black / Grey
		Neutral:	Blue
AC and DC Control Circuits	-	as IEE wiring regulations	

9.4 Motor Control Compartments

Each starter to include:-

* Triple pole fuse switch with auxiliary contacts and provision for padlocking "Off".

* Triple pole contactors with auxiliary contacts.

* Thermal overload unit with "single phase" protection - internally reset.

* Control circuit fuses.

* Terminals to be SAK 4 minimum size manufactured from polyamide material.

Please note that selection switch manual/automatic to be via a HMI (Human Machine Interface).

Start and stop push buttons to be via a HMI (Human Machine Interface).

Where there are no external/remote requirements, the control voltage to be 230V.

Where remote pieces of equipment are used such as external push button stations/limit switches, etc., then the control voltage must be 110V AC or less, obtainable from a double wound safety isolating transformer with an earthed screen. The control transformer to be used shall be fused on both sides of the primary and the switched side of the secondary with a removable link fitted into the common line.

Earthing

A main earth bar shall be provided fitted along the whole length of the MCC.

This bar shall be of adequate cross-sectional area and manufactured from hard or medium hard drawn high conductivity copper.

The completed MCC shall be efficiently bonded together and to the main earth bar.

Each door shall have a flexible earth braid to main metal framework to provide earth continuity between housing and door.

Identification

Each compartment door shall carry an engraved identification label.

The MCC manufacturers label shall contain the following information:-

(a) Name or trademark, type, designation, serial number, date of manufacture

(b) Type of protection of enclosure

(c) The electrical system characteristics - maximum load, rates supply/control voltage, etc

(d) Rated currents of the busbar system

(e) Short circuit rating

The manufacturer shall provide certificates of tests complied with in accordance with the relevant British Standard (BS.EN 60439-1&2).

9.5 Controls Section

General

The system shall allow full control and supervision of all operation plant parameters.

The control system shall:-

- Monitor and control the engine via an engine management system.
- Monitor and control the generator voltage, frequency and phase.
- Activate automatic synchronisation following operator initiation.
- Activate alarms, shutdown plant and warn remotely stationed plant supervisors.

It is highlighted that automatic synchronisation followed by normal parallel running with the grid is required.

Engine Management System

The engine management system shall comprise of an encased dedicated electronic control system. Signals shall be transmitted from sensors located on the engine and compared with programmed control parameters to maintain performance.

Any abnormal parameters shall initiate an alarm which shall be transmitted to the main Controller. If necessary the engine shall be shutdown in a controlled manner.

All monitored signals shall be retransmitted into the Controller for onward transmission and display on the monitoring system.

Generator Control

Generator parameters shall be monitored and controlled to enable synchronisation and parallel operation with the grid. Protection relays shall prevent electrical faults causing damage to the system by opening the generator circuit breaker.

Voltage Regulator

Voltage regulation shall be solid state with the engine governing within the limits specified in BS 150 3046-1, Class A1, and satisfy the Grade 2 requirements specified hereunder.

GRADE 2

a. At any balanced load between zero and rated load and at any load power factor from 0.8 lagging to unity and at any normal service condition temperature, the output voltage is to lie between the limits of plus or minus 2.5% of rated value.

b. On suddenly increasing the load from zero to 60% rated value the initial voltage dip is not to exceed 15% of rated value and recover to at least 97% of rated value within 0.5 seconds.

Voltage Wave Forms

A sine wave shape voltage waveform within the permitted limits of BS 4999 Part 140 and BS 5000 Part 3 shall be maintained.

Frequency Control

The output frequency from the generator shall be monitored and maintained within +/- 0.5% of 50Hz.

Automatic Synchronising

An automatic synchroniser shall be installed to adjust the generator frequency. When the generator frequency matches the grid frequency and both are in phase the CHP set shall be connected to the grid. A signal shall be transmitted from the generator controls to close the CHP set circuit breaker.

Automatic synchronising shall be achieved through the electronic engine governor. The generator AVR shall match generator voltage with grid voltage during automatic synchronising.

Controllers

General

The control/monitoring of the plant and CHP shall be by industry standard Controllers with an open protocol. Each shall have separate battery supported UPS.

A common manufacturer shall be utilised throughout the project.

Tenderers must state clearly the make and type of controllers proposed, detailing the input and output units, i.e. electrical characteristics and function, etc. and where appropriate the optional facilities programmed into the Controller.

(a) Enclosure

Each MCC shall incorporate a controller(s) in a separate cubicle. A separate controller, within a panel shall be provided as an interface between the BMS and the individual CHP units.

(b) Electrical Supply

A 230V dedicated supply shall be used for mains operation. A label shall be provided as the point of supply to warn personnel that a controller is fed from this circuit.

A separate transformer within each panel shall be used to supply:-

(i) The central processor, power supply unit, programme panel and peripheral equipment outlets.

(ii) The input and output circuits.

Transformer (i) shall be of the constant voltage type and shall be fed from the live side of the mains supply via an internally mounted, fully shrouded main incoming isolator.

Transformer (ii) shall be fed from the “dead” side of the main incoming isolator via its own I/O isolator. This allows separate isolation of the I/O circuits whilst still retaining power to the central processor.

A twin RCCD 30mA protected 240V 3 pin socket outlet shall be supplied and mounted adjacent to the main central processor.

(c) Mains Isolation

Mains isolation shall be provided. The isolator shall provide isolation for all circuits with the exception of the internal lamp and heater and a warning notice shall be displayed to warn that these circuits remain alive even when the main isolator is open. A notice shall also be displayed to state where the supply is taken from. The isolator must be mounted inside the panel to ensure that it can only be operated with the door open.

(d) Power Supplies

DC output modules shall be operated on a 24V dc system. The dc voltage must be derived from within the control panel by means of a stabilised and smoothed dc power supply with constant current capabilities.

Special attention must be given to the rating of the power supply to ensure that the input/output loadings, together with a 25% spare capacity, can be supplied by the power supply.

(e) Surge Protection Device

A surge protection device shall be installed on the power supply to the control panel.

The surge protection device shall be configured to protect the PLC and power supply against overvoltage resulting from a lightning strike and/or mains switching.

The device shall be capable of reducing an 11,000 volt transient down to a value less than 400 volts.

(f) Micro Processor Based Controllers

The controls shall fail safe. All safety interlocks critical to plant operation shall be augmented by hard wired equipment independent of the controller. Upon failure of the controller or power supply safety interlocks shall safely shutdown the plant and raise alarms.

The controller shall have the following minimum features:-

(i) Modular construction for ease of expansion

(ii) Software from an industry standard manufacturer

(iii) EEPROM or battery back-up of software

(iv) Programming via an IBM compatible computer

(g) I/O System

Remote input/output devices shall only be used to reduce the complexity of the electrical installation on large systems.

I/O control circuits shall be protected with a cartridge fuse in the line conductor and a link in the neutral. Whenever an I/O control supply is taken from the Controller enclosure it shall be individually fused. Fused terminals shall be utilised. Discrimination shall ensure that the terminal fuse is first to blow in the event of a fault.

(h) System Capacity

The tenderer shall ensure that there is spare capacity or space to expand the number of inputs, outputs, terminals and programme lines by not less than 10% on each PLC. All spare inputs and outputs shall be wired to terminals.

(i) *Operator Interface*

The operator interface shall comprise of an industrial standard colour graphics display. Multiple screens for plant functions shall be selectable via membrane function keys.

Each display screen shall provide time information on all engine, generator, and auxiliary systems. Trend and historical information shall be recorded for a maximum of 8000 hours operation. Downloading facilities onto an external data storage medium shall be included.

Any alarms shall be recorded, with identification and type. Historical alarms shall be held in memory and up to a maximum of 300 no. alarms shall be retained.

(j) *Instrumentation*

Instrumentation shall be provided on the control panel for each CHP set. On each set this shall be provided via a Human/Machine Interface, as follows:

Double volt meter and phase selector switch indicating:-

(i) Grid voltage.
(ii) CHP generator voltage.

Double frequency meter indicating:-

(i) Grid frequency.
(ii) CHP generator frequency.

Synchroscope.

Ammeter phase selector switch.

KWH meter.

Engine tachometer.

Power factor meter and phase selector switch.

(k) Controls

The following operators shall be provided on the control panel for each CHP set.

(i) Engine start push button.

(ii) Engine stop push button.

(iii) Initiate automatic synchronisation push button.

(iv) Alarm mute push button.

(l) Indicating Lamps

The following indicating devices shall be provided on the control panel for each CHP set:-

(i) Alarm lamp.

(ii) Alarm sounder.

(iii) Automatic synchronisation initiated.

(iv) Generator synchronised.

(m) *External Control Systems*

Items of plant external to the CHP set shall effect operation of the CHP set. The signals will comprise of single pole volt free contacts.

Signals shall be:-

(i) Gas safety valve closed.

This shall shut down the engine and isolate the CHP set.

(ii) Remote emergency stop.

This shall shut down the engine and isolate the CHP set.

(iv) Readiness signal for synchronisation with the grid.

9.6 Battery Panel

A regulated DC power supply shall be provided to operate controls for the CHP set. A battery shall maintain the DC voltage during transient interruptions to the incoming power supply.

D.C power supply, batteries and battery charger shall be housed in a separate ventilated cubicle. The cubicle shall be installed with other CHP set control panels and shall be similarly constructed providing a uniform suite of panels.

The battery shall comprise of nickel cadmium cells in ventilated plastic containers, all interconnected. Battery charge shall be maintained through a float charger operated to maximise battery life and minimise maintenance. The battery panel shall be provided with an ammeter and voltmeter to monitor the battery output. A `power on' lamp shall indicate that the battery panel is live.

Wiring between the battery panel and control circuits shall be adequately sized. Maximum resistance limits of cable to permit normal operation of solenoids, relays, contactors etc shall not be exceeded.

9.7 Common Controls Section

A common control panel shall be provided as an interface between the BMS, ENMS and the CHP unit and therefore to select control regimes for the CHP set. Also the panel shall provide overall supervising control of the CHP set and switchgear signals.

The common controls section shall have the following control switches:

(a) Normal Operation/Back Synchronisation (selector switch spring return) to select the system from normal operation to provide control over the G59 circuit breaker. CHP sets will automatically synchronise with the grid. When the site voltage, frequency and phase match the grid the G59.2 circuit breaker will be automatically closed.

(b) Double volt meter via Human/machine interface and phase selector switch indicating

(i) Grid voltage

(ii) Site voltage (CHP set)

(c) Double frequency meter (via Human/machine interface) indicating:-

(i) Grid frequency

(ii) Site frequency (CHP set)

(d) Synchroscope

(e) An automatic circuit breaker will be provided by others under a separate contract. Sensors and signals are included on the circuit breakers as detailed below:-

1. Circuit voltage transformer
2. Busbar voltage transformer
3. Circuit current transformer
4. Busbar current transformer
5. Circuit breaker open - volt free contact (vfc).
6. Circuit breaker closed - vfc.
7. Circuit breaker opened on fault - vfc.
8. Circuit breaker opened manually - vfc.

(f) The common controls section of the CHP panel shall perform synchronisation between the site and the grid. To achieve synchronisation control of the main circuit breaker linking site and grid is required. When the site voltage, phase, and frequency are equal the circuit breaker can be closed.

The common control panel section shall contain `volt free' contacts wired to a terminal strip as listed below:-

Each volt free contact set shall comprise of 230 volt, 5 amp rated changeover contacts with all poles cabled to terminals.

(i) Close circuit breaker.
(ii) Open circuit breaker.

10.0 TESTING, COMMISSIONING AND HANDOVER

10.1 Testing and Commissioning

Project Co. shall be responsible for the complete testing and commissioning of the CHP plant, equipment and installations to prove safe and reliable operation, compliance with statutory requirements and compliance with stated plant performance criteria, including the good quality CHP index.

The testing and commissioning shall include off site testing of individual major plant items, e.g. engine or generator skid units, which shall, at the discretion of the Client, be witnessed by the Client or his representatives. *The test should include a start-up from cold conditions, a period of running (including basic response to controls), and a shutdown of the equipment. During the running period, measurement of fuel input and power output may be carried out.*

Project Co. shall include within the tender for the full commissioning of the complete CHP plant installations and all associated costs including all travelling, engineers' time, service parts, lubricants, coolants etc.

Commissioning of the CHP Plant shall also prove compliance with this specification in terms of equipment performance and with the manufacturers stated performance criteria.

All plant control and Instrumentation shall be subjected to comprehensive proof testing. Tests shall be conducted to ensure that each auxillary plant control and Instrumentation package provides the correct signal outputs to, and correctly responds to commands from, other auxillary plant packages, and the integrated Energy Centre System/Building Management System.

Project Co. shall conduct works and site testing to the point where they are able to provide documentary evidence that each system, including those associated with services provided by others, together with the interfaces between them, function correctly before the equipment is set to work.

Initial site testing shall be carried out once all the equipment has been assembled into a functioning CHP plant and the electrical and heat connections have been made. These tests shall demonstrate that individual plant items, and the entire CHP plant, are able to perform satisfactorily under the appropriate range of conditions.

Project Co. shall make allowance for seasonal commissioning by the CHP supplier when they shall be required to fine tune and prove the controls and integration of the system. This shall be carried in the winter, summer and mid-season after handover.

Project Co. shall allow the Client, with reasonable notice to witness all testing, both at works and on site.

10.2 Fuel for Commissioning

Project Co. shall indicate the expected fuel consumption in the tender.

10.3 Reliability and Performance Running

Following the satisfactory completion of site testing and commissioning and the provision of commissioning results, information and instruction of the Purchaser's staff, the complete CHP plant installation shall be continuously operated for a period of 14 days, during which time it shall have trouble and fault free operation before it is considered to be practically complete. The unit shall be deemed to be acceptable when it can be run for three consecutive 8 hour continuous shifts with an operating time of over 95% of the 24 hours, i.e. max 1.2 hours down time in all.

Performance testing shall be carried out in conjunction with the above reliability running, and is intended to demonstrate that the CHP plant achieves the guaranteed performance levels. The parameters covered shall be:

- Electrical and heat outputs.
- Fuel consumption.
- Electrical consumption by plant auxiliaries.
- Noise.
- Exhaust emissions.

The performance testing shall demonstrate that the plant meets the specified performance parameters over a period of three days.

Should the plant fail these performance tests, the Board will be required to make good the plant deficiencies and repeat the tests. The defects shall be rectified and the plant retested to meet the specified performance.

10.4 Plant Instruction

Project Co. shall include within the tender for the post commissioning instruction of the Client's staff/representatives. The plant instruction shall as a minimum, enable the Purchaser's staff to:-

(a) Satisfactorily carry out the Purchaser's plant housekeeping role as defined in the contract maintenance agreement.

(b) Overview the safety of the plant operation and respond (if present) to any emergency situations.

(c) The plant instruction shall be carried out over a minimum of 2 sessions and the training shall include a review of the final operating & maintenance instructions.

10.5 On-Site Static Pre-Commissioning Checks

Static pre-commissioning checks shall take place only after the installation of all services, connections and ancillary items are complete. This may require completion of works by others.

The static pre-commissioning checks shall be witnessed by the Purchaser or his nominated representative.

The plant pre-commissioning shall include, but not be limited to confirmation that the following are complete and can be put into service:-

(a) Fuel systems are complete, commissioned in accordance with statutory requirements and are ready for use.

(b) Exhaust systems are complete throughout and are gas tight.

(c) Medium voltage cabling to site has been tested and terminated at both ends.

(d) Satisfactory test certificates and results shall be available for medium voltage systems. This shall include proof that all medium voltage cables have undergone a successful pressure test.

(e) All low voltage cabling shall be tested for continuity, insulation resistance, and correct termination.

(f) Noise and set vibration levels shall be measured and recorded.

(g) All control and signal cabling shall be tested for continuity and insulation resistance. shall confirm that all cable cores are located in the correct terminals. Cable types shall be cross checked against the manufacturers schedule to ensure that the correct types are installed.

(h) Project Co. shall liaise with other Boards to confirm that all protection relays on the main site circuit breakers are fully functional.

(i) Dump radiator systems, pumps, pipework, etc are fully complete, tested, flushed out and filled with correct coolant and are ready to put into service.

(j) Lubrication systems are complete, tested and ready to put into service.

(k) All pumps, fans etc have been checked for correct rotation and are ready to put into service.

Static pre-commissioning checks must be satisfactorily completed and witnessed before dynamic commissioning can commence.

10.6 On-Site Dynamic Commissioning & Setting to Work

Dynamic commissioning and setting to work of the plant shall only take place following satisfactory completion of pre-commissioning checks on the complete CHP installation.

The dynamic testing, commissioning and setting to work of the plant shall be witnessed by the Client or his nominated representative and shall be satisfactorily completed, prior to reliability running of the plant.

The dynamic testing and commissioning shall prove the safe, reliable performance of the plant, compliance with stated performance criteria and guaranteed values and shall include, but not be limited to the following:-

(a) The engines shall be cranked and ignition system checked.

(b) The engine management systems shall be modulated and monitored to confirm engine speed control is stable.

(c) All safety and operational interlocks shall be tripped in turn to confirm control actions over engines.

(d) The engines shall be run for an extended period followed by checks to confirm no oil, water or cooling fluid leaks from the installations.

(e) Operation, interlocks and rotation of all motors shall be confirmed.

(f) The generator voltages and frequencies shall be measured and recorded.

(g) Operation of all plant items including dump radiators and cooling circuits shall be checked for satisfactory performance.

(h) The process of automatic synchronisation shall be checked prior to initiation of full synchronisation procedure.

(i) Project Co. shall arrange and co-ordinate testing of protection relays with the Purchaser and the REC. Tests shall confirm the generators protection complies with the requirements of the Electricity Supply Regulations (1988), the requirements of Engineering Recommendation G59/2, G53, G75 and P28 and Engineering Technical Report 113. Following approval from the REC Project Co. shall synchronise the CHP generator with the Grid.

10.7 Efficiency Testing

Efficiency testing of the CHP plant installation shall be carried out after all dynamic testing, commissioning and adjustment of the plant has been satisfactorily completed.

The efficiency tests shall be witnessed by the Client or his nominated representative and shall prove compliance with the stated plant performance criteria and guaranteed values.

Project Co. shall include for the provision of all materials, test equipment and skilled operatives to carry out the tests, which shall include but not be limited to:-

(a) Generator electrical output

(b) Generator and plant electrical parasitic losses, including all ancillaries at full load operation.

(c) Fuel consumption of the engine

(d) Thermal output/hot water production of exhaust gas, oil, water and other heat exchangers.

10.8 Maintenance

The manufacturer shall include for all required maintenance tasks throughout the period between installation and handover of the system to the Client. For dates and time periods reference should be made to the construction programme.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical**	Sheet	**WW AP.1.2.11 SMcK G1547**
Performance Specification Title	**Above Ground Foul Drainage System**	Date	**August 2014**
Prepared By	**DW**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Update for Financial Close	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
ABOVE GROUND FOUL DRAINAGE SYSTEM

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The development of the design, manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by Project Co.,

To carry out the development of the design, Project Co. shall obtain the necessary supporting documentation.

This specification relates to the Above Ground Foul Drainage Systems serving the RHSC-DCN Building and the adjacent Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 3,

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include, but not be limited to, the following:-

- Above ground sanitation installation

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Specification:-

- Below Ground/Basement/Slab Drainage
- Drainage Sumps and Pumps
- Rainwater Drainage Systems
- Gullies in Ground and Basement Slab
- Sanitary Schedules

4.0 INTERFACES AND DEMARCATIONS

The above ground foul drainage system shall comprise of the pipework system from (& including) the joint to the appliance outlet of the sanitary fitment/appliance (specified by others), to (& including) the connection to the above ground foul drainage system and in-slab/in-ground drainage system. The above ground foul drainage system shall also incorporate all plantroom gullies with the exception of the gullies in the ground and basement slabs which shall be included in the below ground drainage package.

5.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

The above ground foul drainage installation shall accord with all appropriate Hospital Technical Memoranda, Codes of Practice and relevant British and European Standards and Building Regulations.

6.0 DESIGN CRITERIA

The above ground foul drainage system shall be based on a secondary ventilated system as described within BS EN 12056: Part 2. The system shall be based on the discharge unit method. Discharge unit values as listed under system III, table 2 shall be used with the following frequency factors:-

- Congested usage, for toilet areas, etc, as used by the public; k=1.0
- Frequent usage, for all other areas, etc, k=0.7
- Intermittent usage, for toilet areas within office areas, etc; k=0.5

The chemical above ground drainage system shall be based on a secondary ventilated system as described within BS EN 12056: Part 2. The system shall be based on the discharge unit method. Discharge unit values as listed under system III, table 2 shall be used with the following frequency factor:-

- Frequent usage, k=0.7

7.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of Parts A, B and C of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Trust's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Specialist Installers. Project Co. shall liaise with other parties as necessary to ensure that all interfaces between the above ground sanitation pipework installation and other systems are allowed for.

Any other member of the Project and Board teams concerned with planning administration of the Above Ground Foul Drainage System.

8.0 SYSTEM DESCRIPTION

This Specification is intended to cover the works involved in the above ground sanitation, chemical drainage installations, and contaminated (radioactive) waste discharge.

Above Ground Foul Drainage System

Foul drainage shall be collected from the sanitary fittings, equipment and outlets, by a system of vertical and horizontal pipework distributed within the building, to connect to the in-slab/underground drainage system.

The system shall be configured to permit foul solid and liquid waste materials to pass uninterrupted from the point of collection, i.e. from the sanitary appliance/fitting etc, to a point of discharge at ground floor level. At this level the soil and waste above ground drainage system shall discharge to the below ground drainage system. Drainage from the basement area shall connect to drainage sumps/ pumps provided in the below ground drainage.

The above ground foul drainage system shall comprise of the pipework system from (& including) the joint to the appliance outlet of the sanitary fitment/appliance (specified by others), to (& including) the connection to the above ground foul drainage system and in-slab/in-ground drainage system. The above ground foul drainage system shall also incorporate all plantroom gullies excluding gullies in ground and basement level slab.

A ventilated soil and waste system shall be provided, i.e. main soil stacks and anti-syphon ventilation stacks.

The above ground foul drainage system 'ventilation and anti-syphon pipework' shall be uPVC. Fire collars shall be installed on uPVC pipework above 40mm diameter where passing through fire barriers and in accordance with Building Regulations.

Air admittance valves shall not be used.

Insulation (for acoustic purposes) to main vertical soil and waste stacks and horizontal soil and waste branches, within ceiling voids, shall be provided on all pipework that passes through sensitive areas of the building, e.g. consulting rooms, meeting rooms and other quiet or noise sensitive areas, etc. Acoustic insulation shall be Isol Acoustic Wrap by Geberit or equal and approved, and to suit the Acoustic Consultant's requirements and strategy.

Condensate drainage shall be connected to the foul drainage discharge stacks via a trapped tundish connection.

Drainage Sump Pumps

Separate drainage sump pumps shall be provided by the structural engineer in the basement to handle the discharges from the following areas:

Main tank room: Water overflow/ drain down from storage tanks.
Sprinkler tank room: Sprinkler test drain sump.
Basement kitchen and FM accommodation: Sanitary discharges.
Heat Stations: Hot water safety discharges and drain down.

All pump sets shall be in duplicate and sanitary pump sets shall be ventilated to the above ground foul drainage system.

All pumped discharges shall rise separately and connect to the external drainage system.

Above Ground Chemical Drainage System

A separate dedicated above ground gravity chemical drainage system shall be provided for this building. The above ground chemical drainage system shall not interconnect with the above ground foul drainage system or radioactive waste system at any point.

Chemical drainage shall be collected by a system of vertical and horizontal pipework distributed within the building, to connect to the in-slab/underground drainage system.

The system shall be configured to permit chemical liquid waste materials to pass uninterrupted from the point of collection, i.e. from the appliance/fitting etc, to a point of discharge at ground floor. At this level the chemical above ground drainage system shall discharge to the below ground drainage system.

A ventilated chemical above ground drainage system(s) shall be provided, i.e. main waste stacks and anti-siphon ventilation stacks.

The above ground chemical drainage system shall comprise of the pipework system from (and including) the joint to the appliance outlet of the sanitary fitment/appliance (specified and installed by others), to (and including) the connection to the above ground chemical drainage system and in-slab/in-ground drainage system.

The above ground chemical drainage system shall be all polypropylene or HDPE to best suit the discharge. Confirmation shall be obtained from the pipework manufacturer of the suitability of the pipework material with the discharges to drain.

Air admittance valves shall not be permitted within any part of the above ground chemical drainage system.

Insulation (for acoustic purposes, on non-metallic pipes) to main vertical chemical waste stacks and horizontal chemical waste branches, within ceiling voids, shall be provided on all pipework that passes through sensitive areas of the building, e.g. consulting rooms, meeting rooms and other quiet or noise sensitive areas, etc. Acoustic insulation shall be Isol Acoustic Wrap by Geberit or equal and approved and to suit the Acoustic Consultant's requirements and strategy.

Above Ground Radioactive Drainage System

A separate dedicated above ground gravity radioactive drainage system shall be provided for this building. The above ground radioactive drainage system shall not interconnect with the above ground foul drainage system or chemical waste system at any point.

Radioactive drainage shall be collected by a system of vertical and horizontal pipework distributed within the building, to connect to the in-slab/underground drainage system.

The system shall be configured to permit radioactive liquid waste materials to pass uninterrupted from the point of collection, i.e. from the appliance/fitting etc, to a point of discharge at ground floor. At this level the radioactive above ground drainage system shall discharge to the below ground drainage system.

A ventilated chemical above ground drainage system(s) shall be provided, i.e. main waste stacks and anti-siphon ventilation stacks.

The above ground chemical drainage system shall comprise of the pipework system from (and including) the joint to the appliance outlet of the sanitary fitment/appliance (specified and installed by others), to (and including) the connection to the above ground radioactive drainage system and in-slab/in-ground drainage system.

The above ground radioactive drainage system shall be all polypropylene or HDPE to best suit the discharge. Confirmation shall be obtained from the pipework manufacturer of the suitability of the pipework material with the discharges to drain.

Air admittance valves shall not be permitted within any part of the above ground chemical drainage system.

Insulation (for acoustic purposes, on non-metallic pipes) to main vertical radioactive waste stacks and horizontal chemical waste branches, within ceiling voids, shall be provided on all pipework that passes through sensitive areas of the building, e.g. consulting rooms, meeting rooms and other quiet or noise sensitive areas, etc. Acoustic insulation shall be Isol Acoustic Wrap by Geberit or equal and approved and to suit the Acoustic Consultant's requirements and strategy.

General design considerations

Head of drain vent(s) shall be provided. This head of drain vent(s) shall connect from the in-slab/underground drainage system and pass up through the building to terminate to atmosphere at roof level or via a public health plenum at plantroom level.

All soil and waste pipework located within ceiling voids shall be a minimum diameter of 50 mm.

Pipework for gravity condensate drains shall be a minimum of 20mm diameter.

Access points shall be provided on all discharge stacks on each floor level above flood level of adjacent appliances.

Rodding access points shall be provided above the flood level of the appliance being served.

Rodding access shall be provided on all ground floor and basement connections to the below slab drainage.

Soil branch pipework at low level shall be in uPVC with fire collars where passing through fire barriers.

Waste branch pipework shall be in MUPVC. HDPE for chemical and radioactive.

Stub stacks shall be provided with rodding access located above the flood level of the appliance being served.

Individual stub stacks shall be in uPVC.

The in-slab basement and ground floor drainage shall be by the below slab drainage engineer including all sumps and pumps.

The detail of all pipework passing through the basement retaining walls shall be by the structural engineer.

Material and Workmanship Clauses

R11 Above ground foul drainage systems

ABOVE GROUND FOUL DRAINAGE SYSTEMS

GENERAL

The sanitation pipework system shall comply with Scottish Building Regulations and BS EN 12056:2.

The above ground foul drainage will be collected from sanitary fittings, equipment and outlets, by a system of vertical and horizontal pipework distributed within the building, to connect to the below ground drainage system. It will be a gravity discharge ventilated soil and waste system, i.e. main soil stacks and anti-siphon ventilation stacks. Pipework will generally be concealed within modular sanitary panels and ceiling voids. Rodding access for pipework will be provided at the floor being served and not within the ceiling void. Pipes passing through non fire rated walls shall be fitted with pipe sleeves of the same material as the pipe and of such a diameter to allow a minimum clearance for the free movement of the pipe.

When pipes are passing through a fire wall the sleeves shall comply with fire regulation and the requirement of the fire officer and building control. Soil and waste connections on the ground floor will connect directly into the below ground drainage via stub stacks with vent pipes to upper floors where required. The upper floors will have a system of soil and waste stacks and vent pipework.

Project Co. shall include for liaison with:-

- Health and Safety Professionals
- The Board.
- Other Specialist Installers.
- The Trust.
- The Architect

Project Co. shall confirm that the holes indicated on the structural engineer's drawings are incorporated on their installation drawings.

Provision for access to the full bore soil/waste and laboratory (chemical) stack access door points, thorough the wall structure, e.g. plasterboard or similar, shall be provided. The size of these access hatches shall be 300 mm x 300 mm in size, positioned centrally to the soil/waste stack, and laboratory (chemical) drainage access door. The setting out of these above ground soil/waste, and laboratory (chemical) drainage, access hatches is the responsibility of the Architect.

The in-slab/underground drainage system, including all drain connection points, shall be the responsibility of the Structural/Below Ground Drainage Engineer.

115 ABOVE GROUND FOUL DRAINAGE SYSTEM

- Sanitary and floor drainage outlets:

An above ground gravity foul drainage system shall be provided for this building with an exception of the basement which shall be pumped.

The system shall be designed to maintain the highest standards of public and environmental health.

The above ground foul drainage system shall comprise of the pipework system from (& including) the joint to the appliance outlet of the sanitary fitment/appliance (specified by others), to (& including) the connection to the above ground foul drainage system and in-slab/in-ground drainage system. The above ground foul drainage system shall also incorporate all plantroom gullies above basement and ground floor levels.

The Board shall be responsible for availing himself of the details of the sanitary fitments/appliances and the installed in-slab/in-ground drainage system, and provide appropriate adaptors/connectors to connect to same.

Nuclear medicine, endoscope washers and chemical sinks shall all have polypropylene waste pipes. Chemical and radioactive drainage shall have separate stacks from general domestic soil and waste water drainage in the above ground drainage system and will discharge into the below ground drainage. Chemical and radioactive discharges will not be retained in any form of storage.

Access points (full bore) for cleaning will be provided on all discharge stacks.

They typically will be at 1200 mm above finished floor level on each floor and will be aligned with the architectural access provision.

Soil and vent pipes shall commonly terminate to atmosphere at 300mm above finished roof level with a domical cage terminal and 1m above and 3m away from any building opening.

Rodding access points shall be provided above the flood level of the appliance being served.

Access on ground floor stub stacks will be by means of top-mounted, full bore, cleaning eyes. A ventilated soil and waste system shall be provided, i.e. main soil stacks and anti-syphon ventilation stacks.

Changes in direction of all soil and waste pipework shall be carried out using 2 No. 45 degree fittings. Air admittance valves shall not be used.

Stub stacks shall be provided with rodding access located above the flood level of the appliance being served.

- Waste pipework: To suit system type.
- Discharge stack and branch pipework: To suit system type.
- Separate ventilating pipework: To suit system type.
- Accessories: See drawings for details.
- Disposal: To below ground drainage.

SYSTEM PERFORMANCE

As part of the development of the co-ordinated working drawings Project Co. shall prepare general arrangement drawings of the above ground sanitation and internal rainwater pipework installations based on the Architect's base drawings and coordinated with other services and building elements. A proposed drawing list shall be submitted with the tender. Insulation (for acoustic purposes) to main vertical soil and waste stacks and horizontal soil and waste branches, within ceiling voids, shall be provided on all pipework that passes through sensitive areas of the building, e.g. consulting rooms, meeting rooms and other quiet or noise sensitive areas, and to suit the Acoustic Consultant's requirements and strategy.

Where exposed to view waste pipework and traps shall be white. Traps used on small bore sanitary appliances, e.g. sinks, wash hand basins, etc, shall be provided with a 75mm deep seal trap. Where chemical or radioactive wastes are installed, Identification labels shall be applied at a maximum of 3m intervals identifying the service- _Chemical Drainage or Radioactive Drainage, along with appropriate hazchem labels.

220 COLLECTION AND DISTRIBUTION OF FOUL WATER

- General: Quick, quiet and complete, self-cleansing in normal use, without blockage, crossflow, backfall, leakage, odours, noise nuisance or risk to health.
- Pressure fluctuations in pipework (maximum): ±38 mm water gauge.
- Water seal retained in traps (minimum): 25 mm.

310 FLOOR CHANNELS Install floor channels as indicated on drawings

- Manufacturer: Blucher
  - Product reference: As drawings
- Floor finish: As Architects schedules.
- Body type As schedule.
  - Material: Stainless steel.
- Sizes: As drawings
- Type of fall: Built in fall.
- Grating/ cover:
  - Loading: Heavy wheeled traffic.
  - Material: Stainless steel, screw fixed.
- Accessories: As drawings

315 FLOOR DRAINS Install floor drains as indicated on drawings

- Manufacturer: Saint Gobain
  - Product reference: As drawings
- Floor finish: As Architects schedule.
- Body type: P-trapped.
  - Material: Nickel bronze, satin finish.
- Grating/ cover:
  - Type: Flat.
  - Material: Antislip mesh.
- Outlet: Type and direction to suit pipework
- Accessories: As drawings

340 COPPER PIPEWORK Copper pipework shall be used for very hot liquid outlets and as detailed on drawings. Where uPVC pipework runs through noise sensitive areas the pipe shall be enclosed to reduce noise nuisance.

- Standard: To BS EN 1057, Kitemark certified.
  - Temper: Half hard R250.
  - Nominal wall thickness: 1.2 mm.
- Nominal outside diameters: As detailed on drawings.
- Brackets: Brass clips.
  - Fixings: To suit location.

  Size: to suit pipework.
- Accessories: Rodding eyes as per specification and drawings.

345A HDPE PIPEWORK For chemical and radioactive waste from laboratories, both hot and cold.

- Standard: To BS EN 1519-1.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Sizes: As drawings.
- Brackets: Pipe supports and support distances shall be as manufactures recommendations.
  - Fixings: Pipe supports and support distances shall be as manufactures recommendations.

  Size: Pipe supports and support distances shall be as manufactures recommendations.
- Accessories: As drawings.

355 POLYPROPYLENE PIPEWORK

All components shall have been designed and manufactured specifically for the safe conveyance and containment of laboratory and chemical waste, both hot and cold.

Pipes and fittings shall be manufactured in an environment compliant with and certified in accordance with BS EN ISO 9001:2008 and/or NSF-61.

Pipes and fittings shall meet the performance requirements as detailed within ASTM-F1412, the international standard specification for polyolefin pipes and fittings for corrosive waste applications.

Pipes and fittings shall be capable of safely conveying and containing chemical and corrosive waste drainage under continuous working conditions operating at temperatures from minus 20ºC to +110ºC and at temperatures up to +130ºC for intermittent use. Pipes and fittings shall be tested and meet the mechanical and chemical resistance requirements of ASTM-F1412. The system shall be suitable for use within domestic, commercial and public buildings in accordance with the requirements of BS EN 12056-2:2000 for the conveyance and discharge of chemical waste, domestic drainage and sewage as is permitted by current legislation and Water Industry Acts. The system shall have been tested in accordance with the current BS EN standards as accepted within the UK and Europe.

Pipes and fittings to be manufactured from heat stabilised co-polymer polypropylene. Pipes shall be clearly marked Chemical Pipe and include manufacturers trade name designated size and production reference number for traceability. Pipe shall have a ring stiffness of >8kNm2 and meet the mechanical requirements of EN1451 (plastic piping systems for soil and water discharge, low and high temperature, within the building structure).

Fittings to be manufactured from heat stabilised co-polymer polypropylene, using virgin material. Fittings shall be clearly marked with the manufacturers name and designated size. Fittings shall be capable of being jointed by fusion welding. Pipes and fittings shall meet the chemical resistance requirements of ASTM-D4101.

Pipes and fittings to be manufactured from flame retardant heat stabilised co-polymer polypropylene, and shall meet the requirements for ASTM-4101 of PP0210 B55042 giving a UL-94 V-2 rating.

Pipes and fittings shall be fusion jointed. The electrofusion joint shall be made using an electrofusion welder. Permanent electrofusion shall be installed for inaccessible and high risk areas.

The pipework system shall have Metric to Inch size transition fittings available.

The installation shall be carried out to the manufacture recommendations

The installation Board shall provide technical documentation relating to the same and shall have received training with regards to the correct installation procedure.

The completed system should be tested for leaks in accordance with BS EN 12056-2:2000.

The Board shall give due allowance for expansion/contraction in the installation of the drain system.

- Standard:
  - To BS EN 12056-Part 2 and Kitemark certified; or
  - To BS EN 1451-1 and Kitemark certified.

  Application area code: B.
  Opening dimensions of access fittings, design of swept fittings, stand off dimensions of pipe and fitting brackets and requirements for adaptors and plugs: To BS EN 1329-1
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Nominal sizes: As drawings.
- Colour: The pipework should be of a colour to alarm the fact that it is chemical waste.
- Brackets: Pipe supports and support distances shall be as manufactures recommendations.
  - Fixings: Pipe supports and support distances shall be as manufactures recommendations.

  Size: Pipe supports and support distances shall be as manufactures recommendations.
- Accessories: As drawings.

365 PVC-U PIPEWORK Jointing is by solvent welding. Where uPVC pipework runs through noise sensitive areas the pipe shall be enclosed to reduce noise nuisance.

- Standard: To BS EN 1329-1, Kitemark certified.
  - Weather resistance, connectors to WC pans, opening dimensions of access fittings, design of swept fittings, stand off dimensions of pipe and fitting brackets and requirements for adaptors and plugs: To BS 4514.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Nominal size: As drawing.
- Colour: Manufactures standard.
- Brackets: Manufactures standard.
  - Fixings: Manufactures standard.

  Size: Manufactures standard.
- Accessories: As drawings.

380 GREASE TRAPS AND CONVERTERS (BY KITCHEN INSTALLER)

383 INSULATION TO INTERNAL PIPELINE

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: As acoustic consultant.
- Thermal conductivity (maximum): As acoustic consultant.
- Thickness: As acoustic consultant.
- Fire performance: Class 1 spread of flame when tested to BS 476-7 or Class CL to BS EN 13501-1.

390 RODDING EYES Rodding access points shall be provided above the flood level of the appliance being served and to BS EN 12056.

- Manufacturer: As pipework.
  - Product reference: As pipework.
- Body material: As pipework.
- Cover type: As manufactures standard.
- Cover material: As pipework.

400 PAINT FOR CUT ENDS OF CAST IRON PIPES

- Manufacturer: As BS EN 12056.
  - Product reference: As BS EN 12056.

EXECUTION

- All above ground and drainage systems shall be tested the satisfaction of the Local Authority as determined by the Building inspector.
- Prior to concealment by suspended ceilings, duct covers, partition cladding etc
- On completion of the whole installation
- On completion of all work, including that of trades

601 INSTALLATION GENERALLY

- Standard: To BS EN 12056-5.
- Components: From the same manufacturer for each type of pipework.
- Electrolytic corrosion: Avoid contact between dissimilar metals where corrosion may occur.
- Plastics and galvanized steel pipes: Do not bend.
- Allowance for thermal and building movement: Provide and maintain clearance as fixing and jointing proceeds.
- Concealed or inaccessible surfaces: Decorate before starting work specified in this section.

- Protection:
  - Purpose made temporary caps: Fit to prevent ingress of debris.
  - Access covers, cleaning eyes and blanking plates: Fit as the work proceeds.

605 PIPE ROUTES

- General: The shortest practical, with as few bends as possible.
  - Bends in wet portion of soil stacks: Not permitted.
  - Routes not shown on drawings: Submit proposals before commencing work.

610 FIXING PIPEWORK

- Pipework: Fix securely plumb and/ or true to line. Fix discharge stack pipes at or close below socket collar or coupling.
- Branches and low gradient sections: Fix with uniform and adequate falls to drain efficiently.
- Externally socketed pipes and fittings: Fix with sockets facing upstream.
- Additional supports: Provide as necessary to support junctions and changes in direction.
- Vertical pipes: Provide a load bearing support not less than every storey level. Tighten fixings as work proceeds so that every storey is self supporting.
- Wall and floor penetrations: Isolate pipework from structure, e.g. with pipe sleeves.
  - Masking plates: Fix at penetrations if visible in the finished work.
- Expansion joint sockets: Fix rigidly to the building.
- Fixings: Allow the pipe to slide.

625 JOINTING FLOOR CHANNELS

- Jointing: Silicone sealant.

630 JOINTING PIPEWORK - GENERALLY

- General: Joint with materials, fittings and techniques that will make effective and durable connections.
- Jointing differing pipework systems: With adaptors intended for the purpose.
- Cut ends of pipes: Clean and square. Remove burrs and swarf. Chamfer pipe ends before inserting into ring seal sockets.
- Jointing or mating surfaces: Clean and, where necessary, lubricate immediately before assembly.
- Junctions: Form with fittings intended for the purpose.
- Jointing material: Do not allow it to project into bore of pipes and fittings.
- Surplus flux, solvent jointing materials and cement: Remove from joints.

650 JOINTING PIPEWORK - COPPER

- Jointing: Integral lead free solder ring capillary fittings:
  - Standard: To BS EN 1254-1, Kitemark certified.
- Connections to appliances and equipment:
  - Compression fittings: To BS EN 1254-2, Kitemark certified.
  - Fittings with threaded ends: To BS EN 1254-4, Kitemark certified.

655 JOINTING PIPEWORK - HDPE AND POLYPROPYLENE

- Jointing: To suite application/Manufactures recommendation.

660 JOINTING PIPEWORK - ABS, MUPVC, PVC-C AND PVC-U

- Jointing: Solvent welded.

675 COATED PIPES

- Cutting: Recoat bare metal.

680 ELECTRICAL CONTINUITY

- Joints in metal pipes with flexible couplings: Make with clips (or suitable standard pipe couplings) supplied for earth bonding by pipework manufacturer to ensure electrical continuity.

685 IDENTIFICATION OF INTERNAL FOUL DRAINAGE PIPEWORK

- Markings: To BS 1710.
  - Type: Black, with arrows to indicate direction of flow.
  - Wording: White lettering 'FOUL DRAINAGE' on a black background.
- Type: Integral lettering on pipe wall, self-adhesive bands or identification clips.
- Locations: At 500 mm centres, junctions and both sides of slabs, valves, appliances, bulkheads and wall penetrations.

695 DISCHARGE AND VENTILATION STACKS

- Terminations: Perforated cover or cage that does not restrict airflow.
  - Material: As stack.

703 FIXING INSULATION TO INTERNAL PIPELINES

- Fixing: Secure and neat. Provide continuity at supports and leave no gaps. Fix split pipe insulation with the split on 'blind' side of pipeline.
  - Method: Waterproof adhesive.
- Timing: Do not fit insulation until completion of pipe airtightness or leakage testing.

705 ACCESS FOR TESTING AND MAINTENANCE

- General: Install pipework with adequate clearance to permit testing, cleaning and maintenance, including painting where necessary.
- Access fittings and rodding eyes: Position to avoid obstruction.

COMPLETION

Project Co. shall protect the system from damage or interference during the works.

Project Co. shall Test, flush and clean the system as per SHTM/HTMs and BS EN 12056

Project Co.’s defects and liability period shall be as the contract prelims.

900 TESTING GENERALLY

- Dates for testing: Give notice.
  - Period of notice (minimum): 5 working days.
- Preparation:
  - Pipework: Securely fixed and free from obstruction and debris.
  - Traps: Filled with clean water.
- Testing:
  - Supply clean water, assistance and apparatus.
  - Do not use smoke to trace leaks.
- Records: Submit a record of tests.

905 PIPEWORK AIRTIGHTNESS TEST

- Preparation:
  - Open ends of pipework: Temporarily seal using plugs.
  - Test apparatus: Connect a 'U' tube water gauge and air pump to pipework via a plug or through trap of an appliance.
- Testing: Pump air into pipework until gauge registers 38 mm.
- Required performance: Pressure of 38 mm is to be maintained without loss for at least three minutes.

910 SIPHONAGE AND BACK PRESSURE TESTS

- Method:
  - WC pans: Test by flushing.
  - Other appliances: Test by filling to overflow level, then removing the plug.
- Number of tests: Test each appliance three times. Recharge traps before each test.
- Self siphonage testing: Test each appliance individually.
- Induced siphonage and back pressure testing: Test by discharging the following numbers of appliances simultaneously on each stack:
  - WCs: In accordance with the code of practice.
  - Washbasins: In accordance with the code of practice.
  - Sinks: In accordance with the code of practice.
  - Selection of appliances: Submit proposals.

915 PREHANDOVER CHECKS

- Temporary caps: Remove.
- Permanent blanking caps, access covers, rodding eyes, floor gratings and the like: Secure complete with fixings.

920 SUBMITTALS

- Manufacturer's instructions for grease traps and manufacturer’s instructions for maintenance of all systems and insert in WW O&M manuals as required.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical**	Sheet	**WW AP.1.2.12 SMcK G1547**
Performance Specification Title	**Rainwater Drainage System**	Date	**August 2014**
Prepared By	**DW**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Update for Financial Close	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
RAINWATER DRAINAGE SYSTEM

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The development of the design, manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by Project Co..

To carry out the development of the design, Project Co. shall obtain the necessary supporting documentation.

This specification relates to the Rainwater Drainage Systems serving the RHSC-DCN Building and the adjacent Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include, but not be limited to, the following:-

- Internal rainwater pipework installation

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Specification:-

- External Rainwater Pipework and system.
- Below Ground Drainage Systems
- Above Ground Foul Drainage Systems

4.0 INTERFACES AND DEMARCATIONS

Rainwater outlets at roof level shall be coordinated with the roofing construction. The interface with the below slab surface water drainage shall be at the connection to the ground floor drainage pop-up.

5.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

The Rainwater Drainage system shall accord with all appropriate Scottish Health Technical Memoranda, Codes of Practice and relevant British and European Standards.

6.0 DESIGN CRITERIA

Design criteria will be based upon BS EN 12056:3-2000.

7.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of Parts A, B and C of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Trust's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Specialist Installers Project Co. shall liaise with other Specialists as necessary to ensure that all interfaces between the internal rainwater pipework installations and other systems are allowed for.

Building Control, Project Co, shall liaise with and adhere to, the requirements of the Building Control Officer. Any other member of the Project and Board teams concerned with the planning and administration of the Ventilation System.

8.0 SYSTEM DESCRIPTION

INTERNAL RAINWATER PIPE SYSTEM

Surface water shall be collected from roof, balcony and couryard areas by rainwater water outlets connected to a system of vertical and horizontal pipework distributed within the building, to connect to the in-slab/underground surface water drainage system.

The system shall be configured to permit rainwater to pass uninterrupted from the point of collection at roof level to a point of discharge at ground floor level. At this level the rainwater pipe system shall discharge to the below ground drainage system.

The rainwater drainage system shall comprise of the pipework system from and the roof level rainwater outlets, by others, to the connection to the in-slab/in-ground surface water drainage system.

Rainwater outlets shall be specified by the Architect.

The stainless steel pipe shall be socket and spigot push fit pipe and fittings manufactured to EN 1124 Parts 1 & 2 and shall be installed in accordance with the manufacturer's recommendations in order to achieve the pressure ratings required.

The connection between the stainless steel internal rainwater pipes, of 110, 160 and 200mm OD, respectively to the below slab drainage shall be by means of a suitable coupling approved by the engineer, to ensure continuity of the pressure rating of the system.

Where there is any discrepancy between the ODs of the rainwater pipe and the plastic/cast iron drainage pipe an approved metal insert shall be provided to the drain pipe to enable the correct application of the coupling and the integrity of the system.

Insulation against surface condensation shall be provided on all internal rainwater pipes throughout the installation. Insulation shall be pre-formed mineral wool, foil faced matt with taped joints and a vapour seal.

Insulation (for acoustic purposes) to main vertical soil rainwater stacks and horizontal rainwater branches, within ceiling voids, shall be provided on all pipework that passes through sensitive areas of the building, e.g. consulting rooms, meeting rooms and other quiet/sensitive areas, etc. Acoustic insulation shall be Isol Acoustic Wrap by Geberit or equal and approved, and to suit the Acoustic Consultant's requirements and strategy.

There shall be a dedicated rainwater pipe serving the helipad, running from the helipad to the below slab drainage system. This shall connect to the helipad pipework (by helipad specialist) and the connection to the below slab drainage (by the structural engineers). The pipework shall be installed with pressure rated couplings capable of withstanding the maximum head of water possible in the event of blockage in the system.

The detail of pipework passing through the basement retaining walls shall be by the structural engineer.

MATERIAL AND WORKMANSHIP CLAUSES

R10 Rainwater drainage systems

GENERAL

The rainwater drainage system will comply with the relevant clauses of SHTM Scottish Building Regulations, BS EN 12056:3, and the descriptions and requirements set out below.

The Architect is responsible for all rainwater outlets, gutters, hopper heads and external rainwater pipes including their type, size, location, material selection, colours/surface finishes, and method of installation.

The Architect is responsible for the external rainwater pipe interface connection with the below ground/slab surface water drainage connection points.

Roof outlet shall be supplied to all flat, upside-down and green roof areas.

The in-slab/underground drainage system, including all drain connection points, shall be the responsibility of the Structural/Below Ground Drainage Engineer.

110 GRAVITY RAINWATER DRAINAGE SYSTEM

Rainwater outlets: All roof rainwater outlets, with the exception of perimeter outlets, will be of the vertical spigot, anti vortex type to give an enhanced performance. Provisions shall be made for electrical continuity on all internal rainwater pipes and should be tested in accordance with the requirements stipulated within BS EN 877.Access points (full bore) for cleaning will be provided on all rainwater pipes. They typically will be at 1200 mm above finished floor level on each floor as appropriate but especially at ground floor level, and will be aligned with the architectural access provision. A gravity, internal rainwater pipework system shall be provided for this building The system shall be designed to maintain the highest standards of public and environmental health.

Gutters: Guttering shall be part of the Architectural package.
Pipework: External down pipes shall be part of the Architectural package.
Below ground drainage: Underground drainage shall be by the Structural Engineers.
Disposal: To surface water drainage.
Controls: Not applicable.
Accessories: Insulation to internal downpipes.

SYSTEM PERFORMANCE

The design rainfall intensity will be based upon BS EN 12056:3.

221 COLLECTION AND DISTRIBUTION OF RAINWATER

- General: Complete, and without leakage or noise nuisance.

230 DESIGN PARAMETERS - GENERAL

- Roof and gutter construction and finish: The internal rainwater system shall be based upon the flow and pipe diameters given within BS EN12056: Part 3 building envelope design life of 60 years and category 2 protection for valley and parapet gutters providing + storm return period of 90 years shall be adopted.

- Design rate of rainfall: As BS EN 12056-3, National Annex NB.4.
  - Category: 2
- Design life of building: As Architects specification. 60 years.
- Available capacity of existing below ground drainage (maximum): As Structural Engineers specification.

431 STAINLESS STEEL PIPEWORK

- Standard:

All internal rainwater pipes shall be stainless steel to AISI 304 and shall be installed in a manner to withstand 3bar internal pressure within the pipework system for the rainwater pipes serving the Tower Block, and 2bar for all other areas.

The stainless steel pipe shall be socket and spigot push fit pipe and fittings manufactured to EN 1124 Parts 1 & 2 and will be installed in accordance with the manufacturer's recommendations in order to achieve the pressure ratings required.

The connection between the stainless steel internal rainwater pipes, of 110, 160 and 200mm OD, respectively to the below slab drainage will be by means of a pressure rated coupling to ensure continuity of the pressure rating of the system.

Where there is any discrepancy between the ODs of the rainwater pipe and the plastic drainage pipe an approved metal insert shall be provided to the drain pipe to enable the correct application of the coupling and the integrity of the system.

Where it is possible rainwater pipes from outlets will be connected together to reduce the number of connections to the below ground drainage. Rainwater pipes will be positioned where a straight route through the building is possible so minimising offsets.

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Shape: Round.
- Thickness: 1.0 mm.
- Nominal size: 110 mm diameter.
- Sealing rings: EPDM to BS EN 681-1.
- Brackets: To match pipework.
  - Fixings: Stainless steel screws.

  Size: As drawings and schedule.
- Accessories: Access fittings and Insulation.

445 INSULATION TO INTERNAL GUTTERS

- Material: Foil faced mineral fibre.
- Thermal conductivity (maximum): 0.045 W/m"K.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Recycled content: Submit proposals.
- Thickness: To suit guttering.
- Fire performance: Class 1 spread of flame when tested to BS 476-7 or Class CL to BS EN 13501-1.

450 INSULATION TO INTERNAL PIPELINES

- Material: Insulation against surface condensation will be provided on all internal rainwater pipes throughout the installation. Insulation will be pre-formed mineral wool, foil faced matt with taped joints and a vapour seal.
- Thermal conductivity (maximum): 0.045 W/m"K.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Recycled content: Submit proposals.
- Thickness: To suit pipelines.
- Fire performance: Class 1 spread of flame when tested to BS 476-7 or Class CL to BS EN 13501-1.

455 MASKING PLATES

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material and finish: Stainless steel.
- Fixing: Raised head screws.

EXECUTION

Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety regulations.

This shall include clean and tidy working and working in confined spaces.

600 PREPARATION

- Work to be completed before commencing work specified in this section:
  - Below ground drainage. Alternatively, make temporary arrangements for dispersal of rainwater without damage or disfigurement of the building fabric and surroundings.
  - Painting of surfaces which will be concealed or inaccessible.

605 INSTALLATION GENERALLY

- Electrolytic corrosion: Avoid contact between dissimilar metals where corrosion may occur.
- Plastics and galvanized steel pipes: Do not bend.
- Allowance for thermal and building movement: Provide and maintain clearance as fixing and jointing proceeds.
- Protection:
  - Fit purpose made temporary caps to prevent ingress of debris.
  - Fit access covers, cleaning eyes and blanking plates as the work proceeds

630 INSTALLING RAINWATER OUTLETS

- Fixing: Secure. Fix before connecting pipework.
  - Method: Rainwater outlet shall be installed to builder’s detail.
- Junctions between outlets and pipework: Accommodate movement in structure and pipework.

635 FIXING PIPEWORK

- Pipework: Fix securely, plumb and/ or true to line.
- Branches and low gradient sections: Fix with uniform and adequate falls to drain efficiently.
- Externally socketed pipes and fittings: Fix with sockets facing upstream.

- Additional supports: Provide as necessary to support junctions and changes in direction.
- Vertical pipes:
  - Provide a load bearing support at least at every storey level.
  - Tighten fixings as work proceeds so that every storey is self supporting.
  - Wedge joints in unsealed metal pipes to prevent rattling.
- Wall and floor penetrations: Isolate pipework from structure.
  - Pipe sleeves: As Section P31.
  - Masking plates: Fix at penetrations if visible in the finished work.
- Expansion joint pipe sockets: Fix rigidly to buildings. Elsewhere, provide brackets and fixings that allow pipes to slide.

640 FIXING VERTICAL PIPEWORK

- Bracket fixings: To suit bracket and pipework.
- Distance between bracket fixing centres up to a maximum of 3000mm but subject to the Manufacturer’s specific fixing instructions.

650 JOINTING PIPEWORK AND GUTTERS

- General: Joint with materials and fittings that will make effective and durable connections.
- Jointing differing pipework and gutter systems: Use adaptors intended for the purpose.
- Cut ends of pipes and gutters: Clean and square. Remove burrs and swarf. Chamfer pipe ends before inserting into ring seal sockets.
- Jointing or mating surfaces: Clean and, where necessary, lubricate immediately before assembly.
- Junctions: Form with fittings intended for the purpose.
- Jointing material: Strike off flush. Do not allow it to project into bore of pipes and fittings.
- Surplus flux, solvent jointing materials and cement: Remove.

655 JOINTING INTERNAL PIPEWORK

- Jointing: The stainless steel pipe will be socket and spigot push fit pipe and fittings manufactured to EN 1124 Parts 1 & 2 and will be installed in accordance with the manufacturer's recommendations in order to achieve the pressure ratings required.

680 FIXING INSULATION TO INTERNAL PIPELINES AND GUTTERS

- Fixing: Secure and neat. Provide continuity at supports and leave no gaps. Fix split pipe insulation with the split on 'blind' side of pipeline.
  - Method: Waterproof adhesive.
- Timing: Do not fit insulation until completion of pipe airtightness or leakage testing.

685 IDENTIFICATION OF INTERNAL RAINWATER PIPEWORK

- Markings: To BS 1710.
  - Type: Black, with arrows to indicate direction of flow.
- Wording: White lettering 'RAINWATER DRAINAGE' on a black background.
- Type: Permanent; integral or painted pipe colour, self-adhesive bands or identification clips.
- Locations: Junctions, both sides of slabs, bulkheads and wall penetrations.

690 ELECTRICAL CONTINUITY - PIPEWORK

- Joints in metal pipes with flexible couplings: Use clips (or suitable standard pipe couplings) supplied for earth bonding by pipework manufacturer to ensure electrical continuity.

700 ACCESS FOR TESTING AND MAINTENANCE

- General: Install pipework and gutters with adequate clearance to permit testing, cleaning and maintenance, including painting where necessary.
- Access fittings and rodding eyes: Position so that they are not obstructed.

COMPLETION

Project Co. shall protect the system from damage or interference during the works.
Project Co. shall Test, flush and clean the system as per SHTM/HTMs and BS EN 12056-2 's defects and liability period shall be as the contract prelims.

900 TESTING GENERALLY

- Dates for testing: Give notice.
  - Period of notice (minimum): 7 days.
- Preparation:
  - Pipework: Complete, securely fixed, free from defects, obstruction and debris before testing.
- Testing:
  - Supply clean water, assistance and apparatus.
  - Do not use smoke to trace leaks.
- Records: Submit a record of tests.

906 INTERNAL PIPEWORK TEST - SCOTLAND

- Standard: To BS EN 12056-2, National annex NG.

915 MAINTENANCE INSTRUCTIONS

- General: Submit to WW O&M system as required, and submit printed instructions recommending procedures for maintenance of the rainwater installation, including full details of recommended inspection, cleaning and repair procedures.

920 IMMEDIATELY BEFORE HANDOVER

- Construction rubbish, debris, swarf, temporary caps and fine dust which may enter the rainwater system: Remove. Do not sweep or flush into the rainwater system.
- Access covers, rodding eyes, outlet gratings and the like: Secure complete with fixings.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.1 SMcK G1547**
Performance Specification Title	**Site External Services**	Date	**August 2014**
Prepared By	**BR**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
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RHSC and DCN EDINBURGH
EXTERNAL SERVICES

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8.8 Ducts for IT Cabling

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MATERIALS AND WORKMANSHIP CLAUSES

S10 INCOMING COLD WATER SUPPLY SYSTEMS

S32 NATURAL GAS SUPPLY SYSTEMS

S65 FIRE HYDRANT SYSTEM

V24 HIGH VOLTAGE CABLING

V32 LOW VOLTAGE CABLING

Y12 MECHANICAL CLEANING AND CHEMICAL TREATMENT

Y50 MECHANICAL COMMISSIONING

1.0 GENERAL INTRODUCTION

Purpose of Document

The procurement, development of the design, manufacture, supply, installation, wiring, setting to work, testing and commissioning of the Works described in this document shall be undertaken by the Mechanical & Electrical Installer, referred to in this document as “”.

To carry out the development of the design, Project Co. Project Co. shall where specified employ the services of a Specialist for particular elements of the Works. The Specialist shall be provided with the necessary.

This Specification relates to the mechanical and electrical services related to the site external services.

This Specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the architectural and civil engineering specifications and drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this specification shall include, but not be limited to the following:-

- Gas supply system from incoming meter outlet to entry points to buildings.
- Water supply system, including fire fighting mains from incoming meter outlet to entry points to building.
- MV power installations from 11kV point of connection(s) to entry points to buildings, including control and monitoring.
- LV power site distribution.
- External lighting services.
- Medical gas oxygen pipework duct for pipework installation by others.

- Ducts for BMS for cable installation by others.
- Ducts for security and CCTV systems for cable installation by others.
- Telephone ducts for cable installation by others.
- Data/telecoms ducts for cable installation by others
- FM services low current cable ducts for cable installation by others.
- Provisions for water proofing below ground services penetrations through the structure.

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Specification:-

- Existing buried services, including diversions and any temporary and/or enabling works.
- Cabling associated with Specialist's works including: automatic controls & BMS, fire detection and alarm system, security & CCTV, data and telecoms.
- Any works on utility service incoming pipe, meter and the utility owned services.
- Any works in relation to the Scottish Power Energy Networks owned services.
- Any work on existing data and telecom cables.

4.0 INTERFACES AND DEMARCATIONS

The site external services systems shall be provided as complete working systems, however the installation work shall be required to comply with the phasing and sequencing of the site works required by

Project Co. shall provide information to other parties for power supplies and fire alarm system and BMS interfaces.

5.0 APPLICABLE STANDARDS

All elements of the Works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

Underground utilities apparatus shall be positioned and colour coded in accordance with the guidelines issued by The National Joint Utilities Group.

The fire protection systems shall accord with all appropriate Hospital Technical Memoranda, Codes of Practice and relevant British and European Standards listed in the SHTM's.

The equipment supplied shall conform with all relevant standards and regulations in force. The equipment shall be supplied with relevant Declarations of Conformity to certify compliance with the EMC directive 89/336/EEC-92/31/EEC and the Machinery Safety Directive 89/392/EEC-91/368/EEC-93/44/EEC. Also the equipment and installation shall comply with all relevant statutory requirements in force at the time:

The gas supply system shall accord with all appropriate Hospital Technical Memoranda, Codes of Practice and relevant British and European Standards.

- The gas supply and distribution systems shall comply with the relevant clauses of BS6644,
- IGEM Guidance, Clean Air Act, and descriptions and requirements set out below.

6.0 DESIGN CRITERIA

Electricity Supply Characteristics

MV power characteristics: 11000 V, 3-phase, 50 Hz.
LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

Gas pressures

Low pressure supply at outlet of meter: 65mbar

Incoming Water Main Pressure

Minimum Water Pressure: 1.0bar

7.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this Specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Other Specialist Project Co. shall liaise with other specialist as necessary to ensure that all interfaces are allowed for.

Building Control. Project Co. shall liaise, with and adhere to, the requirements of the Building Control Officer.

Any other member of the Project and Board teams concerned with the planning and administration of the site services systems.

Local authority for the disconnection of the public footpath lighting.

Any other member of the project and Hospital Board teams concerned with the planning and administration of the services.

Drawings

This Specification shall be read in conjunction with WW site services drawing No. WW-EW-XX-PL-750-001.

Site Levels

The site levels are indicated on the Architects drawings and the External Civil Engineering drawings.

8.0 SYSTEM DESCRIPTIONS

8.1 Water Supply Service

8.1.1 Site Water Mains

A combined Fire and Domestic water main shall be taken from the Scottish Water main in Craigmillar Castle Road. The main shall be run from this point which provides dual supply to the site boundary by an appropriate accredited installer who will be responsible for the design and instruction.

The supply will be split at the boundary to provide a separate metered 100mØ DI domestic supply and an unmetered 150mm fire main.

8.1.2 Incoming Water Supply

Wholesome water shall be derived from the separate incoming water supply entering the basement tank room. A water meter shall be incorporated on the supply with direct reading and a BMS interface.

8.1.3 Incoming Fire Main Supply

A 150mm unmetered fire main supply shall be taken from the 150mm water supply connection at the boundary.

The 150mm DI fire main shall be run around the RHSC-DCN Building with branches to serve underground hydrants.

The fire hydrants shall be in purpose made chambers below ground in accordance with the requirements of Water for Scotland 2 Edition, and the local Fire Authority and be fitted with a sluice valve. The hydrant cover shall be as required by Strathclyde Fire & Rescue and badged Fire Hydrant.

Fire hydrants shall be located as close as practicable to the fire main, preferably directly above the main to reduce dead leg lengths to an absolute minimum.

8.1.4 Supply to Sprinkler Tank

A 150mm DI branch shall be taken from the external fire main and enter the hospital basement at high level.

The 150mm supply shall be routed into the tank room to serve as a fill supply for the sprinkler tanks. The supply shall be capable of isolation within the tank room and shall be unmetered

8.1.5 Pipework, Installation and Testing

The installation of wholesome water services shall comply with and to the approval of Scottish Water Byelaws.

All pipework for underground installation shall be light weight ductile iron to BS EN 545.

8.2 Gas Supply

The gas supply to the site shall be fed from a twin stream metering assembly operating at low pressure (65mbar), located on the site boundary adjacent to the Old Dalkeith Road.

The meter housing and base for the metering assembly shall be provided by Smart Metering Systems.

The low pressure installation pipe down stream of the metering equipment shall be buried alongside the main entrance roadway to serve pressure regulating equipment and plant located within the Energy Centre.

The boiler plant and CHP plant located within the Energy Centre shall be fed by the low pressure gas supply, thus avoiding the need for individual plant gas boosters.

All individual gas supplies shall be locally sub-metered and provided with pulsed outputs for monitoring by the BMS system.

Pipework

Buried pipework shall be in accordance with the recommendations of the Institute of Gas Engineers and Managers Document IGEM/UP/2 Edition 2. Minimum depth and position in the ground for pipework shall comply with Table 10.

Proprietary plastic warning marker tapes or 150 mm wide mesh shall be laid along the pipe run during backfilling and positioned between 150 mm and to 225 mm below ground level, the tape or mesh to have a stainless steel wire for pipe detection on plastic pipework systems.

All gas distribution pipework shall be installed by Gas Safe Register registered installers in a manner compliant with the requirements of the Gas Safety Regulations and Institute of Gas Engineers and Managers Standards and Recommendations.

Project Co. shall install all underground pipework in gas quality MDPE pipe and fittings and in compliance with the IGEM and pipework manufacturers' recommendations.

A separation of 3000 mm shall be maintained between the MDPE pipework and all buildings. Where this separation cannot be maintained then steel pipework, black heavy weight to BS 1387, shall be installed and double wrapped with self-adhesive plastic tape or petroleum, impregnated woven cloth. Wrapping shall only take place after testing has been successfully carried out and witnessed.

All isolating valves shall be accessed via valve boxes as indicated on the drawings. The valves selected shall be suitable for this method of access.

Project Co. shall ensure that, at the end of each working period, any open pipe end is capped off to prevent the ingress of dirt, dust, water, etc

The pipework shall enter buildings above ground unless otherwise indicated. The pipework material shall change from MDPE to steel as it enters the building.

The Board shall be responsible for purging the section of pipework prior to commencing work.

Upon completion of the installation the services Board shall provide flow rate and pressure readings at all outlets.

8.3 Medical Gases Pipework Duct

For full details of the medical gas requirements refer to separate Specification WW-AP1.2.14 SMcK G1547.

The Board shall construct and install a purpose built ground duct as indicated on the drawings to accommodate the medical gas pipework between the VIE enclosure and the hospital. The pipework shall be designed and installed by the Medical Gases Specialist under a separate contract.

8.4 MV Site Distribution Systems

The information contained in this Specification is for general information only. For full details of the MV installation including the site distribution systems refer to Specification WW-AP1.2.23 SMcK G1547.

Incoming electrical supplies

SPEN are providing two incoming electrical supplies each with a rating of 3MVA. These are to be arranged such that if either fails the other is capable of taking the complete building load at 3MVA.

The incoming MV electrical supplies shall be terminated within the new sub-station located within the energy centre.

General Description

The MV systems shall be required to safely distribute the outputs from the available incoming supplies, MV standby generators, and CHP to the distribution load centres.

The cabling for these circuits shall be buried direct in soft landscapes and drawn into cable ducts and pits under roads, hard standings and extensive paved areas.

The nominal minimum depth for all buried MV cables shall be 1000mm below finished ground level, unless otherwise indicated. Cable route markers shall be installed where practical along the whole route of each cable, and warning tapes and tiles incorporated in the trench for both direct-buried and ducted cables with the exception of the incoming SPEN supplies all MV cabling will be run internally within the Energy Centre and via the service trenches and underground ducts to the main RHSC-DCN building.

Energy Centre and Site Distribution

Details of the site cable routes and the cable routes within the Energy Centre are indicated on the drawings accompanying this Specification.

8.5 LV Services for External Lighting, Signage, Car Park Control & Security – General

Project Co. shall supply and install new feeder pillars as indicated on the drawings and schedules, and shall install permanent sub-main feeds to these.

The road lighting services including the main pedestrian route lighting, for the main site traffic roads to the RHSC-DCN Building and for the main service road around the RHSC-DCN Building, shall be provided and installed under the main external roadway construction package. This lighting including its feeder pillars, controls and final circuitry, has been specified and set out by the Civil Engineer.

External luminaires other than roadway lighting are specified in the Schedule of Luminaires. The types of amenity lighting luminaires have been specified by the Landscape Architect to suit the intent of the external works Masterplan.

External amenity lighting, illuminated signs, fire brigade direction signs and indicators, and any other equipment physically mounted on the RHSC-DCN Building and the Energy Centre shall be provided and installed under the appropriate building design package, and are excluded from this external works package.

External amenity and footpath lighting, illuminated signs, car park barriers, fire brigade direction signs and any other equipment mounted independently from buildings shall be provided and installed under this external works package.

The external lighting, illuminated signs, car park barriers, fire brigade direction signs, bus shelters and any other equipment shall be served from distribution boards installed in LV external lighting feeder pillars, or within buildings and outbuildings. External LV feeder pillars shall be served by LV feeds from the RHSC-DCN Building, as shown on the drawings. These shall all be located generally as indicated on the external works drawings; their precise location co-ordinates shall be given on the Landscape Architect's layout drawings. Any illuminated external signs shall have their lighting connected to a convenient local photocell controlled external lighting circuit.

Where bus shelters incorporate a digital information system, a permanent supply for the display shall be taken from a convenient feeder pillar if no permanently live lighting circuit is available locally. Requirements for such displays shall be identified by the Specialist.

External amenity lighting control shall generally be provided by photocells. Column mounted lighting shall be controlled by photocells integral with the luminaires. Bollard and decorative or indirect lighting which cannot be fitted with individual photocells shall be controlled by photocells mounted on suitable convenient local lighting columns, a suitable dedicated pole on or adjacent the feeder pillar, or on local building fabric, switching the whole circuit via a contactor in the feeder pillar.

Where several circuits from one feeder pillar are to be switched by photocell, a single photocell switching all circuits via a multiple contactor is acceptable. The details of the circuitry are indicated on the drawings and feeder pillar distribution schedules. Each lighting control contactor shall be mounted in the relevant feeder pillar, and shall be suitable for use in that environment. The cables shall be ducted or buried direct, as indicated on the drawings.

LV power supplies for CCTV Cameras shall be taken from local external lighting circuits as required (non contactor switched circuits). The CCTV provisions and the necessary power supply requirements shall be advised by the Security/CCTV Specialist.

8.6 BMS Site Links and FM Services

Ducts and draw-pits for the BMS and Facilities Management (FM) services linking the RHSC-DCN Building and Energy Centre shall be provided around the site. These shall carry the site FM fibre optic backbone link, the BMS site links and any BMS or FM links required to existing buildings off-site. The BMS cabling shall be installed by the controls specialist. Ducts for FM dedicated LV services shall be included. Draw ropes shall be left in the duct system for the use of the Specialist.

The changeover of existing BMS and other FM services serving existing buildings shall be co-ordinated with FM department.

8.7 Telephone Ducts

The telephone cabling shall be provided by the Hospital Board's Telephone Service Provider outside the scope of this Specification. Project Co. shall provide cable ducts to allow the Telephone Service Providers telephone service to be installed to the RHSC-DCN and to provide routes for Telephone Service Provider links with other buildings around the site. The ductwork system is intended to allow diverse routes into the Hospital to enhance system resilience. The duct system shall be as indicated on the drawings.

The drawings indicate the scope and general routes and an allowance for tender purposes for ducts and draw pits for Telephone Service Provider cabling.

Project Co. shall liaise with the Telephone Service Provider and with the Board to finalise the Specification of ducts and draw pits prior to installation to ensure that the cable ways meet the Provider's requirements. In particular the location of the terminal draw pits adjacent the site boundary, and the route of the ducts from it to the RHSC-DCN, shall be agreed with the Telephone Service Provider.

Project Co. shall leave all ducts complete with draw ropes and inspection chambers/draw pits, tested and ready for installation of cables by the Telephone Service Provider.

8.8 Ducts for IT Cabling

The incoming and cross-site IT (data/telecoms) cabling (including any NHS voice communications and internal telephone communication systems) shall be provided by others outside the scope of this Specification. Project Co. shall provide cable ducts to allow the installation of the cabling for these systems. A network of ducts and draw pits shall be provided as indicated on the layout drawing to provide diverse incoming service routes around the site.

The drawings indicate the scope and general routes and an allowance for tender purposes for ducts and draw pits for IT cabling. The Board shall detail draw pits and confirm that the locations shown meet the relevant specialist's cable laying requirements.

Project Co. shall liaise with the Board to finalise the Specification of ducts and draw pits prior to installation to ensure that the cable ways meet the Hospital IT requirements.

Project Co. shall leave all ducts complete with draw ropes and inspection chambers/draw pits, tested and ready for installation of cables.

8.9 CCTV & Security

External CCTV cameras and security systems such as vehicle control barriers shall be installed to cover the car parks, building entrances and approaches. Their locations shall be confirmed by the Security/CCTV System Specialist. Security system ducts shall be provided to serve the cameras located remote from buildings. The LV supplies for cameras shall be derived from permanently live local external lighting circuits or dedicated circuits from feeder pillars as required.

8.10 Remote External Installations

The alarms for the petrol interceptors on the drainage outflow from the car parks shall be provided with indication and alarm facilities. Ducts shall be installed as indicated on the drawings to link these to the security control room in the RHSC-DCN.

The outbuildings for the external medical gas and liquid oxygen (VIE) installations and support facilities shall be provided with an LV supply, telecom/data and alarm/monitoring service duct connections as indicated on the layout drawings.

8.11 Draw Pits

Draw/valve pits shall be provided as indicated on the drawings and constructed to meet the detailed requirements of the structural engineer and in numbers and spacings indicated by and agreed with the specialist services providers. The exact location and cover finish shall be confirmed by the landscape architect, and draw-pits shall be installed to the co-ordinates provided by the Landscape Architect. The locations indicated on the External Services drawings are indicative only.

Any combined Data/Telecoms/LV draw-pits shall be divided to suit the split between Data/Telecoms and LV at each pit. The divider shall provide effective physical segregation between the two services.

8.12 Ducts Generally

Ducts for MV (11kV), LV, ELV/Comms/Data/signals/controls cables shall be of HDPE or equal and approved material, unless specifically stated otherwise elsewhere in this or another Specification.

Any vacant cable ducts shall be left sealed and provided with draw ropes/cords for the use of cable installers.

Where cables have been installed in ducts into buildings, the ducts shall be sealed around the cables to meet the applicable standards appropriate to the services involved.

Multiservices duct systems shall be installed to form the site internal services distribution network as indicated on the drawings. These shall be generally as follows, and shall share sub-divided draw pits where indicated as Site Services on the drawings:

- Comms – Site incoming main fibre optic cable ducts from the site boundaries, providing diverse incoming routes for fibre optic telecoms and data into the Hospital.

  Internal data and telecommunications services (fibre optic/multicore copper as required by Data/Comms Specialist linking the new buildings and the existing estate.

- LV (Low Current) – FM services such as LV/ELV/Security/BMS/Site-wide copper multicore and fibre-optic controls/monitoring as required by the various systems specialist designers.

The purpose of each duct shall be allocated on site according to the services to be installed in each location.

8.13 Colour Coding of Underground Ducted Services

Project Co. shall agree with the Hospital Board a colour coding system that identifies the purpose of each duct. This system shall then be used on site over the re-development process.

The ducts in the combined site data, telecoms and LV system shall be black or another colour agreed with the Hospital Board. Individual service identification shall be provided by paint marking the duct ends in draw pits. Duct service allocation shall be defined by the telecom, data and other specialist services providers.

The following services shall be identified, using colours that are not designated by British Standards for water, gas, oil and other mechanical services.

MV
LV
ELV for security and fire alarms
ELV for communication services
ELV BMS cabling

MATERIALS AND WORKMANSHIP CLAUSES

S10 INCOMING COLD WATER SUPPLY SYSTEMS

110 INCOMING WATER SUPPLY

- Water company: Scottish Water/Business Stream
- Position of incoming mains water supply: As site plan Drawing No. WW-EW-XX-PL-750-001. 1 No. mains supply shall be taken onto the site from the Scottish Water main in Craigmillar Castle Road.

Site water mains shall be installed in accordance with Water for Scotland 2nd Edition and NJUG requirements for utility, apparatus with regards to depth, colour coding, identification markers, and position, and to the requirements of Scottish Water.

Site water mains shall be WRAS approved ductile iron the BS EN 545 complete with anchor gasket joints at all tee-pieces and changes of direction suitable for the site contaminated ground conditions and approved by Scottish Water. All backfill shall be from a clean source.

A leak detection water meter shall be incorporated with direct reading and a BMS interface onto the incoming mains supply at the entry to the site and at point of entry to the basement. All sub meters shall be linked to the BMS. All water meters shall be fitted with isolation valves.

Water connection point to Scottish Water main and the provision of dual supplies are subject to confirmation by Scottish Water.

SYSTEM PERFORMANCE

- The Hot and Cold water supply system shall be install, flushed, cleaned, tested and commissioned as per Water Byelaws SHTMs and HTMs. Where any standards or documents contradict one another Project Co. shall contact the Board for further guidance.

220 COLD WATER SUPPLY

- Incoming mains water supply:
  13. Site factors: One water main from the Scottish Water main in Craigmillar Castle Road.

PRODUCTS

Project Co. shall supply and install services and equipment to perform as per Specification. Project Co. shall submit details of all mechanical equipment for comment and place orders in a timely fashion to ensure delivery as per programme. Where a particular manufacture is specified, Project Co. shall include for that manufacturer.

Where considered appropriate, provide for equivalent standard alternatives to be offered for consideration. This must be done in a timely manner and Project Co. shall provide all details including but not limited to:

14. detailed description
15. Cost comparison
16. Technical comparison
17. References to standards
18. References to SHTM/HTMs

310 DEZINCIFICATION

- Fittings, pipelines and equipment located below ground or in concealed or inaccessible locations: Resistant to dezincification, e.g. gunmetal.

320 WATER METERS

Water meters shall be installed as indicated on drawings.
Stool pieces between isolating valves shall be provided for the ease of installation of local metering at a later date. Water meters shall be removed during the flushing of the system.

- Standard: To ISO 4064-1.
- Type: In-line meters. Shall be capable of being read by the clients BMS system.
- Size: To suit service.
- Pressure class: To suit service.
- Temperature class: To suit service.
- Metrological class: To suit service.
- Connections: To suit service.
- Indicating device: Type 2 - digital.
- Features: Pulsed output for remote monitoring.
- Accessories: To BS EN 14154-2.

EXECUTION

Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety regulations. This shall include clean and tidy working and working in confined spaces. Due to the size of the water systems being installed all pressure testing and commissioning equipment shall be cleaned and chlorinated before each use. This is to prevent the systems from being contaminated with pseudomonas.

620 INSTALLATION GENERALLY

- Installation: To BS EN 806 + BS 8558 and Water Byelaws
- Performance: Free from leaks and the audible effects of expansion, vibration and water hammer.
- Fixing of equipment, components and accessories: Fix securely, parallel or perpendicular to the structure of the building.
- Preparation: Immediately before installing tanks and cisterns on a floor or platform, clear the surface completely of debris and projections.

- Corrosion resistance: In locations where moisture is present or may occur, avoid contact between dissimilar metals by use of suitable washers, gaskets, and the like.

630 INSTALLING WATER METERS

- Standards: To BS EN 14154-2.
- Interconnection to Building Management System (BMS): Required.

COMPLETION

Project Co. shall protect the system from damage or interference during the works. shall Test, flush and clean the system as per section Y12, Y50,SHTM/HTM's and TR/20.
Project Co. shall submit O&M's as required by The Board
Project Co. shall provide training as per section Y12, Y40 & Y50.
Project Co. shall provide spares as per section Y12, Y40 & Y50.
Project Co's. defects and liability period shall be as the contract prelims.

910 HYDRAULIC PRESSURE TESTING OF HOT AND COLD WATER SUPPLY SYSTEMS

- Standard: To BS 6700.
- Notice (minimum): 1 week.
- Pressure: 1.5 times working pressure.
- Duration of test: 1 h.

980 DOCUMENTATION

- Manufacturers' operating and maintenance instructions: Submit for equipment and controls.
- System operating and maintenance instructions: Submit for the system as a whole giving optimum settings for controls.
- Record drawings: Submit drawings showing the location of circuits and operating controls.

990 OPERATING TOOLS

- Tools: Supply tools for operation, maintenance and cleaning purposes.
- Keys: Supply keys for valves and vents.

995 MAINTENANCE

- Servicing and maintenance: Undertake.
  19. Duration: Until 24 months after Practical Completion.

S32 NATURAL GAS SUPPLY SYSTEMS

110 INCOMING GAS SUPPLY

- Gas transporter: Medium pressure main.
- Gas supplier: Smart Metering Systems (UK Gas Connection).

PRODUCTS

All elements of the work shall be in accordance with the requirements of current legislation, regulations and industry standards.

The natural gas installation shall also comply to the SHTM's, code of practices and relevant British standards.

A proposed drawing list shall be submitted by .

Project Co. shall provide working drawings for the installation and issue them for comment before work commences.

310 SECONDARY GAS METERS

Secondary gas meters shall be installed as detailed on drawing and in this Specification. Gas meters shall be installed with isolation valves for maintenance.

- Standard:
  - Gas meters: To BS EN 1359.
  - Unions and adaptors: To BS 746.
  - Low pressure meters: In accordance with IGEM/GM/6.
  - Electrical connections: In accordance with IGEM/GM/7A & B.

- Project Co. shall submit technical details of the proposed meter.
- Accessories: Pulsed output for BMS monitoring.
- Housing type: To suit gas meter type.

330 LOW PRESSURE GAS SUPPLY PIPELINES

Over ground pipes 15 mm to 50 mm nominal size inclusive (internal) shall be Black mild steel to BS1307 heavyweight grade, screwed fittings if installed in a ventilated space, otherwise fully welded. Over ground pipes greater than 50mm shall be Black mild steel to BS1387 heavyweight grade welded throughout its length. All above ground natural gas pipe shall be painted yellow ochre.

- Standards: To BS EN 1775 and in accordance with IGEM/UP/2.
- Materials: Steel, heavy weight.

335 INDUSTRIAL GAS SUPPLY PIPELINES

- Standards: In accordance with IGEM/UP/2.
  - Up to and including 0.5 bar: To BS EN 1775.
  - From 0.5 bar up to 60 bar: To EN 15001-1.

- Material: Indoor above ground shall be Black mild steel to BS1387 heavyweight grade welded throughout its length and painted yellow ochre, Underground pipe shall be yellow medium density polyethylene thick wall pipes (PE80).
- Jointing method: Steel pipe wielded throughout its length, Fusion jointing of polyethylene.

400 SAFETY AND CONTROL DEVICES

- Standard: To BS EN 13611.

410 BALL VALVES, MANUALLY OPERATED

Valve shall be suitable for type of gas pipe in which they are installed.
- Standard: To BS EN 331.
- Type: Lever operated.
- Manufacturer: Project Co. choice.
  Product reference: Project Co. choice.
- Material: Bronze or dezincification resistant brass (DZR).
- Connections: Threaded.

420 PLUG VALVES, CAST IRON

Valve shall be suitable for medium pressure gas main.
- Standard: To BS 5158.
- Type: Regular.
- Manufacturer: Project Co. choice.
  - Product reference: Project Co. choice.
- Connections: To suit pipework.
- Options: Wrench.

425 PLUG VALVES, STEEL

Valve shall be suitable for medium pressure gas main.
- Standard: To BS 5353.
- Type: Regular.
- Manufacturer: Project Co. choice.
  - Product reference: Project Co. choice.
- Connections: To suit size of pipework.

430 PLUG VALVES, TAPER

Valve shall be suitable for type of gas pipe in which they are installed.
- Standard: To BS 1552.
- Type: Project Co. choice.
- Manufacturer: Project Co. choice.
  - Product reference: Project Co. choice.
- Material: Dezincification resistant brass (DZR) copper alloy
- Connections: Threaded.

EXECUTION

Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety regulations. This shall include clean and tidy working and working in confined spaces.

620 INSTALLATION GENERALLY

Installation: In accordance with IGEM/UP/10.

625 GAS SAFE REGISTRATION REQUIREMENTS

- Type of service: Non-domestic.
- Type of gas: Natural gas.
- Area of work:

The installation, testing and commissioning of the natural gas system shall be undertaken by a registered installer. A copy of the installer's certificate shall be attached to the test and commissioning documents.

630 INSTALLING GAS METERS

Secondary gas meters:
- Low pressure: In accordance with BS 6400-1.
- Medium pressure: In accordance with BS 6400-2.
- Non-domestic: In accordance with IGEM/GM/8.

650 INSTALLING GAS PIPELINES

- Installation: In accordance with BS EN 1775.

660 INSTALLING INDUSTRIAL GAS PIPELINES

- Standard: In accordance with EN 15001-1.

COMPLETION

Project Co. shall protect the system from damage or interference during the works.
Project Co. shall submit O&M's.
Project Co's. defects and liability period shall be as the contract.

930 COMMERCIAL AND INDUSTRIAL GAS INSTALLATIONS

- Soundness testing and purging: In accordance with IGEM/UP/1.
- Testing, purging and commissioning pipelines: In accordance with BS EN 1775 and BS EN 15001-2.
- Commissioning gas fired plant: In accordance with IGEM/UP/4

940 PRESSURE TESTING OF NATURAL GAS SUPPLY SYSTEMS

- Notice (minimum): 1 week.
- Pressure: 1.5 times working pressure.
- Duration of test: 1 h.

960 DOCUMENTATION

- Manufacturers' operating and maintenance instructions: Submit for equipment and controls.
- System operating and maintenance instructions: Submit for the systems as a whole giving optimum settings for controls.
- Record drawings: Submit drawings showing the location of circuits and operating controls.

970 OPERATING TOOLS

- Tools: Supply tools for operation, maintenance and cleaning purposes.
- Valve keys: Supply keys for valves and meter housing.
  - Quantity: 4 of each type.

S65 FIRE HYDRANT SYSTEMS

GENERAL

Fire hydrants shall be located as close as practicable to the main, preferably directly above the main, to reduce dead leg lengths to an absolute minimum.

The fire hydrant shall conform to BS 750: 2006 Specification for underground fire hydrants and surface box frames and covers and BS EN 14339: 2005 Underground fire hydrants and Water for Scotland 2nd Ed. 2007.

Hydrant main pipework shall be ductile iron to BE EN 545 complete with anchor gasket points at all tee-pieces and charges of direction installed in accordance with the pipe manufacturers requirements.

Pipe in trenches shall be laid on a minimum of 100mm bed of <20mm gravel or coarse sand and trenches shall ensure 900mm cover, measured from the crown of the pipe.

Pressure testing shall be undertaken in accordance with the requirements of the pipe manufacturer, the local Fire Authority and Water Authority.

Backfilling shall be undertaken in such a manner so as to avoid any deformation of the pipe.

Heavy compaction equipment shall not be used with less than 300mm of cover. A marker tape shall be laid 300mm above the crown of the pipe.

110 FIRE HYDRANT SYSTEM

This underground fire hydrants shall:
a) be installed in a water distribution system;
b) be size DN 80;
c) be suitable for a maximum allowable operating pressure (PFA) of 1.6 MPa or 2.5 MPa (16 bar or 25 bar);
d) be fitted with screw-down type valves; and with one outlet.

Comply with BS 750.
WRC approved materials of construction.
Standard outlet - 2½" male hydrant round thread (other options available).
Universal inlet flange (3" BS10 Table E or 80mm BS 4504 NP16)
Blank cap, chain and frost valve provided.

- Water source: new site fire main.
- Distribution: Ductile iron to BS EN 545
- Outlets: Underground fire hydrants.
- Accessories:
  - Indicator plates;
  - Surface boxes; and
  - Warning marker tape.
- Completion: Project Co. shall test, flush and clean the system as per regulations, SHTM/HTM's, this Specification and Fire Officer requirements.

SYSTEM PERFORMANCE

All fire hydrant pipework exposed to the frost shall be insulated or trace heated to prevent freezing.

210 DESIGN

- Standards: To BS EN 806-2 and in accordance with BS 9990.
- Design: Complete the design of the fire hydrant system.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.
- Mains water supply to hydrants: Provide an independent water supply.
  - Evidence of capacity of mains water supply: Submit.

320 DUCTILE IRON PIPELINES

- Standard: To BS EN 545
- Manufacturer: Saint Gobain.
  - Product reference: Submit proposals.
- Jointing: Anchor Gasket (EPDM Gasket)

340 UNDERGROUND FIRE HYDRANTS

- Standards: To BS EN 1074-6 and BS 750.
- Hydrant type to BS EN 1074-6: Underground.
- Valve type to BS 750: Screw-down (type 2)

Valve shall be fully maintainable.

- Ductile iron construction.
- 2½_ London round thread gunmetal outlet to BS 750.
- Exceeds flow requirements:
- Kv = 92 minimum, 2000l/min,
- Kv = 101 maximum, 2200l/min.
- Corrosion resistant construction, compliant with BS EN 1074-6 for disinfection products.
- Universal drilled inlet flange BS EN 1092-2:1997, BS 10 Table D/E.
- Inlet is of a proprietary type.
- Auto-frost drain valve as standard.
- Draining stopper.
- Kite marked.
- Low weight design.
- WRAS approved.

- Manufacturer: Submit proposals.
- Product reference: Submit proposals.
- Duckfoot bend: Not required.
- Outlet material: Submit proposals.
- Plug: Submit proposals.
- Accessories: Spindle cap, outlet cap and frost valve.

350 INDICATOR PLATES

Shall be installed adjacent Hydrant

- Standard: To BS 3251.
  - Class: A.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals .
- Material: Cast iron.
- Finish: Vitreous enamel.
- Colours:
  - Characters: Black.
  - Front surface: Reference number 309 (Canary yellow) to BS 381C.
- Accessories: As Specification and schedule.

360 SURFACE BOXES

Shall be suitable for application e.g. footpaths, heavy traffic.

- Standard: To BS 750.
  - Grade: Submit proposals.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals (as recommended by Strathclyde Fire & Rescue).
- Material: Grey cast iron (CI).
- Finish: As structural Engineers Specification.
- Marking: 'FIRE HYDRANT' in 30 mm high letters.
- Accessories: Lifting keys and Marker posts.

370 WARNING MARKER TAPES

- Manufacturer: Board's choice.
  - Product reference: Submit proposals.
- Type: Continuous colour coded, heavy gauge polyethylene identification tapes.
- Wire detection aid: Required.

EXECUTION

The Board shall Test, flush and clean the system as per regulations, SHTM/HTM's, this Specification and Fire officer requirements.

610 ISOLATION

- Connection to existing fire hydrant systems: Provide an isolation valve and non-return valve.

630 INSTALLATION GENERALLY

- Fire hydrant position: Unobstructed by the parking, loading and unloading of vehicles.
- Protection: Protect from damage, e.g. by frost, traffic loads or vibration.

640 INSTALLING PIPELINES

- Depth of cover: As NJUG.
- Set out: Lay in straight lines.
- Concealment: As drawings.
- Trench excavations: Carefully prepare to a firm even base. Remove sharp objects and replace with pea gravel to give 100 mm (minimum) cover above and below the pipe.
- Installation: Thoroughly clean lengths of pipe internally before laying. Temporarily cap until jointing takes place. After laying and jointing keep leading end capped.
- Thrust blocks: Install at changes of direction and blank ends.
- Backfilling: Excavated material free from large stones and sharp objects. Leave joints exposed until after pipeline pressure test. Lay and compact in 300 mm maximum layers. Do not use heavy compactors before backfill is 600 mm deep.

650 INSTALLING UNDERGROUND FIRE HYDRANTS

- Installation: In accordance with BS 9990.
- Depth (maximum): 300 mm from hydrant outlet to finished ground level.
- Details of pit construction: Submit proposals.

660 INSTALLING SURFACE BOXES

- Clear openings: To BS 750.
- Frame depth:
  - Grade A: 100 mm.
  - Grade B: 75 mm.
- Frame width: 75 mm.
- Fit of frames and covers: Set top of cover flush with top of frame.

670 INSTALLING INDICATOR PLATES

- Aluminium plates: Aluminium alloy, zinc coated steel or copper alloy screws.
- Plastics plates: Zinc coated steel screws or adhesive.
- Ferrous plates: Zinc coated steel screws or bolts.

680 INSTALLING WARNING MARKER TAPES

- Installation: During backfilling, lay along the route of the hydrant main.
- Location, depth, colour and markings: To requirements of service undertaker.

COMPLETION

910 FLUSHING

- Operation: Fill system with water and discharge it via the hydrant. Flush out debris.

920 TESTING

- Standard: To BS 9990:2006
  - Notice before commencing testing (minimum): 1 week.
- Static pressure test: Charge the system with water twice the maximum pressure to which the installation is designed to be subjected in operation. Maintain for 1 h. During this period check that no water leaks from joints or valves.
  - Results: Submit.
- Flow test: Pass water through the system under pressure and record flow and pressure readings.
  - Timing: After static pressure test.
  - Results: Submit.

930 SYSTEM DISINFECTION

- Standard: To BS 6700.
- Certification: Submit disinfection certificate.

940 SETTING TO WORK

- Operation: Check operation of hydrant valves.
- Make ready: Check operation of frost valve and leave ready for use.

950 DOCUMENTATION

- Manufacturers' operating and maintenance instructions: Submit.
- Test records: Submit a record of inspections and tests.
- Record drawings: Submit drawings showing location of pipe runs, hydrants and valves.

960 OPERATING TOOLS

- Tools: Supply for operation, maintenance and cleaning purposes.
- Keys: Supply for hydrants.
  - Quantity: as per contract requirements.

V24 HIGH VOLTAGE CABLING

To be read with Preliminaries/ General Conditions
PRODUCTS

370 UNDERGROUND PLASTICS CABLE PROTECTION COVERS

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Polyethylene.
- Size:
  - Length: Submit proposals.
  - Width: 150 mm.
  - Thickness: Submit proposals.
- Jointing method: Peg.
- Identification: Laminate underground cable marker tape to top face.

380 UNDERGROUND CONCRETE CABLE PROTECTION COVERS

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Standard: To BS 2484.
- Type: Flat.
- Size:
  - Length: 914 mm.
  - Width: Submit proposals.
  - Thickness at outer edge: Submit proposals.

390 PLASTICS DUCTS FOR UNDERGROUND CABLES

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Standard: To ENA 12-24.
- Diameter (minimum): 150 mm.
- Accessories: Proprietary duct plugs.

400 UNDERGROUND CABLE MARKER TAPE

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Standard: To ENA 12-23.

EXECUTION

620 EXCAVATIONS

- Excavations next to existing underground services: In accordance with HS(G) 47.
- Existing underground services: Expose and identify.

650 CABLES IN TRENCHES

- Base:
  - Material: All cables and ducts to be surrounded by 75 mm sand, free of any sharp stones or flints.
- Multiple cables in same trench: Set 150 mm apart.
- Cable formation within trench: Submit proposals.
- Cables below roads and hard standings: Duct and derate if longer than 10 m. Extend ducts 1m beyond hard standing.
- Cable identification and protection: Underground cable marker tape and protective covers.

670 CABLES IN DUCTS

- Cable installation from cable drums: Submit method statement.

680 PROTECTION TAPE FOR BURIED ELECTRICITY SUPPLY CABLE

- Installation: In accordance with ENA 12-23.

V32 LOW VOLTAGE CABLING

To be read with Preliminaries/General conditions.

PRODUCTS

465 UNDERGROUND CABLE MARKER TAPE

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Polyethylene.
- Size:
  - Width: 150 mm.
  - Thickness: 0.1 mm.
- Format:
  - Background colour: Yellow.
  - Text colour: Black.
- Labelling: _CAUTION ELECTRIC CABLE BELOW_ continuous along the tape length.

470 UNDERGROUND PLASTICS CABLE PROTECTION COVERS

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Polyethylene.
- Size:
  - Width: 150 mm.
  - Thickness: Submit proposals.
- Jointing method: Peg.
- Identification: Laminate underground cable marker tape to top face.

475 UNDERGROUND CONCRETE CABLE PROTECTION COVERS

- Standard: To BS 2484.
- Type: Flat.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Size: 914 mm.
- Width: Submit proposals.
- Thickness at outer edge: Submit proposals.

EXECUTION

680 CABLES IN TRENCHES

- Base: Newly prepared bedding.
- Multiple cables in same trench: Set 150 mm apart.
  - Cable formation within trench: Space cables apart by a distance of half the cable diameter.
- Trefoil cable groups and protective conductors: Bind at 1 m intervals.
- Cables below roads and hard standings: Install within duct and derate cable if longer than 10m. Extend ducts 1 m each side of hard standing.

- Cable identification and protection:
  - Underground plastics cable protection covers and underground cable marker tape;
  - Underground concrete cable protection covers and underground cable marker tape; and
  - Submit proposals.

700 INSTALLING CABLE DUCTS

- Routes and arrangement: As drawings.
- Duct formation within trench: Submit proposals.
- Gradient (maximum): 1:20.
- Duct bends: Suitable for cable bending radii.
- Manholes: Provide manholes, draw pits and jointing chambers.
  - Location: Submit proposals.
- Duct alignment: Check before installing cables.
- Duct cleaning: Clean duct run before installing cables.
- Draw ropes: Install draw ropes in ducts.
  - Type: Board's choice.
- Duct ends: Plug and seal with proprietary duct plugs.

710 CABLES IN DUCTS

- Cable installation from cable drums: Submit method statement.
- Single core trefoil cable groups and protective conductors: Install within a single duct and bind at 1m intervals.

Y12 MECHANICAL CLEANING AND CHEMICAL TREATMENTS

To be read with Preliminaries/ General conditions.

PRODUCTS

310 BIODISPERSANT CHEMICALS

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Type: Subject to analysis.

320 CORROSION INHIBITOR CHEMICALS

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Type: Subject to analysis.

330 DISPERSANT CHEMICALS

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Type: Subject to analysis.

340 NON-OXIDIZING BIOCIDES

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Type: Subject to analysis.

350 OXIDIZING BIOCIDES

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Type: Subject to analysis.

360 PH CONTROL CHEMICALS

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Type: Subject to analysis.

370 SCALE INHIBITOR CHEMICALS

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Type: Subject to analysis.

EXECUTION

610 GENERALLY

- Water analysis: Analyse water samples before treatment.
- Preliminary checks: Before cleaning or chemical treatment, complete pressure tests.
- Waste products: Neutralize, and dispose of to drain.

620 FLUSHING OF HOT AND COLD WATER SYSTEMS

- Standard: To BS EN 806-4.
- Installation checks: Thoroughly inspect pipework.
- Drainage: Provide adequate drainage, preferably direct to manhole.

630 FLUSHING OF HEATING AND CHILLED WATER SYSTEMS

- Flushing: In accordance with BSRIA 1/2001.1.
- Installation checks: Thoroughly inspect pipework.
- Drainage: Provide adequate drainage, preferably direct to manhole.

640 PURGING GAS PIPEWORK

- Standards: To IGE/UP/1 and IGE/UP/1A.

650 DISINFECTION OF HOT AND COLD WATER SYSTEMS

- Standard: To BS EN 806-4.
- Samples for analysis: Provide after flushing.

660 CHEMICAL TREATMENT FOR HEATING SYSTEMS

- Treatment: In accordance with BSRIA 2/93.

670 CHEMICAL TREATMENT FOR CHILLED WATER SYSTEMS

- Treatment: In accordance with BSRIA 2/93.

700 WATER QUALITY TESTS

- Standard: To BS EN 806-4.
- Samples:
  - Sample points: Main supply to site.
  - Samples for analysis: Submit samples for bacteriological analysis.
- Water temperature: Record at each sampling point at the time of taking the sample.
- Test results:
  - Record: Details of analyses.
  - Submit: On completion.
  - Number of copies: Four.

Y50 MECHANICAL COMMISSIONING

To be read with Preliminaries/ General conditions.

EXECUTION

610 COMMISSIONING PROGRAMME

- Submission: Four weeks (minimum) before commissioning commences.
- Commissioning manager: Submit details with programme.

620 COMMISSIONING OF HOT AND COLD WATER SUPPLY SYSTEMS

- Pre-commissioning: In accordance with BSRIA 2/89.3 and CIBSE Commissioning Code W.
- Commissioning: In accordance with BS EN 806-4, BSRIA 2/89.3 and CIBSE Commissioning Code W.
- Notice (minimum): One week.
- Equipment: Check and adjust operation of equipment, controls and safety devices.
- Outlets: Check operation of outlets for satisfactory rate of flow and temperature.

630 COMMISSIONING OF WATER HEATING SYSTEMS

- Pre-commissioning: In accordance with BSRIA 2/89.3 and CIBSE Commissioning Code W.
- Commissioning: In accordance with BSRIA 2/89.3 and CIBSE Commissioning Code W.
- Variable flow systems: In accordance with CIBSE KS09 Commissioning variable flow pipework systems.
- Notice (minimum): One week.

660 COMMISSIONING OF CHILLED WATER SYSTEMS

- Pre-commissioning: In accordance with BSRIA 2/89.3 and CIBSE Commissioning Code W.
- Commissioning: In accordance with BSRIA 2/89.3 and CIBSE Commissioning Code W.
- Variable flow systems: In accordance with CIBSE KS09 Commissioning variable flow pipework systems.
- Notice (minimum): One week.

700 PERFORMANCE TESTING PROGRAMME

- Submission: Four weeks (minimum) before performance testing commences.
- Performance testing manager: Submit details with programme.

710 PERFORMANCE TESTING

- General: Demonstrate the performance of the installations.
- Guaranteed efficiency: Tolerances defined in this specification.
- Environmental tests: Carry out environmental testing. If necessary, use artificial loads to simulate operating conditions.

- Recorders:
  - Type: Supply and maintain portable seven day space temperature and relative humidity recorders, complete with charts.
  - Number: N/A.
  - Duration of loan: N/A.
- Reports: Submit on completion.

750 INSPECTION AND TEST RECORDS

- Reports:
  - Construction phase: System commissionable.
- Records for water systems: In accordance with BSRIA 2/89.3.
- Records for air systems: In accordance with BSRIA 3/89.3.
- Record sheets:
  - Submission: On completion.
  - Number of copies: Four.

760 DEMONSTRATIONS

- Running of plant:
  - Operation: Run, maintain and supervise the installations under normal working conditions.
  - Duration: Two weeks.
- Instruction: Instruct and demonstrate the purpose, function and operation of the installations.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.14 SMcK G1547**
Performance Specification Title	**Medical Gas Installation**	Date	**August 2014**
Prepared By	**BR**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Update for Financial Close	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
MEDICAL GAS INSTALLATIONS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The development of the design, manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by a Medical Gas Specialist and is referred to in this document as “the Specialist”.

To carry out the development of the design, the Specialist shall obtain the necessary supporting documentation.

This specification relates to the Medical Gas Installation serving the RHSC-DCN Building.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Motors

All motors shall be selected to provide the most energy efficient solution conforming to Section 6 regulations. All motors shall have an efficiency rating of IE2 in accordance with EN 60034-30:2009 and suitable for operation in ambient temperatures of 40 degrees C.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 EXISTING SITE AND SERVICES

The Medical Gas installation shall operate as a standalone system within the new hospitals, being self contained from other systems on the hospital site.

3.0 SCOPE

The scope of work covered by this Performance Specification shall include, but not be limited to the following:-

- Medical Gas Installation
- All associated control wiring

4.0 PERFORMANCE SPECIFIED SYSTEMS

The Medical gas installation is a performance specified system and this specification outlines the requirements to be met by the system.

5.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this performance specification:-

- Power supplies to plant
- Main cable containment (other than final run outs of conduits)
- Fire and BMS interface connections
- Supply and installation of central VIE oxygen plant

6.0 INTERFACES AND DEMARCATIONS

The Medical Gas Installation shall be provided as a complete working system serving the RHSC-DCN Building.

The new VIE plants shall be provided by the Hospital Board under their existing FM contract, with the plant being terminated with valves for extension by the Specialist.

The Specialist shall liaise with the Hospital Board to ensure coordination with the VIE supplier in terms of builders work, power supplies, connection points, etc and anything else that is required to form a complete working system.

7.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

The Medical Gas Installation shall accord with all appropriate (SHTM) Scottish Health Technical Memoranda (HTM) Health Technical Memoranda, Codes of Practice and relevant British and European Standards listed in SHTM 02-01. Any differences/conflicts in the standards shall be brought to the Board's attention and clarification sought.

In addition to the NBS clauses noted in this specification, the medical gas system shall also meet the requirement of the NHS Model Engineering Specification Part C11.

The equipment supplied shall conform with all relevant standards and regulations in force. The equipment shall be supplied with relevant Declarations of Conformity to certify compliance with the EMC directive 89/336/EEC-92/31/EEC and the Machinery Safety Directive 89/392/EEC-91/368/EEC-93/44/EEC. Also the equipment and installation shall comply with all relevant statutory requirements in force at the time:

8.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

All low current systems to be self-rebooting following mains failure and generator test conditions.

All battery systems shall be easy to test and change, it should be possible to replace the batteries without powering down or interrupting the operation of the system.

Warning shall be provided to the BMS when battery systems are failing and require maintenance replacement.

Circuits serving control panels shall be protected by MCB's not RCD's/RBCO's.

9.0 LIAISON

The Specialist shall include for liaison with:-
Health and Safety Professionals. As well as the Health and Safety requirements of this specification, the Specialist shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Other Specialist and Suppliers. The Specialist shall liase with other specialist suppliers as necessary to ensure that all interfaces between the Medical Gas Installation and other systems are allowed for. This shall include but not be limited to:-

- Building Management System specialist
- Fire Alarm and Detection specialist
- VIE Plant supplier

The Electrical Services Installer. The Specialist shall liase with the Electrical Services Installer to provide details of:-

1. Medical gas installation power supply requirements
2. Cable tray requirements

Building Control. The Specialist shall liase, with and adhere to, the requirements of the Building Control Officer.

Any other member of the Project and Board teams concerned with the planning and administration of the medical gas installation, including co-ordinating the pipework installation with all the other services.

10.0 SYSTEM DESCRIPTION

General

The Medical Gas Specialist shall provide a medical gas distribution system sized to accommodate the demand of the works as defined in the ADB Sheets, with the capacity to accommodate an increase in demand (flow and consumption) of no less than 25%;

Manifolds, vacuum and medical air plant shall have a capacity of 125% of the design capacity to allow for future expansion.

Central gas storage

A medical gas storage compound will be located adjacent to the New Energy Centre as indicated on the external services layout drawings. The compound will house the oxygen VIE plant.

The positioning of the compound provides the required safe separation distances as required by SHTM 02-01. Access for tanker deliveries will be provided so as not to cause obstruction of the roadways.

Oxygen supply plant

Oxygen will be supplied from the new VIE compound. The VIE (Vacuum Insulated Evaporator) units will be arranged as main supply.

The VIE oxygen supply equipment will be sized and installed by a specialist under direct leasing arrangements with the Hospital Board; a valved connection being left in the compound for continuation by the medical gas specialist. Indicative sizes of plant for tender purposes are shown on the External Services layouts, but these shall be confirmed by the Specialist prior to construction commencing.

From the VIE unit an oxygen supply will be taken underground to enter the new building and then connect to the oxygen ring main running at ground floor level. The ring main will connect to the major risers serving the upper floors of the RHSC-DCN Building.

An emergency bottle manifold shall be provided within the medical gas manifold store.

Manifold supplied services

Nitrous Oxide will be provided from manifold room located within the Energy Centre.

A single pipeline for each service will run from the manifold room where it will run to rise within ventilated service risers to the various departments to be served.

Laboratory Helium and Nitrogen will employ local bottled supplies due to the infrequent use of the gases.

Central compressor plants

Central Plant will be located within the Level 4 and Level 2 plant rooms as detailed below for the following systems:-

(a) ***Medical Air (4Bar)***

- The medical Air 4bar plant will be installed within the Level 4 plantroom.

Emergency reserve bottle manifold to supply each of the 4bar and 7bar plant will be installed in the central manifold room within the Energy Centre.

(b) ***Medical Vacuum***

- A vacuum plant will be installed in the Level 4 plant room.

(c) ***Surgical Air (7Bar)***

The specialist shall be responsible for the design, supply and installation of any compressed air systems necessary to serve medical equipment e.g. Theatre Pendants.

The air shall be compliant with SHTM02-01.

The compressor shall be an oil free screw type with dryer, pre-filter, final filter, condensate drain and suitably sized receiver.

The compressed air unit shall be able to be operated remotely.

The compressor unit shall be located in the Level 4 plantroom.

- All round access for maintenance.
- Good lighting levels (200 lux) for maintenance.
- A dust-free, dry, well ventilated environment.
- Operating temperatures between 10-35°C.

The pressure drop from plant to the station shall not exceed 50 kPa.

The compressed air distribution pipework shall be heavy grade steel with a flexible connection to the compressor in accordance with the standard NHS specifications.

Plant Noise

The sound pressure level within the compressor plantrooms need to be carefully considered. It is, therefore, intended that screw compressors will be used whenever possible to reduce the sound pressure levels.

Anaesthetic gas scavenging systems (AGSS)

Anaesthetic Gas Scavenging Systems will be provided for wherever Nitrous Oxide is used for anaesthetic purposes, as identified on the ADB Sheets, and pumped to local exhauster sets within the Level 4 plantroom.

AGSS exhauster pumps shall be duplex with auto-changeover and duty sharing.

AGSS systems shall generally be provided to cover the same zone areas as covered by the ventilation air handling systems.

Within the departmental areas wherever AGSS terminal outlets are provided, local starter panels with plant run/fault indications will be provided.

Terminal units

Terminal units will be single outlets, wall mounted or part of a horizontal medical trunking or part of a ceiling pendant.

Within play rooms and recreation rooms all outlets shall be located in lockable areas together with masks and flow meters, etc.

Area valve service units (AVSUs)

These will be generally located for both departmental isolation units located immediately within the department adjacent to the hospital street and local area isolation units located adjacent to nurse's stations etc.

Medical gas alarms

Medical gas alarm systems will be stand-alone systems and only give status and alarm facility to the central BMS via volt free contacts *as detailed in the BMS specification*.

All central panels will have audible and visual alarms for all remote plant conditions and visual pipeline pressure fault conditions. Repeater panels will show all the alarm conditions on the control panel.

Main alarm panels will be located in the main hospital switchboard room with a repeater panel within the Hospital Estates Facilities Management office.

At the main alarm monitoring panel and repeater panels, the pipeline status in critical care areas will also be indicated, e.g. Theatres, and Intensive Care Areas

AGSS alarms will be local to the area served.

Dental Systems

Separate compressed air and vacuum systems shall be provided for the dental room, compressor shall be located within the Level 2 plant room and vacuum supplied locally. The system shall meet the requirements of SHTM 02-01.

Pathology

Separate compressed air and vacuum systems shall be provided for the Pathology Department and shall be located within the Level 4 plant room. The system shall meet the requirements of HTM08-06.

S20 MEDICAL OXYGEN SUPPLY SYSTEMS

General

110 MEDICAL OXYGEN SUPPLY SYSTEM Serving Hospital

- Primary supply: Vacuum insulated evaporator (VIE) storage vessels.
- Secondary supply: Vacuum insulated evaporator (VIE) storage vessels.
- Reserve supply: Emergency supply manifolds.
- Pipelines: Copper to BS EN 13348, as section S29.
- Pipeline ancillaries: Line valves, as section S29.
- Zone service units: Area service module, as section S29.
- Medical gas alarms: Area, as section S29 and Central, as section S29.
- Terminal units: Required.
- Bedhead units: Refer to ADB Sheets.
- Pendants: Refer to ADB Sheets and Client Equipment Specifications.
- Completion:
  - Plant and equipment identification: As section S29.
  - Commissioning: As section S29.

System performance

210 DESIGN

- Design: Complete the design of the medical oxygen supply system in accordance with SHTM 02-01 Part A
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

Products

310 PRODUCTS GENERALLY

- Products: In accordance with SHTM 02-01 Part A.

340 VACUUM INSULATED EVAPORATOR (VIE) STORAGE VESSELS Sited in a dedicated compound adjacent the Energy Centre.

- Type: Vertical.
- Manufacturer: submit proposals
  - Product reference: Not applicable.
- Capacity: To be advised by specialist
- Pressure (minimum): 10.5 bar (1050 kPa).
- Accessories: To be advised by specialist

360 EMERGENCY SUPPLY MANIFOLDS To support VIE Plant
- Standard: To BS EN ISO 407.
- Type: Manually adjusted regulator.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Number of cylinders: To be determined by Specialist.
- Accessories: To be determined by Specialist.

370 AREA VALVE SERVICE UNITS For use at department entrances and staff bases.
- Type: Concealed wall mounted.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

380 TERMINAL UNITS For all areas.
- Standard: To BS EN ISO 9170-1.
- Type:
  - Bedhead trunking mounted;
  - Boom mounted;
  - Modular wall mounted;
  - Pendant mounted; and
  - Wall mounted flush.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Accessories: To suit fixing background.

Execution

620 INSTALLATION GENERALLY
- Installation: In accordance with SHTM 02-01 Part A.

650 INSTALLING VACUUM INSULATED EVAPORATOR STORAGE VESSELS
- Location: In accordance with SHTM 02-01 Part A, figure 23.
- Installation: In accordance with British Compressed Gases Association CP 36.

660 INSTALLING COMPRESSED GAS CYLINDERS
- Location: At ground level, and close to the delivery point.
- Pressure regulating valves: Separate for each cylinder bank.

670 INSTALLING TERMINAL UNITS
- Mounting order: In accordance with SHTM 02-01 Part A, figure 1.
- Mounting heights: In accordance with SHTM 02-01 Part A, figure 2.

Completion

910 DOCUMENTATION

O&M documentation shall be issued at least three months before completion of any part of the contract.

The contents and format shall be agreed with the Board. The document shall be issued/uploaded on Aconex.

Project Co. shall provide instruction to the clients engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the manufactures' recommendations and best practice. shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

S21 MEDICAL NITROUS OXIDE SUPPLY SYSTEMS

General

110 MEDICAL NITROUS OXIDE SUPPLY SYSTEM Serving areas of the Hospitals identified on the ADB Sheets

- Primary supply: Compressed gas cylinders.
- Secondary supply: Compressed gas cylinders.
- Reserve supply: Emergency supply manifolds.
- Pipelines: Copper to BS EN 13348, as section S29.
- Pipeline ancillaries: Line valves, as section S29.
- Zone service units: Area service module, as section S29.
- Medical gas alarms: Area, as section S29 and Central, as section S29.
- Terminal units: Required.
- Bedhead units: Refer to ADB Sheets.
- Pendants: Refer to ADB Sheets and Client Equipment Specification.
- Completion:
  - Plant and equipment identification: As section S29.
  - Commissioning: As section S29.

210 DESIGN

- Design: Complete the design of the medical nitrous oxide supply system in accordance with SHTM 02-01 Part A.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

Products

310 PRODUCTS GENERALLY

- Products: In accordance with SHTM 02-01 Part A

320 COMPRESSED GAS CYLINDERS for Hospitals

- Standard: To BS EN ISO 407.
- Type: Automatic changeover.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Number of cylinders: To be determined by Specialist.
- Accessories: Manifold control systems.

330 EMERGENCY SUPPLY MANIFOLDS for Hospitals

- Standard: To BS EN ISO 407.
- Type: Manually adjusted regulator.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Number of cylinders: To be determined by Specialist.
- Accessories: To be determined by Specialist.

340 AREA VALVE SERVICE UNITS At department entrances, theatre entrances and staff bases

- Type: Concealed wall mounted.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

350 TERMINAL UNITS For all areas

- Standard: To BS EN ISO 9170-1.
- Type:
  - Bedhead trunking mounted;
  - Boom mounted;
  - Modular wall mounted;
  - Pendent mounted; and
  - Wall mounted flush.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Accessories: To suit fixing background.

Execution

620 INSTALLATION GENERALLY

- Installation: In accordance with SHTM 02-01 Part A.

630 INSTALLING COMPRESSED GAS CYLINDERS

- Location: At ground level, and close to the delivery point.
- Pressure regulating valves: Separate valves for each cylinder bank.

640 INSTALLING TERMINAL UNITS

- Mounting order: In accordance with SHTM 02-01 Part A, figure 1.
- Mounting heights: In accordance with SHTM 02-01 Part A, figure 2.

Completion

910 DOCUMENTATION

O&M documentation shall be issued at least three months before completion of any part of the contract.
The contents and format shall be agreed with the Board. The document shall be issued/uploaded on Acconex.

Project Co. shall provide instruction to the clients engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the manufactures' recommendations and best practice. Project Co. shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

S22 MEDICAL COMPRESSED AIR SUPPLY SYSTEMS

General

110 MEDICAL COMPRESSED AIR SUPPLY SYSTEM Serving the hospitals

- Primary supply: Compressors.
- Secondary supply: Compressed gas cylinders.
- Reserve supply: Emergency supply manifolds.
- Pipelines: Copper to BS EN 13348, as section S29.
- Pipeline ancillaries: Line valves, as section S29.
- Pressure reducing stations: Duplex.

- Zone service units: Area service module, as section S29.
- Medical gas alarms: Area, as section S29 and Central, as section S29.
- Terminal units: Required.
- Bedhead units: Refer to ADB Sheets.
- Pendants: Refer to ADB Sheets and Client Equipment Specification.
- Completion:
  - Plant and equipment identification: As section S29.
  - Commissioning: As section S29.

System performance

210 DESIGN

- Design: Complete the design of the medical compressed air supply system in accordance with SHTM 02-01 Part A.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

Products

310 PRODUCTS GENERALLY

- Products: In accordance with SHTM 02-01 Part A.

320 COMPRESSORS For all areas

- Pressure: 1100 kPa.
- Type: Quadruplex (4Bar Air), twin (7Bar Air)
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Compressor: Rotary screw.
- Flow rate: To be determined by Specialist.
- Number of vessels: To be determined by Specialist.
  - Total vessel capacity: To be determined by Specialist.
- Electrical supply type: Three phase.
- Accessories: To be determined by Specialist.

330 COMPRESSED GAS CYLINDERS For emergency reserve

- Standard: To BS EN ISO 407.
- Type: Automatic changeover.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Number of cylinders: To be determined by Specialist.
- Accessories: Manifold control systems.

340 EMERGENCY SUPPLY MANIFOLDS In association with compressor plant.

- Standard: To BS EN ISO 407.
- Type: Manually adjusted regulator.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

  Number of cylinders: To be determined by Specialist.
- Accessories: To be determined by Specialist.

350 PRESSURE REDUCING STATIONS as required to suit Specialist's design
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Accessories: Pressure relief valves, pressure gauges and quarter turn ball valves.

360 AREA VALVE SERVICE UNITS At department entrances and staff bases
- Type: Concealed wall mounted.

Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

370 TERMINAL UNITS For all areas
- Standard: To BS EN ISO 9170-1.
- Type:
  - Bedhead trunking mounted;
  - Boom mounted;
  - Modular wall mounted;
  - Pendent mounted; and
  - Wall mounted flush.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Accessories: To suit fixing background.

Execution

620 INSTALLATION GENERALLY
- Installation: In accordance with SHTM 02-01 Part A.

630 INSTALLING COMPRESSORS
- Location: Site to allow adequate flow of air for:
  - air intake to the compressors;
  - cooling of the compressed air by the after-coolers; and
  - cooling of the compressors.
- Air inlets: To be determined by Specialist.

640 INSTALLING COMPRESSED GAS CYLINDERS
- Location: At ground level, and close to the delivery point.
- Pressure regulating valves: Separate valves for each cylinder bank.

650 INSTALLING TERMINAL UNITS
- Mounting order: In accordance with SHTM 02-01 Part A, figure 1.
- Mounting heights: In accordance with SHTM 02-01 Part A, figure 2.

Completion

910 DOCUMENTATION

O&M documentation shall be issued at least three months before completion of any part of the contract.
The contents and format shall be agreed with the Board. The document shall be issued/uploaded on Aconex.

Project Co. shall provide instruction to the clients engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the manufactures' recommendations and best practice. Project Co. shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

S23 MEDICAL VACUUM SYSTEMS

General

110 MEDICAL VACUUM SYSTEM Serving the hospitals

- Primary supply: Medical vacuum plant.
- Pipelines: Copper to BS EN 13348, as section S29.
- Pipeline ancillaries: Line valves, as section S29.
- Zone service units: Area service module, as section S29.
- Medical gas alarms: Area, as section S29 and Central, as section S29.
- Terminal units: Required.
- Bedhead units: Refer to ADB Sheets.
- Pendants: Refer to ADB Sheets and Client Equipment Specification.
- Completion:
  - Plant and equipment identification: As section S29.
  - Commissioning: As section S29.

System performance

210 DESIGN

- Design: Complete the design of the medical vacuum system in accordance with SHTM 02-01 Part A.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

Products

310 PRODUCTS GENERALLY

- Products: In accordance with SHTM 02-01 Part A.

320 MEDICAL VACUUM PLANT Serving the hospitals.

- Type: Quadruplex
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Number of vacuum receiver vessels: To be determined by the Specialist.
- Number of pumps: To be determined by the Specialist.
- Number of motor control units: To be determined by the Specialist.
- Electrical supply type: Three phase.
- Accessories: Central control unit.
  - Other accessories: To be determined by the Specialist.

330 AREA VALVE SERVICE UNITS At department entrances and staff bases.

- Type: Concealed wall mounted.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

340 TERMINAL UNITS For all areas.

- Standard: To BS EN ISO 9170-1.
- Type:
  - Bedhead trunking mounted;
  - Boom mounted;
  - Modular wall mounted;
  - Pendent mounted; and
  - Wall mounted flush.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Accessories: To suit fixing background.

Execution

620 INSTALLATION GENERALLY

- Installation: In accordance with SHTM 02-01 Part A.

630 INSTALLING MEDICAL VACUUM PLANT

- Vacuum plant exhaust: Clear of windows, ventilation intakes and the intake of air compressors.
- Notice at discharge points: Weatherproof, stating 'MEDICAL VACUUM DISCHARGE

POINT - DO NOT OBSTRUCT'.

640 INSTALLING TERMINAL UNITS

- Mounting order: In accordance with SHTM 02-01 Part A, figure 1.
- Mounting heights: In accordance with SHTM 02-01 Part A, figure 2.

Completion

910 DOCUMENTATION

O&M documentation shall be issued at least three months before completion of any part of the contract.
The contents and format shall be agreed with the Board. The document shall be issued/uploaded on Acconex.

Project Co. shall provide instruction to the clients engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the manufactures' recommendations and best practice. Project Co. shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

S25 MEDICAL ANAESTHETIC GAS SCAVENGING SYSTEMS

General

110 MEDICAL ANAESTHETIC GAS SCAVENGING SYSTEM Serving the hospitals
- Exhauster units: Required.
- Pipelines: Copper to BS EN 13348, as section S29.
- Pipeline ancillaries: Line valves, as section S29.
- Terminal units: Required.
- Remote start switch panels: Required.
- Vacuum flow regulating valves: Required.
- Bedhead units: Refer to ADB Sheets.
- Pendants: Refer to ADB Sheets and Client Equipment Specification.
- Completion:
  - Plant and equipment identification: As section S29.
  - Commissioning: As section S29.

System performance

210 DESIGN
- Design: Complete the design of the medical anaesthetic gas scavenging system in accordance with SHTM 02-01 Part A.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

Products

310 PRODUCTS GENERALLY
- Products: In accordance with SHTM 02-01 Part A.

320 EXHAUSTER UNITS Serving the hospitals
- Standard: To BS EN ISO 7396-2.
- Type: Duplex.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Electric supply: Three phase.
- Integral accessories: Flexible connectors, moisture drain flask and starter isolator panel.
- Other accessories: Pressure switch.

330 TERMINAL UNITS For all areas.
- Standard: To BS EN ISO 9170-2.
- Type:
  - Bedhead trunking mounted;
  - Boom mounted;
  - Modular wall mounted;
  - Pendent mounted; and
  - Wall mounted flush.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Orifices: To be determined by Specialist.
- Accessories: To suit fixing background.

340 REMOTE START SWITCH PANELS Located in areas served by the systems
- Standard: To BS EN ISO 7396-2.
- Type: Double pole rocker switch, green NORMAL indicator, amber PLANT FAULT indicator and red PLANT EMERGENCY indicator.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Electric supply: 24 V.
- Accessories: To be determined by the Specialist.

350 VACUUM FLOW REGULATING VALVES To systems served
- Standard: To BS EN 737-2.
- Type: To be determined by Specialist.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Accessories: To be determined by the Specialist.

Execution

620 INSTALLATION GENERALLY
- Standard: To BS EN ISO 7396-2 and in accordance with SHTM 02-01 Part A.

630 INSTALLING EXHAUSTER UNITS
- Discharge outlet: At roof level, clear of ventilation inlets, opening windows and apertures.

640 INSTALLING REMOTE START SWITCH PANELS
- Location: Refer to ADB Sheets and discuss/agree with the Users.

650 INSTALLING TERMINAL UNITS
- Mounting heights: In accordance with SHTM 02-01 Part A, figure 2.

Completion

910 DOCUMENTATION

O&M documentation shall be issued at least three months before completion of any part of the contract.
The contents and format shall be agreed with the Board. The document shall be issued/uploaded on Aconex.

Project Co. shall provide instruction to the clients engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the manufactures' recommendations and best practice. Project Co. shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

S29 MEDICAL GAS EQUIPMENT

Products

310 PRODUCTS GENERALLY
- Products: In accordance with SHTM 02-01 Part A.

320 AREA SERVICE MODULES Located at department entrances and staff bases.
- Type: Recessed.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Number of area valve service units: Refer to layout drawings.
- Integral medical gas area alarm: Required.
- Panel colour: Submit proposals.

330 MEDICAL GAS AREA ALARMS Associated with areas served by medical gases.
- Type: Concealed.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Accessories: Bezel for concealed installation and Pressure switch assemblies.

340 MEDICAL GAS CENTRAL ALARMS Associated with central plant items.
- Type: Concealed.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Accessories: Bezel for concealed installation.

420 COPPER TUBES
- Standard: To BS EN 13348.
  - Up to 54 mm R250.
  - 76 mm and above R290.
- Fittings: To BS EN 1254-1.

430 LINE VALVES For section and plant isolation
- Standards: To BS EN ISO 7396-1 and in accordance with SHTM 02-01 Part A.
- Type: Ball valve.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Connections: Submit proposals.
- Integral accessories: Copper stub pipes, padlock.

Execution

610 INSTALLATION GENERALLY
- Installation: In accordance with SHTM 02-01 Part A

630 INSTALLING AREA ALARMS
- Location: Downstream of the area valve service units.

640 INSTALLING CENTRAL ALARMS

- Location:
  - Facilities management office
  - ITU nurses station
  - Telephone switchboard
  - Operating room
  - Theatre managers desk
  - 24 hour manned FM facility

680 PLANT AND EQUIPMENT IDENTIFICATION

- Identification: In accordance with SHTM 02-01 Part A

Completion

910 COMMISSIONING OF MEDICAL GAS SYSTEMS

- Commissioning: In accordance with SHTM 02-01 Part A.
- Notice (minimum): To be agreed with the Board.

920 INSPECTION AND TEST RECORDS

- Records for medical gas systems: In accordance with SHTM 02-01 Part A
- Record sheets: Submit.
  - Number of copies: To be agreed with the Board.

S30 COMPRESSED AIR SUPPLY SYSTEMS

General

110 COMPRESSED AIR SUPPLY SYSTEM Serving specialist systems and equipment

- Manufacturer: Submit proposals.
- Source supply: Compressors.
- Pipelines: Copper.
- Pipeline ancillaries: To be determined by the Specialist.
- Pressure reducing stations: To be determined by the Specialist.
- Air receivers: To be determined by the Specialist.
- Dryers: To be determined by the Specialist.
- In line filters: To be determined by the Specialist.
- Aftercoolers: To be determined by the Specialist.
- Oil/ water separators: To be determined by the Specialist.
- Couplings: To be determined by the Specialist.
- Completion:
  - Plant and equipment identification: As section Y32.

System performance

210 DESIGN
Design: Complete the design of the compressed air supply system.
Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

Products

310 COMPRESSORS Serving the compressed air system

- Pressure: To be determined by the Specialist.
- Type: Duplex.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Compressor: Oil free.
- Flow rate: To be determined by the Specialist.
- Number of vessels: To be determined by the Specialist.
  - Total vessel capacity: To be determined by the Specialist.
- Electrical supply type: Three phase.
- Accessories: To be determined by the Specialist.

Execution

620 INSTALLING COMPRESSORS

- Location: Site to allow adequate flow of air for
  - air intake to the compressors;
  - cooling of the compressed air by the after-coolers; and
  - cooling of the compressors.
- Air inlets: Fit filters to the compressor inlets or inlet ductwork.

Completion

905 TESTING AND COMMISSIONING

- Requirements: To be determined by the Specialist.

910 DOCUMENTATION

O&M documentation shall be issued at least three months before completion of any part of the contract.
The contents and format shall be agreed with the Board. The document shall be issued/ uploaded on Aconex.

Project Co. shall provide instruction to the clients engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the manufactures' recommendations and best practice. Project Co. shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

Specification Check / Revision Sheet

Project	**RHSC-DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical**	Sheet	**WW AP.1.2.15 SMcK G1547**
Performance Specification Title	**Pneumatic Tube Transfer System**	Date	**August 2014**
Prepared By	**BR**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Update for Financial Closure	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
PNEUMATIC TUBE SYSTEMS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The development of the design, manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by the Specialist Installer and is referred to in this document as “the Specialist”.

To carry out the development of the design, the Specialist shall obtain the necessary supporting documentation.

This specification relates to the Pneumatic Tube Transportation System (PTS) serving the new RHSC-DCN facility.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

Motors

All motors shall be selected to provide the most energy efficient solution conforming to Section 6 regulations. All motors shall have an efficiency rating of IE2 in accordance with EN 60034-30:2009 and suitable for operation in ambient temperatures of 40 degrees C.

2.0 EXISTING SITE AND SERVICES

The PTS shall interconnect with existing facilities on the hospital site. The PTS specialist shall liaise with the Hospital Board to agreed suitable points of interface whilst causing minimum disruption to the operation of the hospitals.

3.0 SCOPE

The scope of work covered by this Performance Specification shall include, but not be limited to the following:-

- Pneumatic tube conveying system
- All associated control wiring

4.0 PERFORMANCE SPECIFIED SYSTEMS

The PTS is a performance specified system and this specification outlines the requirements to be met by the system.

5.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Performance Specification:-

- Power wiring to plant
- Main cable containment (other than final run outs of conduits)
- Fire and BMS interface connections

6.0 INTERFACES AND DEMARCATIONS

The PTS shall be provided as a complete working system serving the new RHSC – DCN Building and be as detailed within the Table below. Allowance shall be made for interface with other parts of the hospital site, with direct connection to deliver to and receive from the Pharmacy and Laboratories rooms S6107 & GS119 within the RIE.

The PTS supplier shall provide information to other parties for power supplies and fire alarm system interfaces.

Ref	Department	Pneumatic Air Tube Delivery System Required and Number	Location
RHSC SPECIFIC DEPARTMENTS			
A	**Front Door – ED/ Assessment Ward**		
A1	Emergency Department	2	1 Laboratory Area and 1 outside Resuscitation Room
A2	Paediatric Acute Receiving Unit – 34 Beds	1	Central Location Staff Base
B	**Critical Care/ HDU/ Neonatal Surgery**		
B1	PICU and HDU's – 24 Beds	2	1 close to Room 5/8 and the other close to Room 14

Ref	Department	Pneumatic Air Tube Delivery System Required and Number	Location
C	**RHSC In Patient Pathway/ Ward Care**		
C1.1	Medical Inpatients – 23 Beds	1	Staff Base Central Location
C1.2	Surgical Long Stay Inpatients – 15 Beds	1	Staff Base Central Location
C1.3	Neuroscience Inpatients – 12 Beds	1	Staff Base Central Location
C1.4	Haematology/ Oncology Inpatients & Daycases – 17 Beds & 2 Chairs	1	Staff Base Central Location
C1.8	Surgical Short Stay Inpatients – 14 Beds	1	Staff Base Central Location
C1.9	Inborn Metabolic Disorders Lab	1	
D	**RHSC Ambulatory Care**		
D1	RHSC Main Outpatients	2-(1 Ground Level 1 First Level)	In corridor In the D1 Area Reception Area
D9	Medical Day Care Unit – 5 Beds	1	Reception Area
H	**Academic**		
H2	Clinical Research Facility	1	Close to reception area
DCN SPECIFIC DEPARTMENTS			
L	**DCN In Patient Pathway/ Ward Care**		
L1	DCN Acute Care – 24 Beds	1	Staff Base closest to Resuscitation Room
L2	DCN Inpatients – 43 Beds	1	Near to MD Staff Office closest to PIU
M	**DCN Out Patient Departments**		
M1	DCN Outpatients	1	Reception Area
JOINT DEPARTMENTS			
P	**Combined Theatres**		
P1	Operating Theatres & RHSC Surgical Day Case Unit	2	1 location close to reception area in DCN & RHSC end.
Q	**Combined Radiology**		
Q1	Radiology	1	Located close to DCN Reception Area

7.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with SHTM 08-04 Pneumatic Tube Transport Systems and the requirements of current legislation, regulations and industry standards unless otherwise stated.

The Fire Protection Systems shall accord with all appropriate Scottish Health Technical Memoranda, Codes of Practice and relevant British and European Standards listed in SHTM 08-04.

The equipment supplied shall conform with all relevant standards and regulations in force. The equipment shall be supplied with relevant Declarations of Conformity to certify compliance with the EMC directive 89/336/EEC-92/31/EEC and the Machinery Safety Directive 89/392/EEC-91/368/EEC-93/44/EEC. Also the equipment and installation shall comply with all relevant statutory requirements in force at the time:

8.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

9.0 LIAISON

The Specialist shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, the Specialist shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Other Specialist. The Specialist shall liase with other specialist as necessary to ensure that all interfaces between the Fire Detection and Alarm System and other systems are allowed for. This shall include but not be limited to:-

- Building Management System specialist
- Fire Alarm and Detection specialist
- Security systems specialist

The Electrical Services Installer. The Specialist shall liase with the Electrical Services Installer to provide details of:-

3. PTS power supply requirements
4. Cable tray requirements

Building Control. The Specialist shall liase, with and adhere to, the requirements of the Building Control Officer.
Any other member of the Project and Board teams concerned with the planning and administration of the PTS.

10.0 SYSTEM DESCRIPTION

General

A PC controlled 160mm diameter pneumatic tube system (PTS) shall be installed in the RHSC-DCN with links to the existing building via the corridor link facility building.

The system shall be capable of transporting various liquids, solids and documents up to a load of 5kg at a speed of 5-6m/s. The system shall be capable of transporting all the items advised within a specified time limit. The overall performance and percentage usage of the systems capacity during a normal working day shall be demonstrated using a real-time simulation model if required.

The system shall be capable of supporting 21 transactions per hour not including the return of the capsules. The system shall have a 70% maximum system capacity.

A front end PC shall be provided complete with dedicated printer and web link for remote operation and analysis.

The system shall incorporate an advanced platform software control package with full automatic dual control redundancy to provide optimal flexibility, performance and convenience in the management and maintenance of the pneumatic tube system.

The controller shall have battery backup for system memory and status, and be capable of being remotely controlled through the PC.

The equipment shall be supplied and installed in accordance with SHTM 08-04, utilising optical carrier detectors, safety extra low voltage cabling to the stations, electronic positioning sensors, volt free contacts for BMS alarm status and fire alarm interface at the controller.

Configuration

The pneumatic tube system network shall consist of several individual zones or systems. It is a requirement that full intercommunication shall be possible between all zones and systems.

The equipment shall be configurable in any appropriate manner, and shall not be restricted to a single hub or interchange. The software shall be capable of allowing several interchanges to exist in a single network, and allow link-chaining of systems to allow carriers to be transferred between several systems between sender and receiver.

Where networks are configured to provide alternative routes between locations, the software shall intelligently decide the most appropriate route depending on operational circumstances.

Express (Power) Lines

Where destinations are more than 250m apart, the equipment shall be capable of incorporating “express” or “power” lines capable of transporting several carriers simultaneously in a single tube. These special systems shall be configured between transfer units or interchanges, or alternatively terminate directly at a station.

Stations

The stations shall generally be of front-loading design of the fully recessed pattern with a wipeable membrane type keypad. All connecting tubing and cables shall be concealed behind removable panelling.

A ‘spare carrier’ rack holding up to four carriers shall be wall mounted adjacent to the station.

The stations are to be designed to comply with the latest Health & Safety Regulations. Access to the station mechanism is to be protected by an electronically controlled opening/closing guard door with full mechanical interlock.

The stations in-built LCD display shall show:

Time and date
Carrier destination
The station the last carrier arrived from
Station status - ready, selection OK, out of use, maintenance, faulty, basket full, invalid address and purge.
The display shall also have a directory of all system station names and numerical addresses.

The stations indicators display shall show:

- A text message to prompt the user to enter the destination address.
- Text messages providing context sensitive operational guidance.
- Entered destinations shall display departmental names as well as numeric addresses.
- Ability to look up addresses on an in-built directory.
- Display of appropriate information messages.
- When appropriate, display that the station is out of use or on divert.
- Display a list of recently received carriers including carrier ID numbers.
- Display a list of recently dispatched carriers including carrier ID numbers.
- Display appropriate operational instructions when remote signal devices are used.

Stations shall be fully automatic and capable of accepting a carrier when another carrier is incoming to that station.

Destinations shall be addressed by the use of the 4 digit number or by accessing the station name through the directory.

Destinations may be restricted if required.

The destination setting can be optionally set to return to 1 of 3 settings after carrier has been sent:

Force new address input
Default to a pre-set address
Default to “last number re-dial”

Wrongly addressed carriers shall not be accepted by the system. A code reader at the station shall allow only carriers to be introduced into the system, e.g. objects such as cans shall not be accepted.

Incoming carriers shall be able to be re-directed to another station.

All stations shall be fitted with air control to ensure carrier soft arrival. This system shall provide total safety of even delicate glass samples.

The station shall automatically clear and eject a blocked carrier exit by agitating the station mechanism.

The station shall be set to automatically return a carrier to the station from where it has been received by use of a single keystroke.

Carriers shall be received into a basket with the exception of the station at the Reception desk, which shall be a cabinet. The cabinet shall have the ability to retain arriving carriers within the station which may only be released by PIN entry via the keypad, and the ability to secure the station against unauthorized use via a PIN code entered via the keypad Arrival signal units shall be able to be programmed to discriminate to different user addresses, thereby allowing urgent full carriers to be immediately notified to the user, whilst allowing no alarm for empty returns.

The use of the station shall be restricted by a user identifiable touch key and security card.

The station shall include an in-built carrier arrival indicator consisting of a warning bleep and light. The bleep is to be enabled or disabled as required at the station by the user.

Remote indicators shall be provided in some locations to indicate the arrival of a carrier at the station, as indicated in the schedule. The remote signal devices shall be configurable to sound different bleep patterns for different addresses to discriminate for priority arrivals. These are generally from the Clean Utility Rooms to the appropriate Staff Base and indicated on the Nurse Call Panel.

Carriers

Carriers shall be capable of carrying specimens, blood bags, medications and documents and shall be manufactured from transparent high impact resistant plastic material. Both ends shall have caps with “flip-swivel lids” and self-latching feature, preventing cap from opening during transportation inside the tubing. Carriers shall not have any metallic components.

Velcro type wear bands on both caps shall provide smooth travel and noise reduction. Each cap shall incorporate an elastic rubber bumper on the outside end for impact reduction.

Carriers shall be fitted with an RFID transponder in both ends of the carrier to avoid operators having to turn carriers during dispatch operation.

The following carriers shall be provided:

- 5 No. carriers per station
- 1 No. special cleaning carrier for dispersing cleaning agent throughout the system in the event of a spillage

Carriers shall be leak resistant to avoid the spillage of fluids outside of the carrier within the tube in the event of a breakage. Each carrier shall come complete with transponder technology that allows automatic redistribution and allow only correct carriers to be sent from any station.

Carriers shall be secured during both the send and receive operations.

Carriers & RFID

Every carrier shall be fitted with a RFID (radio frequency identification) transponder that uniquely identifies it.

Every station shall be fitted with a transponder reader so that the identity and location of every carrier is recorded on every transaction.

RFID shall enable the carrier to be individually identified on each transaction so that the following functionality is included as a minimum:-

- Automatically send the carrier to a carrier specific destination (e.g auto return to home location).
- Automatically send the carrier to a station specific destination (e.g auto send this carrier to A/E).
- Invoke a carrier specific priority.
- Prevent the carrier being sent to prohibited destinations. (e.g. prohibit Pharmacy carriers from being dispatched to laboratories).
- Automatically distribute the carrier according to station stock levels.
- Automatically remove the carrier from service after a pre-set number of transactions for cleaning/service.
- Re-allocate stock levels when auto-distribution is in use so that “walked” carriers are correctly accounted for without manual resetting of stock allocations.
- Identify the location of any specific carrier at any time.
- Prevent the dispatch of non-carriers (spurious payloads)

Main Control Unit.

The main control system shall incorporate the following features as a minimum:-

- Be a dedicated standard PC.
- The control software shall be installed onto Windows 7 operating system.
- The pneumatic tube system hardware shall be connected via the industry standard USB interface
- A back-up PC may be supplied so that the control PC may be quickly swapped by unplugging and re-plugging the USB interface. The back-up PC shall be pre-configured with all relevant software as a duplicate to the main PC.
- The control PC shall be configurable so that it may be accessed remotely either:- i) Through connection to a local network, or ii) via direct connection to the internet so that all PC functionality is available from several remote locations as required.
- The control PC shall be fitted with a UPS.

Control Software

The control software shall provide the following features as a minimum:-

- Automatic start up after power is switched on.
- Automatic recovery after power is restored from a failure such that all transactions are resumed.
- Overview of all operations in progress showing sending and receiving destinations, order time, transaction start time, transaction ID number, carrier ID number.
- Any systems/units in error or fault status shall be highlighted in a different colour to the rest of the display.
- Ability to allocate default (reject) stations at any location on the network, so that initially, in the case of error, delivery is attempted to a single location on the network. Secondary reject stations within individual zones and systems shall be available in case the single primary location is unobtainable.
- Automatic initiation of clearing (purge, freerun) cycles in case of error.
- Ability to initiate a manual clearing cycle (purge, freerun) selectable by individual station, individual zone or system or globally for the whole network.
- Ability to allocate priorities to individual stations, addresses and carriers as required.
- Timetable feature programmable for different times, days of the week, and holidays, so that priorities, diverting of transactions and enabling/disabling of stations may be carried out according to a predetermined schedule.
- The ability to make individual stations and/or addresses “invisible” so that they don’t appear on directories, to protect special stations and/or priorities from abuse.
- Password protected access to any service areas of the control software where configuration data may be entered.
- Individual remote control and monitoring of all elements of the network including e.g. station motors, switches, displays such that the whole network may be manipulated via the central PC control if required.

- A database of carriers available for use on the network which records: the number of transactions each carrier has made; the location of each individual carrier; the actual stock level of carriers at each station compared to the required stock.
- Provide connection facilities to fire alarms so that the system shuts down in the case of an alarm.
- Provide the facility for data exchange with BMS systems using an industry standard OPC interface so that individual and independent operation and fault signals can be transmitted if required.
- Provide the ability to freeze operation of the whole network in an emergency, stopping all operation.
- Provide a carrier stock control and management system so that each station may be allocated a specific stock of carriers that is replenished automatically according to demand using an automatic re-distribution feature. The transponder functionality shall ensure that stocks are automatically re-allocated if a carrier is “walked” between locations.
- The control software shall be automatically backed up.
- Configuration and data logs shall be transportable as a single back-up file.
- Provide the (optional) facility to broadcast operational and error status via email, SMS, pager, as required. This facility shall be configurable so that either all or only selective messages may be broadcast.

Management and Monitoring Software.

The installation shall be provided with a management and monitoring software application to allow analysis and audit of both active and historical transactions. The management software shall include the following features as a minimum:-

- Real time graphic schematic of the various systems and zones of the network showing transactions in progress in a graphical format.
- Real time floor plan graphic showing the locations of stations and diverters on individual floor plan “maps” so that the physical location of any unit in operation or fault may be easily identified.
- Carrier ID information for each station showing:- carriers recently dispatched; carriers recently received; carrier IDs of carriers currently at that station; present location of carriers allocated to that station.
- Presentation and print of textual and graphical information extracted from the transaction log. The software shall have the ability to filter by time, date, route, errors. It shall also be capable of displaying the efficiency of individual zones or systems and shall clearly identify the waiting time (queuing time), total transaction time, and transfer time for each transaction.

Error Management

The following features shall be included as a minimum:-

- Errors shall be recorded in text format in the transaction log.
- All errors shall be searchable using error type filters.
- A graphical representation shall be available showing the frequency of errors for specific time periods.

- A system in fault shall be highlighted in a different colour to systems in normal operation.
- Within the device directory the device(unit) in fault shall be highlighted in a different colour to stations in normal operation.
- Optionally, specific station/zone/network faults shall be capable of being notified via a remote alarm connected to any station on the network.

Optionally specific fault notification shall be capable of broadcast via email, SMS, pager or via the BMS system.

Diverters

Diverters may be mounted in any orientation and may be provided with 2, 3, or 4 ports depending on the design intent.

Diverters shall be installed so that service access is not impeded.

If required, diverters shall be capable of operating in such a way that they are able to manipulate the air stream away from sensitive areas as quickly as possible, and shall therefore be capable of operation with “active air”

The rest position of the diverter shall be capable of being easily changed directly from the PC through the control software.

Transfer Units (Interchange Devices)

Transfer Units or Interchange devices (other than simple diverter interchanges) shall provide the following features as a minimum:-

- Automatic transfer of carriers from one system to another.
- Ability to recognize priority carriers and process them more quickly than normal transactions.
- Modular construction so that the network may be expanded as required.
- Ability to connect directly to “Express” or “Power” lines capable of transporting several carriers simultaneously in a single tube.
- Have a throughput capacity in the order of 21 carriers/hour (not including the return of capsules).
- Provide a carrier reading device such that the individual carrier ID is logged during transfer.
- When carriers pass through the transfer device, have the ability to reinstate any carriers recognized by their individual ID to their correct transaction destination if they have been previously “rejected” through a clearing operation.
- The ability to prohibit specific transfer routes if required for operational reasons.

Blowers (Exhausters)

Blowers shall incorporate the following features as a minimum:-

- Be 3 phase units appropriate to achieve a carrier speed of 6m/s in all circumstances.
- Incorporate anti-vibration mountings.

- Have soft start using a frequency inverter.
- Incorporate speed/energy control through manipulation of the inverter.
- Provide filter screens on all inputs.
- Provide silencers for air noise reduction.
- Be provided with an appropriate air shifter/valves to control the blow and suck operations.

Tube

Tube shall be installed to the following specification:-

- Transmission tube shall be outside diameter 160 mm grey colour hard UPVC tubing specifically produced for pneumatic tube transport system according to standards DIN/ISO 8061/8062 and 6660/6661.
- Tube bends shall be manufactured from UPVC tube as specified above. Bend radius shall be 800 mm, measured from the bend centre line and shall allow passage of carriers with dimension 350 mm inside length x 120 mm inside diameter. Bends shall maintain a uniform cross-section free from wrinkles and distortions.
- Joints shall be manufactured with UPVC tube connecting sleeves that are solvent welded with special solving glue.
- Expansion joints shall be provided in locations where building movement or change of ambient temperature might cause dislocation within the UPVC tubing.
- All tubing in the system shall be adequately supported at appropriate intervals with suitable clips, rods attached to suitable fixing anchors. The maximum distance between supports shall not exceed 2.5 meters. Support also has to be provided at centre of bend radius and at equipment connections. Special brackets may be used where convenient. All supporting material shall be of galvanized steel suitably protected at cut edges.
- Where tubing passes through a wall or floor the integrity of the fire rating shall not be reduced. Intumescent (crushing) type fire sleeves shall be installed at all such points.

Cable

Cable shall be appropriate for the installation and shall have shielded data cables that ensure compliance with EMC legislation.

Cable shall be securely mounted on to the transmission tube using cable ties at appropriate intervals.

Static Electricity

The system shall be designed to minimise the build up of static electricity and facilities are provided to safely discharge to earth, such that neither system malfunction or nuisance is caused.

Condensation

The system shall be designed to minimise the potential for condensation caused by the movement of warm wet air through cold tubes. The location of air inlets shall be designed to reduce the potential for large temperature reductions on the air within the system, both during the systems peak operation periods, and during times when the system is only lightly used.

The “timetable” feature in the control system shall be capable of programming regular air movement through the system if required.

Web Link Monitoring

This shall enable external connection to allow remote technical support from the Facilities Management Department or any other external point.

Power Failure

In the event that a power failure occurs, the system shall automatically be reinitiated on restoration of power, and any carriers that are contained within the system shall be removed and taken to their pre-programmed destination or to the assigned ‘dump’ station.

Fire Alarm

In the event that the fire alarm system is activated in the RHSC-DCN building (either in a real event, by accident or a planned test) then the system shall close down following completion of any transaction in progress. In the event of a fire alarm activation within the RIE Pharmacy and Laboratories then links to these buildings shall be closed down. As and when the Fire Alarm is reset then the system shall be reinstated. This can be carried out either manually or automatically. A manual ‘test’ key shall be provided to override and disable this facility for fire alarm testing, so as to avoid disruption to the system operation. This is to be positioned at the main control location (to be agreed).

X31 Pneumatic Tube Transportation System

GENERAL

110 PNEUMATIC DOCUMENT CONVEYING SYSTEM: RHSC + DCN building

- Completion:
  - Plant and equipment identification: Mechanical plant and equipment identification.
  - Commissioning: Testing and Documentation

SYSTEM PERFORMANCE

210 DESIGN
- Design: Complete the design of the pneumatic document conveying system.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

PRODUCTS

310 STATIONS: Refer to drawings for locations.

EXECUTION

620A INSTALLING STATIONS
- Location: As indicated on the Architect's drawings
- Mounting heights (maximum):
  - Top, side and front entry stations: Top of cabinet 1.6 m above finished floor level.
  - Bottom loading stations: Bottom of station 1.2 m above finished floor level.

630 INSTALLING BLOWERS
- Location: A clean, dust-free environment isolated from: Areas in which patients may be sleeping or staff working.

640 INSTALLING DIVERTERS
- Location: In service areas with good access for maintenance.

650 INSTALLING PIPELINE AND FITTINGS
- Location: Routed in ducts and ceiling voids, where possible.
- Arrangement: Use large bend radii to avoid blockages.
- Fire stopping: Where tubing passes through a wall, floor, ceiling or other barrier, ensure that the fire rating of the construction is not reduced. Install crushing type intumescent fire sleeves or collars.

COMPLETION

910 CLEANING

- Blower air intake: Free of dust, vegetation, waste, rubbish, builder's debris, or any other possible source of contamination.
- Pipelines: Purge to an open end, and clear of any dirt, dust or debris accumulated during construction.

920 TESTING

- Pre-commissioning:
  - Manual operation of equipment;
  - Static measurements and functional tests of individual components ; and
  - Visual inspection.
- Prior to handover: Ensure:
  - Access to all parts of the system is satisfactory and safe.
  - All components function correctly.
  - Electric circuits are completed, tested and energized.
  - Correct direction of rotation for electric motors.
  - Interlocks are operative and in accordance with specification.
  - Plant and installations have been provided and installed in accordance with the design specification and drawings.
  - Plant installation is complete, insulation, if required, is applied, and ducts and pipelines are identified, as specified.
  - Area containing blower is clean and dust free.

930 DOCUMENTATION

O& M documentation shall be issued at least three months before completion of any part of the contract.

The contents and format shall be agreed with the Board. The document shall be issued/uploaded on Aconex.

The Specialist shall provide instruction to the clients Engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the Manufactures recommendations and best practice.

The Specialist shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

- Instructions: Submit operation and maintenance instructions for each station. .
- Label information: A directory of all available stations, clear step-by-step operating instructions, and action to be taken in the event of system failure.
- Record drawings: Provide:
  - Schematic diagrams of pneumatic air tube transport systems;
  - Schedules of blowers, stations, diverters, plant items, control sensors;
  - Schematic diagrams of control systems marked with set points; and
  - Traffic flow matrix.
- Programmes used by system: Submit full software listing.

Specification Check / Revision Sheet

Project	**RHSC-DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical**	Sheet	**WW AP.1.2.3 SMcK G1547**
Performance Specification Title	**Heating Systems**	Date	**August 2014**
Prepared By	**MM**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Update for Financial Close	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
HEATING SYSTEMS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by the Mechanical and Electrical Installer and is referred to in this document as Specialist.

To carry out the development of the design to form the installation, shall obtain the necessary supporting documentation.

This specification relates to the heating systems.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

Pumps

All motors shall be selected to provide the most energy efficient solution conforming to Section 6 regulations. All pumps shall be fitted with IE2 efficiency motors to EN 60034-30:2009 as standard, and suitable for operation in ambient temperatures of 40 degrees C.

2.0 SCOPE

The scope of work covered by this specification shall include, but not be limited to the following:-

- Boilers
- Pumps
- Pressurisation Units
- Chimneys (including secondary steelwork)

- Pipework and associated items
- Heating terminal devices
- CHP

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this specification:-

- BMS and automatic controls

4.0 INTERFACES AND DEMARCATIONS

The heating system shall be provided as a complete working system serving the hospital. Project Co. shall provide information to other parties including power supplies and fire alarm system interfaces.

5.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

The heating system shall accord with all appropriate Scottish Health Technical Memoranda, Codes of Practice and relevant British and European Standards.

The equipment supplied shall conform with all relevant standards and regulations in force. The equipment shall be supplied with relevant Declarations of Conformity to certify compliance with the EMC directive 89/336/EEC-92/31/EEC and the Machinery Safety Directive 89/392/EEC-91/368/EEC-93/44/EEC. Also the equipment and installation shall comply with all relevant statutory requirements in force at the time:

6.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

External Design Conditions

Winter	-	-6°C sat
Sizing for air handling plant		-10°C
Summer	-	26°C db 19°C wb
Sizing for refrigeration plant	-	30°C

System Design Conditions

LTHW Flow Temperature	-	80°C
LTHW Return Temperature	-	60°C
LTHW Operating Pressure	-	3.5 bar
Incoming gas pressure		65mbar
Limiting noise criteria at site boundary	-	Refer to Acoustic Consultant's report

7.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety Regulations.

Other Specialist. Project Co. shall liaise with other specialists as necessary to ensure that all interfaces between the Fire Detection and Alarm System and other systems are allowed for. This shall include but not be limited to:-

- Building Management System specialist
- Fire Alarm and Detection specialist

Any other member of the Project and Hospital Board teams concerned with the planning and administration of the heating system.

8.0 SYSTEM DESCRIPTION

Heating Installation

Heating for the building fabric, ventilation plant and hot water generation shall be derived from a Low Temperature Hot Water (LTHW) heating system.

The total heating load for the hospital site has been assessed at 5.6MW. For resilience purposes the boiler plant shall be arranged as two boilers duty with another standby boiler. The boilers shall be housed in the main Energy Centre to the South of the main hospital building to concentrate the maintenance of heavy plant away from the main hospital building.

To provide the 5.6MW load, the boiler plant shall comprise 3 No dual fuel LTHW boilers each sized at 3.2MW output giving a total available duty capacity of 6.4MW. Operation shall be on a 2 No. run. In the event of a catastrophic failure of a boiler the standby boiler shall be brought on line contribution which will allow the site to continue.

The boilers shall fire to maintain heat supply to primary LTHW heating circuits designed to operate at nominal system flow and return temperatures of 80ºC and 60ºC respectively. Temperature schedules and flow rates shall be introduced via the BMS control to enhance load matching and control regimes.

The boilers shall be of the shell and tube type with fully modulating dual fuel burners selected to provide efficient operation at varying load conditions in conjunction with sequence controls. Natural gas shall be the primary fuel. Emergency fuel shall be provided by gas oil. Both gas and oil supplies to the boilers shall have solenoid shut off valves linked to a fire detection system.

The boilers shall be arranged with reverse return flow and return headers and each boiler shall have its own primary circulating pump. A back end protection bypass shall be incorporated into each boiler assembly.

Each boiler shall have a matched flue gas economiser fitted to improve heat output efficiency.

Combined Heat and Power Plant

A natural gas fired combined heat and power (CHP) plant shall provide electricity (at Medium Voltage) and heat (85^{o}C Flow and 75^{o}C Return. A single gas fired CHP unit will provide 400kW electrical power and 600kW heating to reduce overall site CO2 emissions.(Refer to CHP specification WW AP.1.2.18 SMcK G1547).

Chimney

The boilers, CHP units and standby generators shall each have a stainless steel twin wall insulated flue, which shall exit the Energy Centre and terminate at a height to comply with the requirements of the Clean Air Act.

Project Co. shall allow for all supporting steelwork related to the flues.

Primary Heating Circuits

Primary heating circuits shall emanate from the Energy Centre arranged as A and B circuits fed from the respective boiler system. Each of the A and B pipework circuits is sized to provide the full hospital heating requirement.

The flow and return pipework shall be routed from the Energy Centre using accessible ground level ducts to enter the basement corridor system of the main hospital. At this point the A and B circuits shall join a header which, for resilience purposes, shall allow either A or B circuits to feed the hospital.

From the hospital header LTHW radial feeds shall run via the basement corridors and risers to the hospital's plant areas to serve heat stations and domestic hot water calorifiers.

The primary LTHW heating system (A and B) shall include the following elements:

- A common heating pressurisation plant with twin pump make-up plant and multiple expansion vessels to maintain the pressure in the heating system.
- Multiple circulation pumps (including one standby unit).
- A combined dirt separator/deaeration unit on the main flow pipework.
- The system shall be capable of being treated with corrosion inhibiting chemicals via a manual-dosing unit.

Two port control valves shall be provided on all of the major load centres to allow the use of variable volume control of the primary heating circuit. The circulating pumps shall be controlled by the BMS in sequence as needed to match the varying load demand. This shall maintain the pressure differential between flow and return pipework within set limits with sensors located within the main sub-distribution pipework. The system shall incorporate a number of three port constant volume valves to act as bypasses so that the minimum flow shall not be less than 40% of a single pump in operation.

In times of low heating load, one of the Boilers shall act as the lead boiler and with the CHP system provide heat to both the A & B circuits. The switching of one boiler, to the other, to act as lead, incorporating the CHP unit, shall be achieved by the opening and closing of various 2 port motorised valves.

A constant temperature flow and return will run from the energy centre to the air handling units located in the second and fourth floor plantrooms of the main building together with door curtains and duct mounted re heat coils.

Secondary Heating Circuits

From the heat stations installed within the plantroom areas, the secondary heating circuits systems shall emanate to serve specific zones of the hospital.

Each of the main secondary heating systems shall be self-contained to provide security of supplies between the various zones.

Each secondary heating system shall include the following elements:

- Run and stand-by secondary constant temperature circulation pumps.
- The system shall be capable of being treated with corrosion inhibiting chemicals via a manual-dosing unit.

The secondary constant temperature pumps shall circulate all the secondary water through the DHW calorifier integral heat exchanger with temperature control on the secondary side of the calorifier.

The main heating secondary flow and return temperature shall operate with a nominal design condition of 80ºC flow and 60ºC return.

The primary constant temperature system shall supply:

- The heating systems
- The various air handling unit heater batteries located throughout the associated plantroom areas and remote heater batteries as appropriate.

Two port control valves shall be provided on all the air handling unit heater batteries. This shall allow the use of variable speed control on the secondary constant temperature pumps to conserve energy and reduce carbon emissions. Pump speeds shall be varied by inverter motor control units which shall be controlled by the BMS to maintain the pressure differential between flow and return pipework within set limits with sensors located in the main sub-distribution pipework. The system shall not permit the secondary constant temperature pumps to operate at less than 40% of their design maximum.

The secondary heating circuit shall serve all the occupied areas heat emitters such as - radiant heating panels, low level low surface temperature heaters/ radiators and underfloor.

The local heat emitter valves shall generally be controlled by direct acting thermostatic radiator valves or electrically operated valves in conjunction with the room cooling devices, and, therefore, the secondary variable volume pumps shall be variable speed type with control via motor inverter unit, under the command of the BMS. BMS sensors and direct acting pressure differential units shall be installed in the secondary heating pipework system, as constant temperature system. The system shall not permit the heating pumps to operate at less than 40% of their design maximum.

The systems shall be divided into sections to allow individual wards and areas to be isolated from the main system for maintenance or shutdown.

Where departments are not operated on a 24 hour basis, the local heating circuits shall incorporate motorised valves controlled by the BMS on a timed basis, with optimised control to suit the particular occupation times.

All main and subsequent department branches shall be provided with balancing/measurement and isolation valves along with drain cocks, air vents etc. to ensure proper control and regulation of water flow rates under design load condition with flushing, draining and re-filling facilities.

Heat Emitters

Heat emitters shall generally be ceiling located providing inherent safety in respect of patient care. Where heat emitters are within touch of patients or the public, the emitters shall be of the low surface temperatures type with a mean surface temperature below 43^{o}C.

The majority of heating shall be by either ceiling radiant panels, LST radiators or warm air systems.

These solutions shall limit surface temperature to prevent scalding to patients and the general public.

The individual room heating emitters (radiant heating panels, radiators etc.) shall be provided with local direct acting control valves, to restrict the water flow on rise of air temperature and provide local control facility. These shall be occupant adjustable, within set parameters.

Where emitters are located in areas provided with unitary cooling or air conditioning, controls shall be integrated to minimise energy consumption while maintaining local control.

Certain large open areas of the building, for example, hospital main entrance, atrium and Pod atrium shall be provided with underfloor hot water heating systems.

Air curtains shall be provided above entrance doors to alleviate drafts.

Domestic Hot Water Calorifiers

Domestic hot water service semi-storage calorifier equipped with integral non storage heat exchanger shall be served directly from the respective LTHW primary heating main to provide rapid recovery and optimum storage capacity.

T10 HEATING SYSTEMS

120 LOW TEMPERATURE HOT WATER HEATING SYSTEM

The LTHW system shall run from the heat stations situated at various locations around the hospital and serve the various heating circuits and emitters.

- Type: Constant temperature circuits.
- Heat source: Via dual fuel boilers and CHP located in energy centre.
- Pressurisation units: As section Y20 and schedule.
- Feed and expansion tanks: As part of the pressurisation unit for air break.
- Pumps: As section Y20 and pump schedule.
- Pipelines: As section Y10.
- Pipelines ancillaries: As section Y11.
- Thermal insulation: As section Y30.
- Vibration isolation: Inertia bases, as section Y31 and advised by the acoustic consultant.
- Heat emitters: As schedules.
- Controls: As section Y40.
- Accessories: As specification.
- Completion:
  - Cleaning and chemical treatment: Flushing and chemical treatment, as section Y12.
  - Plant and equipment identification: Mechanical plant and equipment identification, as Section Y32 and schedule.
  - Commissioning: Commissioning of heating systems, as section Y50.

SYSTEM PERFORMANCE

Project Co. shall supply and install services and equipment to perform as per specification. Project Co. shall submit details of all mechanical equipment for comment and place orders in a timely fashion to ensure delivery as per programme.

Where a particular manufacture is specified, Project Co. shall include for a product of that quality and performance.

Where considered appropriate, provide for equivalent standard alternatives to be offered for consideration.

This must be done in a timely manner and Project Co. shall provide all details including but not limited to.

- Detailed description
- Cost comparison
- Technical comparison
- Energy and carbon performance impact
- References to standards
- References to SHTMs

275 VARIABLE FLOW PIPEWORK SYSTEMS

Where the LTHW systems utilise variable volume control systems they shall have differential pressure control valves (DPCV) installed as indicated on the drawings, and supplied and installed by .

The purpose of the DPCV is to automatically compensate for the rise in differential pressure across the circuit that it services, as the circuit flow rate falls under the dictate of the 2-port control valve(s), and vice versa.

DPCVs used in conjunction with motorised control valves and TRVs will be arranged to maintain a constant differential pressure across the circuit.

Project Co. shall, in conjunction with the BMS Specialist, liaise with the DPCV supplier to ensure the correct motorised control valve selections are made and the whole system is compatible in terms of operating pressure ranges, etc.

Similarly, Project Co. shall, in conjunction with the BMS Specialist also liaise with the pump supplier, to ensure that the pump speed control system is totally compatible between the 3 elements, i.e. DPCV, motorised/thermostatic valves and pump characteristic and control.

It shall be noted that the minimum pressure drop across combination of control valve, coil and interconnecting pipework system and accessories is to be 25kPa to suit operation of DPCV.

The maximum operating pressure of the control valve, coil and interconnecting pipework/accessories shall also be reviewed against the selection of the DPCV.

EXECUTION

Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety Regulations.

This shall include clean and tidy working and working in confined spaces.

Due to the size of the water systems being installed all pressure testing and commissioning equipment shall be cleaned and chlorinated before each use.

This is to prevent the systems from being contaminated with pseudomonas.

620 INSTALLING WATER BASED HEATING SYSTEMS

- Standard: To BS EN 14336.

COMPLETION

O& M documentation shall be issued at least three months before completion of any part of the contract.

The contents and format shall be agreed with the Board. The document shall be issued/uploaded on Acconex.

Project Co. shall provide instruction to the clients engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the manufactures' recommendations and best practice. Project Co. shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

Project Co. shall protect the system from damage or interference during the works. Project Co. shall Test, flush and clean the system as per section Y12, Y50, SHTM's and TR/20.

Project Co. shall submit O&M's.

Project Co. shall provide training as per section Y12, Y40 & Y50.

Project Co. shall provide spares as per section Y12, Y40 & Y50.

Project Co's. defects and liability period shall be as the contract prelims.

905 HYDRAULIC PRESSURE TESTING OF SYSTEMS

- Testing: In accordance with HVCA TR20 & TR/6. Also see section Y50.
- Notice (minimum): 1 week
- Pressure: 1.5 times working pressure (LTHW)
- Duration of test: 2 h.

920 OPERATING TOOLS

- Tools: Supply tools for operation, maintenance and cleaning purposes.
- Keys: Supply keys for valves and vents.

T20 GAS AND OIL FIRED BOILERS

380 DUAL FUEL FIRED STEEL SHELL BOILERS

The boilers shall be of the three pass shell and tube type with fully modulating dual fuel burners selected to provide efficient operation at varying load conditions in conjunction with sequence controls.

The entire boiler shall be clad within a heavy gauge sheet steel insulated jacket complete with inspection panels. The maximum case emission shall be no greater than 0.5% of the rated output.

Natural gas shall be the primary fuel. Emergency fuel shall be provided by gas oil to BS 2869 Grade D. The boilers shall have pressurised burners that operate on both fuels. Burners to be digital modulating with variable speed and air damper control and capacity control to achieve a high turndown ratio.

The burner shall be capable of operating safely at O_2 levels of less than 2% at high fire on gas through to 3.5% at low fire across the turndown range. On oil O_2 levels shall be 2.5% at high fire through to 4% at low fire.

Each boiler shall have a matched flue gas economiser fitted to improve heat output efficiency. The economiser shall be capable of being mounted as a stand-alone unit as well as directly attached to the boiler. Each economiser shall be fitted with an automatic motorised bypass unit which shall be activated when the boiler is operating on oil, or in the event of the economiser pump failing. This is to prevent damage to the economiser.

The boilers shall be arranged with reverse return flow and return headers and each boiler shall have its own primary circulating pump.

The boilers shall be supplied complete with burner attenuating hoods (refer to the acoustic consultants reports) to minimise noise breakout. Boilers or associated pumps shall not cause noise or vibration above that stated in this specification or SHTM's.

Safety blow of valves shall be piped to drain via a vented blowdown vessel.

All plinths/ anti vibration mounts shall be in situ prior to the delivery of the boilers so that the boilers can be sited in their permanent positions to prevent damage from moving.

- Standards: To BS 855, BS 2790 and BS EN 12953.
- Mounting: Floor mounted.
- Output (kW): As schedule.
- Seasonal efficiency: on gas 90% net excluding economiser
- Thermal performance testing: To BS 845-1.
- NOx emissions (maximum): Low NOx burner with oxygen trim control (<70mg/KWhr natural gas and <120mg/KWhr oil).
- Dual fuel burner: To BS 5885-1.
- Fuel: Natural Gas and Gas Oil to BS 2869 Grade D.
- Burner control: Modulating with turndown ratio on gas of 1:10
- Burner manufacturer – Dunphy, Weishaupt or Riello.
- Safety, control and monitoring of monobloc oil burners: To BS EN 230.
- Integral controls.

- Accessories: Both gas and oil supplies to the boilers shall have solenoid shut off valves linked to a fire detection system with battery back-up in the event of power failure, and:
  - Pressure gauge;
  - Safety valve; and
  - Temperature gauge.

A boiler instrumentation panel shall be provided and shall incorporate:-

On/off switch,
Control thermostat,
Limit thermostat (automatic reset),
Thermometer.
Burner enable relay
Safety controls/burner, water flow interlocks
Modulating controller
Remote fuel change over switch
Gas/oil key switch
Motor/control relay fuses
Valve proving lamp
Indicating Lamp for both gas and oil;

- Burner on
- Burner lock-out/fault
- Boiler excess temperature
- Gas pressure/valve proving system fault
- Gas fault
- Re-set button
- % Firing rate indicator.

Some of the above features may be duplicated on the burner control panel as described below. The burner controls shall take precedence and the duplicated elements of the boiler controls may be omitted.

The boiler control panel must be capable of being fully interrogated by the building management system through the independent network protocol.

The direct digital combustion control system shall incorporate the following features:

- membrane keypad
- programmable sequence timing control for pre-purge, ignition and post-purge
- controls fuel safety valves, ignition circuit, oil pump and fan motor
- gas and oil valve proving and leakage detection systems with continuous pressure monitoring and alarm limits
- proof of closure system for fuel valves
- choice of operation with or without pre-purge or post purge
- pilot with or without main valve
- programmable thresholds for pilot and main flame
- primary and secondary air pressure monitoring
- simultaneous firing capability

- range of self checking, fail-safe boiler pressure and temperature sensors
- servo drives on each system (power rating restricted)
- fuel/air ratio control with independent control of each valve controlling servo
- valves and dampers may open and close within the modulating section of the profile
- multiple fuel profiles
- profile change while firing
- PID for control of modulation rate from boiler sensor
- auxiliary modulation / set-point input, suitable for modulation from BMS
- adjustable boiler warming limit and period
- fail safe digital inputs for alarm / shut-down / lockout– e.g. high/low water, low oil temperature etc. with annunciation on display
- programmable relay outputs + Alarm/Fault relay
- real time clock
- hours run logged per profile
- diagnostics and 1at least 100 event history log (fault history)
- auto / manual modulation
- Comview access for commissioning data and boiler/burner data display
- variable fan speed control
- Oxygen trim

A burner mounted control cabinet shall house all primary components:

- ignition unit
- starter for oil pump
- The cabinet shall be hinged to provide access to the internal components.
- All necessary relays and circuit breakers

The digital burner management system shall control the burner by an electronic air /fuel ratio control system giving direct digital control of the air and fuel drives including motors for the air inlet damper, gas butterfly valve and oil metering valve. The accuracy of the servo motors shall be controlled to 0.1 degrees angular.

- PT 100 Modulating temperature controller
- Modbus RS 485

The oxygen and monitoring trim system shall monitor flue gas oxygen and temperature levels and provide closed loop oxygen trim control including:

- Oxygen analyser probe complete with: -
  - zirconia cell
  - in-built probe heater
  - probe mounting boss
  - air inlet temperature sensor
- Oxygen probe interface unit providing indication of: -
  - oxygen level
  - flue gas temperature
  - burner inlet temperature
  - calculated boiler efficiency

The burner gas train constructed to BS EN 161 including:

- Gas line inlet filter
- low gas pressure switch
- high gas pressure switch
- twin gas valve actuators
- valve proving system
- gas pressure test points
- terminal connection box

400 AIR SUPPLY TO APPLIANCES

- Standards: To BS 5440-2 and BS 6644.
- Sizes The boiler house shall have natural ventilation openings for combustion and ventilation in accordance with BS6644/1990.
- Location: See Drawings.

EXECUTION

Project Co. shall protect boilers from damage or interference during the works.

Project Co. shall include for the services of the presence of the boiler and burner manufacturer's skilled services engineers to start up, test and check all burner/boiler controls. The units when commissioned, shall be "Set Up" to give maximum combustion efficiency of no less than 80% when the draught over the combustion space has been regulated within the limits laid down by the boiler manufacturer. Flue gas outlet temperatures shall require to be recorded at this stage, together with all relevant details necessary to ascertain the efficiency of the plant. All of the testing shall be carried out by 's appointed specialist and then witnessed by the Board's appointed representative before the boiler plant shall be accepted from the Board. A complete set of boiler flue cleaning tools shall be supplied complete with wall mounting rack and fixings. Project Co. shall allow for instruction of the clients representative on the working of the boiler plant.

610 INSTALLING BOILERS

- Standards:
  - Gas fired boilers: To BS 6798 and BS 6644.
  - Oil fired boilers: In accordance with BS 5410.
- Fixing of equipment, components and accessories: Fix securely on purpose-made bases or supports.
- Preparation: Immediately before installation of lagging and casing, pressure test joints.
  - Results: Submit.
- Space around the boiler: Adequate:
  - to ensure sufficient air circulation for draught diverter operation;
  - to ensure sufficient air for combustion and cooling; and
  - for maintenance and servicing.
- Location: Minimum 75 mm from combustible material.
  - Access: Provide for inspection and servicing of boilers and ancillary equipment.

T30 HEAT EMITTERS

PRODUCTS

All elements of the work shall be in accordance with the requirements of current legislation, regulations and industry standards.

The installation shall also comply to the SHTM code of practices and relevant British standards.

Project Co. shall allow for supplying samples and constructing mockups for comment.

This shall include ceiling mockups for the radiant panels.
All emitters must be selected to meet the schedule and specification with particular reference to noise criteria.

All emitters shall have smooth easy clean surfaces with no sharp edges or dirt collecting gaps.

All emitters shall be suitable for hospital application.

Access doors and hatches shall be provided to service and maintenance purposes.

310 AIR CURTAINS

Warm air curtains shall be provided in entrance areas to avoid draught. All units shall be fed from the LTHW system.

The air curtain shall be suitable for the mounting height. Grilles to be powder coated to Architect's specification.

Heat exchanger tube material to be copper, fin material: aluminium.

Connections to be terminated externally on recessed models and hidden within the unit on exposed models.

All coils pressure tested to 22 bar (350 lbs/in2).

Fans to have a unit mounted two-speed switch.

Unit to be fitted with air flow device to alarm BMS in case of fan failure.

- Method for testing and rating: To BS 4856-1,-2,-3 and -4.
- Type: LTHW Water.
- Requirements: As air curtain schedule.

340 NATURAL CONVECTORS LOW LEVEL

Low level convectors shall be cased copper fined tubes with extruded aluminium grilles suitable for hospital applications.

The emitters will be of the low surface temperatures type with a mean surface temperature below 43°C.

Final sizes of convectors to be site measured by and made to order.
Control shall be via thermostatic radiator valves.

- Standards: To BS EN 442-1, -2 and -3.
- Requirements: As Natural convector schedule.
- Third party certification to RADMAC scheme: As BS 442.

355 RADIANT PANELS

Radiant panel shall be lightweight, manufactured from Aluminium plate and have copper tube pathways and have foil faced Class O encapsulated insulation fitted at the back of the panels. Radiant panel shall be suitable for ceiling type.

All panels to be of modular length to suit 600 mm ceiling tile arrangement. Strengthening sleeves should be used with compression fittings.

Any junctions between panels to be covered by a purpose made cover plate which allows for any panel expansion.

The panels shall come complete with necessary supports, headers, drains, vents, or panel interconnectors.

The face plate to be attached by an extrusion to a copper pipe grid which shall provide plain copper ends for connecting to the heating system. The extrusion shall allow for differential thermal movement when attached to the face plate without distortion.

Each panel shall have a set of plain copper ends for connection by the aub-Board.

The panel connections shall avoid excessive pressure drops.

The panel manufacture shall supply all flexible interconnections between panels where required.

In locations where no other forms of heating or cooling is supplied the panels shall be fitted with an isolation valve on the return and a TRV on the flow.

Where panels are fitted in a location with other forms of heating or cooling the panel shall be controlled via a motorized two port valve and wall-mounted room sensor.

The faceplate of the panels shall be continuously supported by a trim to allow support and thermal movement without distortion of the face plate.

The edge trim shall be supported of the perimeter wall by suitable fixings.

Project Co. shall provide a typical ward layout drawing and install a mock up as part of the contract. The mock up installation type shall be agreed upon before final installation commences. Ral colour by Architect

- Standard: To BS EN 14037-1, -2 and -3.

380 TRENCH HEATING

Trench heating shall be cased copper fined tubes with extruded aluminium grilles suitable for hospital applications.

Final sizes of convectors to be site measured by and made to order
The depth of the trench heating is to be co-coordinated with the Board to ensure the trench heating is flush with the finished floor surface.
Control shall be via two port valves with room thermostats.

- Standards: To BS EN 442-1, -2 and -3.

EXECUTION

Project Co. shall protect the emitters from damage or interference during the works.

Project Co. shall supply and install services and equipment to perform as per specification. Project Co. shall submit details of all mechanical equipment for comment and place orders in a timely fashion to ensure delivery as per programme.

Where a particular manufacture is specified, Project Co. shall include for that manufacturer.

Where considered appropriate, provide for equivalent standard alternatives to be offered for consideration.

This must be done in a timely manner and Project Co. shall provide all details including but not limited to.

- Detailed description
- Cost comparison
- Technical comparison
- References to standards
- References to SHTM's

610 INSTALLATION GENERALLY

- Fixing: Securely and parallel or perpendicular to the structure of the building.
- Stud walls: Fix to studs and/ or noggins.
- Isolating valve: Provide on flow pipelines.
- Regulating valve: Provide on return pipelines.

620 INSTALLING UNIT HEATERS AND AIR CURTAINS

- Suspension: Fix high level supports.

T42 UNDERFLOOR HEATING

PRODUCTS

All elements of the work shall be in accordance with the requirements of current legislation, regulations and industry standards.

The installation shall also comply to the SHTM code of practices and relevant British standards.

A proposed drawing list shall be submitted by .
All items of heating plant and system controls must be capable of being fully interrogated by the building management system through the independent network protocol.

310 LOW TEMPERATURE HOT WATER UNDERFLOOR HEATING

- Standards: To BS EN 1264-1.
- Manufacturer: Project Co. choice

Project Co. shall employ a specialist underfloor heating company to design the layout, supply and install the underfloor heating where shown on the drawings.

The construction drawings shall be sent to the Board at an agreed period prior to installation.

The manifold shall be easily accessed for servicing with the minimum disturbance to the running of the hospital.

The underfloor heating shall be five layered polybutylene pipework fixed to the insulation, covering the area. All materials used I the construction of the pipework and insulation shall be free from CFCs, HFC's or HCFC's

A compatible screed shall be applied to the whole floor area, encasing the pipework.

The screed over the pipework shall be as manufacture recommendations and shall have expansion joints. Screed cover and drying times must be adhered to.

The system shall have a mixing modular manifold to allow for the lower water temperatures for the underfloor heating system and to disturbed the heating medium.

- Product reference: As schedule.
- Pipes: To BS 7291 or DIN4726.
- Material: Polybutylene (PB).
- Floor type: Solid.
- Maximum floor surface temperature:
  Floor surface temperatures shall not exceed level that will cause discomfort or damage the floor. Recommended temperatures are:
  Occupied areas 29^{o}C
  Peripheral areas 35^{o}C

- Accessories:
  - Flow control valve;
  - Manifold; and
  - Regulation valve.
- Water temperature control unit: Part of the manifold system.

Room temperature control: The underfloor heating shall be controlled by tamperproof room thermostats.

- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

EXECUTION

Project Co. shall ensure the area where the underfloor heating has been installed is clearly marked and protected to prevent damage from drilling or impact to the floor.

610 INSTALLATION

- Standard: To BS EN 1264-4.
- Fixing of manifold: With access for regulation and maintenance.
  - Location: Away from areas sensitive to noise.
- Fixing of pipes: A proprietary fixing system to locate pipes accurately until floor finish is laid.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.10 SMcK G1547**
Performance Specification Title	**Dry Riser and Sprinkler System**	Date	**August 2014**
Prepared By	**DW**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Update for Financial Close	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
SPRINKLER SYSTEM

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The design, manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by the a specialist fire protection Installer and is referred to in this document as “specialist”.

To carry out the development of the design to form the installation, Project Co. shall obtain the necessary supporting documentation.

This Performance Specification relates to the Fire Fighting Systems.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

Pumps

All pumps shall be fitted with IE2 efficiency motors to EN 60034-30:2009 as standard, and suitable for operation in ambient temperatures of 40 degrees C.

2.0 SCOPE

The scope of work covered by this Performance Specification shall include, but not be limited to the following:-

- Dry Riser Systems
- Automatic Sprinkler Systems

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Specification:-

- Fire detection and alarms
- Gas suppression systems
- External fire hydrant systems
- Helipad foam fire suppression system
- Energy Centre foam protection system.

4.0 INTERFACES AND DEMARCATIONS

The fire fighting systems shall be provided as complete working systems serving the new building with interface with existing system serving Main Hospital Building and. Project Co. shall provide information to other parties including for power supplies and fire alarm system interfaces with the existing Main Building System.

5.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

The Fire Fighting Systems shall accord with all appropriate Hospital Technical Memoranda, Codes of Practice and relevant British and European Standards, LPC Rules, Building Control, Scottish Water Regulations.

6.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400 / 230 V, 3 phase, 50 Hz 230 V, 1 phase, 50 Hz.

The dry riser system shall generally comply with BS9990.

Generally the sprinkler installation shall comply with the requirements of BS EN 12845:2004 + A2:2009 and LPC Rules for Automatic Sprinkler Installations 2009, life safety, and comply with the requirements of BS 9999:2008 with the following criteria:

Life Safety
Hazard classification = OHI (TBC by Sprinkler Designer)
Minimum density of discharge = 5mm/min
AMAO = 216m²
System types = wet automatic
General Sprinkler temperature rating = 68°C
Sprinkler head type: Quick Response
Single sprinkler coverage = 12m²
Highest sprinkler = 30 metre between highest and lowest.

7.0 LIAISON

Project Co. shall include for liaison with:

Health and Safety Professionals. As well as the Health and Safety requirements of Parts A, B and C of this specification, the Specialist shall include for close liaison with Health and Safety professionals including the Trust's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Other Specialist installers. The Specialist shall liaise with other Specialists as necessary to ensure that all interfaces between the Fire Fighting Systems and other systems are allowed for.

Any other member of the Project and Trust teams concerned with the planning and administration of the fire fighting systems.

8.0. SYSTEMS DESCRIPTIONS

Fire Fighting Systems shall comprise of the following:-

1) Dry riser System
2) Automatic sprinkler installation

DRY RISER SYSTEM

A dry riser main shall be provided in each of the 6No protected fire fighting cores. Dry riser landing valves shall be provided on each floor landing of the fire fighting cores and the dry riser main shall extend down to basement level to serve landing valves.

Dry riser landing valves shall also be provided to serve each plant room.

Dry riser inlet boxes shall be located at the ground floor perimeter of the building to serve their respective fire fighting cores. The inlet boxes shall contain a two-way or four way dry riser inlet breeching pieces and shall complete with a 25mm diameter drain valve.

Air release valve shall be provided at the top of each riser.

Each breeching piece shall be contained within a vandal resistant box complying with the requirements Where inlet valve boxes are located in areas of aesthetic consideration an Architectural infill to the box front shall be provided as described with the equipment schedules.

Dry riser mains shall be electrically earthed. Any points which do not provide electrical continuity shall be bonded.

AUTOMATIC SPRINKLER INSTALLATION

Sprinkler System Strategy Description

A Sprinkler System shall be provided to protect the departments as detailed in the final agreed fire strategy document.

An Ordinary Hazard level of protection as described within BS EN 12845 shall generally be provided to all hospital areas identified as high hazard or adjacent area within Fire Engineering Report.

Areas that shall not be automatic sprinkler protected and these include:

- Hub Rooms
- Computer Rooms
- Sub Stations
- Areas out with those highlighted in the fire strategy

Other areas to be identified on final agreement of the Fire Engineering Report and Strategy document.

An unmetered mains water supply shall provide water to the sprinkler storage tank and shall be provided as part of the fire water main to the site. The main shall be trace heated as it enters the basement. Water storage shall be provided by 70m^3 full capacity storage in a dedicated split tank within a dedicated fire protection water tank room, situated in the plant zone in the basement of the building. Water Storage tanks to be LPC approved

Duplicate electric run/standby pump sets shall be provided to satisfy the system demand pressure as detailed in BS EN 12845:2004 + A2:2009. Both pumps shall be fed from the general electrical distribution system and off the essential services generator supported supply.

A small jockey pump shall be included in the automatic sprinkler pump set to maintain static pressure on the system. Test water shall be returned to the tanks for water preservation purposes.

Each pump shall be arranged to draw water from either tank section and arranged so that any one pump or either tank section can be isolated.

All sprinkler main installation control valves, dual sprinkler pumps and valves sets etc shall be housed within the tank room. From the sprinkler tanks water shall be pumped via sprinkler mains running in the basement corridors to run to main service risers to rise and be distributed to the various sprinkler protected areas on the upper floors.

All sprinklers system signals must be interfaced into the BMS for monitoring and maintenance purposes. Sprinkler heads shall be pendant bulb type with brass finish in plant and other associated areas, and chrome or white finish in hospital areas. Sprinkler heads shall be either exposed or semi-recessed and of the quick response type. All sprinkler heads shall be nominally 15mm diameter. On a floor where sprinkler protection is required there shall be suitably sized branch lines from the riser with flow switches and drain lines. All sprinkler heads on the local pipe ranges shall be fast response heads set at $68^{O}C$, but consideration shall be given to the likelihood of a raised ambient temperature in special process areas, where a localised hot spots could result in $68^{O}C$ being exceed.

Testing procedures shall be carried out by an LPC qualified installer and shall consist of a dry pipework test involving a charge to the system with water to a pressure of 2.5 bar (250 kPa) which shall be maintained for a 24 hour period. During this period inspect the system to check that no water leaks at joints or valves.

Standards

The Sprinkler System will be designed, installed & commissioned to comply with the intent of the following:-

- IHSL Fire Strategy Document
- SHTM82 Supplement 4
- SHTM/HTM 05-01
- BS EN12845:2004
- BS 5306 Part 2:1990
- LPC Rules for Automatic Sprinkler Installations 2009
- EMC Directive 89/336/EEC

Sprinkler Equipment and Facilities

Tanks

Standard: To BS EN 12845.

The tanks shall be sectional steel type construction free from suspended fibrous or other matter, which may accumulate in the system pipework and provided with suitable isolating valves (interlocking key type) and drain points.

Pump Sets

Duplicate electric run/standby pump sets shall be provided to satisfy the system demand pressure as detailed in BS EN 12845:2004 + A2:2009. Both pumps shall be fed from the general electrical distribution system and off the essential services generator supported supply.

A small jockey pump shall be included in the automatic sprinkler pump set to maintain static pressure on the system.

Pipework

Standard: To BS EN 12845.

Wet installation pipework shall be carbon steel tube with appropriate screwed fittings or mechanical grooved couplings and prefabricated welded sections.

All pipeline materials including any pipeline ancillaries shall be as listed and approved by the LPC.

The pipework for the sprinkler installations will be black coated steel medium weight to B.S. 1387 or BS EN 10255.

Valves will be black steel or galvanised heavyweight, depending on the requirements of the local water authority.

The fittings would be malleable iron, cast iron or welded.
From 65 mm diameter and above grooved coupling will be used.

The necessary pipe support brackets for hanging the pipework are included and will comply with the BS EN 12485 requirements for spacing and size of the components.

Sprinkler Heads

Standard: To BS EN 12259-1

The installation shall be upright or pendant in line with the architectural finish of the ceiling or void. The heads shall be chrome or white finish in hospital areas and brass where located in exposed areas such as Plant rooms.

Where appropriate the heads shall be fitted with the deflector parallel to the slope of the roof, ceiling or pitch line of the stairs and plant electrical distribution equipment.

Sprinkler heads shall be pendant bulb type with brass finish in plant and other associated areas, and chrome or white finish in hospital areas.

Temperature rating: Normally 68C, in areas of high ambient temperatures, sprinkler heads with a higher temperature will be used.

Valves

The Sprinkler System will be controlled by wet pipe control valves tested and approved to L.P.C. standards each comprising a 150mm alarm valve with flanged or grooved connections, a 150mm butterfly valve, two 100mm diameter dial pressure gauges and cocks, an alarm trim, a drain valve and butterfly valve and flow switch.

Pressure Gauges

100 mm diameter Pressure Gauges to be installed as per SHTM/HTM 05 and LPC Rules for Automatic Sprinkler Installations These will be manufactured and installed to BS EN 837-1.

The gauges shall be installed immediately downstream of the tail end valve but upstream of any subsidiary stop valve; between the supply pipe stop valve and the check valve on a town main connection; and downstream of outlet check valve and upstream of outlet stop valve on pump supply.

Trace Heating

Exposed incoming pipework shall be trace heated to provide frost protection to maintain a minimum water temperature at 4°C.

Identification and Labelling
Labelling shall be to BS 1710, BS 5499-1 and BS EN 12845. A location plate shall be provided on external wall as close as practical to the entrance nearest the installation main control valve set. Label signage shall be provided for stop valves, incorporating the main and any subsidiary stop valves. Sprinkler heads shall include the orifice size on sprinkler body or deflector.

Monitoring & Alarms

All sprinklers system signals must be interfaced into the BMS for monitoring and maintenance purposes. Alarm indication shall alert on the BMS panel, Fire Panel, Main reception and Security office

All the monitored sprinkler equipment such as pumps valves and flow switches will be wired to an addressable panel. A flow alarm switch will be provided on the alarm valve riser to give remote alarm indication.

A water motor alarm gong will be supplied with the alarm valve. All the stop valves will be completed with a tamper switch. The installation of the gong will be on the outside of an exterior wall.

Each zone valve and flow switch will be connected to an I/O box wired to the addressable panel and fire detection system.

Specialist Systems

Fire suppression systems such as the Foam Extinguishing System to the Helipad and the FM200 type gas suppression to the Server rooms are provided as a separate package provided by a specialist contractors.

These systems do not form part of the sprinkler system installation, but shall be integrated with the Fire Alarm and BMS panels in event of operation.

User Interface

A specialist sprinkler maintenance contractor shall perform the routine maintenance activities on the sprinkler installation.

Day to day operation of the system will involve monitoring of the installation status via the dedicated sprinkler control panel and the interfaces with the BMS and Fire Alarm system.

Training and O&M information shall be provided during the commissioning and handover period of the construction.

MATERIAL AND WORKMANSHIP CLAUSES

S61 Dry riser systems

To be read with Preliminaries/ General conditions:

109 GENERAL: The Board shall employ a specialist Board to design, supply and install the dry risers.

110 DRY RISER SYSTEM: [Shall be located in the protected fire cores]
Inlet breechings: [Twin inlet breeching for 100 mm nominal bore riser].
[Four way inlet breeching for 150mm nominal bore riser].
Distribution pipelines: Heavy quality galvanized wrought steel pipe.
Outlets: Landing valves.
Accessories: [As specialist Board schedules].

209 SYSTEM PERFORMANCE:
All drawings and calculations for the dry riser system shall be issued to the Consultant and Fire Officer for comment two weeks before programmed construction commences.

210 DESIGN:
Standards: In accordance with CIBSE Guide, volume E and BS 9990.
Design: Complete the design of the dry riser system.
Proposals: Submit drawings, technical information, calculations and manufacturers literature.

310 INLET BREECHINGS AND BOXES: [5No]
Standard: To BS 5041-3.
Type: [Two way] + [Four way]
Manufacturer: [Board's choice].
Product reference: [Board's choice].
Integral accessories: Instantaneous inlet coupling, cap and chain, drain valve, non return valve.
The two-way + four way inlet breeching valves shall be contained within a valve box to a pattern and colour approved by the Architect. The box is to be marked "FIRE MAIN INLET – DRY RISER".

320 LANDING VALVES AND BOXES: [To all floor landings, plant rooms and basement level]
Where the landing valves are required to be contained within a landing valve box, the pattern and colour shall be approved by the Architect. The valve box shall be marked "FIRE MAIN OUTLET – DRY RISER".
All valve boxes in risers shall be provided with fire protection cladding, to give fire integrity protection to match the riser wall specification, in accordance with Building Control requirements.
Landing valves: To BS 5041-2.
Outlet boxes: To BS 5041-4.
Type: [Board's choice].
Manufacturer: [Board's choice].
- Product reference: [Board's choice].
Integral accessories: Cap and chain, leatherstrap.
Other accessories: [Board's choice].

330 COUPLINGS:
Standard: To BS 336.
Type: [Board's choice].
Manufacturer: [Board's choice].
- Product reference: [Board's choice].

340 CAPS AND CHAINS:
Standard: To BS 336.
Manufacturer: [Board's choice].
- Product reference: [Board's choice].

350 DRAIN VALVES:
Standards: To BS 5154 or BS EN 12288, rating PN 16, and BS 5041-3.
Type: Gate valve.
Manufacturer: [Board's choice].
- Product reference: [Board's choice].
Size: 25 mm.
Handwheel: Provide with leather securing strap and notice.
Accessories: Cap and chain.

360 AIR RELEASE VALVES:
Manufacturer: [Board's choice].
- Product reference: [Board's choice].

370 NON-RETURN VALVES:
Type: [Board's choice].
Manufacturer: [Board's choice].
- Product reference: [Board's choice].

380 LEATHER STRAPS:
Manufacturer: [Board's choice].
- Product reference: [Board's choice].
Width (minimum): 12 mm.
Thickness (minimum): 2 mm.
Accessories: Small non-ferrous padlock with keys.

609 EXECUTION:
The Board shall clean, flush and test the system as per regulations, SHTM, BS 9990, this specification and to the Fire Officer's requirements.

620 INSTALLING INLET BREECHINGS:
Location: Within 18 m and within sight of access road.
- Unrestricted access: Required.
Length of connecting pipework between the inlet and the vertical run of the main riser: Minimize.
Fall: Towards the drain valve.
Inlet box mounting height: Lower edge400 - 600 mm above ground level.
Inlet boxes: Identify with permanent signage.

630 INSTALLING PIPELINES:
Appearance: Install pipes straight and parallel or perpendicular to walls, floors, ceilings, and other building elements.
Dirt, insects and rodents: Prevent ingress.

Access: Locate runs to facilitate installation of equipment, accessories and allow access for maintenance.
Changes in direction: Provide standard bends. Do not use elbows.
Pipelines finish: Smooth, consistent bore, clean, free from defects, e.g. external scratching, toolmarks, distortion, wrinkling, and cracks.
Joints, bends and offsets: Minimize.
Drains and vents: Fix to falls. Provide draining valves at low points and vents at high points.
Electrical equipment: Install pipelines a minimum distance of 300 mm from electrical equipment. Do not run pipelines through electrical plant areas or above switchgear.
Fixing: Secure and neat.
Pipeline support: Prevent strain, e.g. from valve operation.
Thermal expansion and contraction: Allow for thermal movement of pipelines. Isolate from structure. Prevent noise or abrasion of pipelines caused by movement. Sleeve pipelines passing through walls, floors and other building elements.

640 INSTALLING LANDING VALVES:
Mounting height above floor level to underside of landing valve: 750 mm.
Testing: Provide an outlet at roof level.

650 IDENTIFICATION AND LABELS:
Standards: To BS 1710 and BS 5499-1.
Valve labels: Provide stating function.
Drain valve identification: Provide notice stating ‘Dry riser drain valve’.

909 COMPLETION:

910 FLUSHING:
Operation: Fill the system with water and discharge it via the topmost outlet. Flush out debris.

920 TESTING:
Testing: In accordance with BS 9990.
Notice before testing (minimum): 3 days.
Static pressure test: Charge the system with water to a pressure of 1000 kPa. Maintain for 15 minutes. During this period, inspect the system to check that no water leaks at joints or landing valves.
- Results: Submit.

Flow test: Pass water through the system under pressure and record flow gauge readings.
- Timing: After static pressure test.
- Results: Submit.

930 SETTING TO WORK:
Operation: Check operation of non-return valves.
Make ready: Drain system and leave ready for use.

940 DOCUMENTATION:
Manufacturers’ operating and maintenance instructions: Submit.
Test records: Submit a record of inspections and tests.
Record drawings: Submit drawings showing location of pipe runs, inlets, landing valves and drain valves.

950 OPERATING TOOLS:
Tools: Supply tools for operation, maintenance and cleaning purposes.
Keys: Supply keys for padlocks and air release valves.
- Quantity: As per contract requirements.

S63 Sprinkler systems

GENERAL

Project Co. shall employ a licensed specialist to design and install the sprinkler system.

Fire Protection Services shall be provided to protect the building to meet the requirements of SHTM/HTM05, the Fire Officer, Building Control, LPC Rules for Automatic Sprinkler Installations and the current Fire Safety Design Strategy.

All items of Sprinkler plant and system controls must be capable of being fully interrogated by the building management system through the independent network protocol.

The system will protect the building from serious fire damage.

110 SPRINKLER SYSTEM

All areas identified as requiring sprinklers shall be ordinary hazard group 1 life safety.
(TBC by Sprinkler Designer)

Test water shall be returned to the tanks for water preservation purposes. From the sprinkler tank(s), water shall be pumped throughout the building and distributing to the various sprinkler protected areas via the main service risers; from dual electric run/standby pumps both supported off the standby diesel generator. A small jockey pump shall be included to maintain static pressure on the system.

Where sprinkler protection is required, there shall be suitably sized branch lines from the riser with flow switches and drain lines. All sprinkler heads on the local pipe ranges shall be fast response heads set at 68oC, but consideration shall be given to the likelihood of a raised ambient temperature in special process areas and could result in 68oC being exceed.

Wet installation pipework shall be carbon steel tube with appropriate screwed fittings or mechanical grooved couplings and prefabricated welded sections.

All pipeline materials including any pipeline ancillaries shall be as listed and approved by the LPC.

All sprinklers system signals must be interfaced into the BMS for monitoring and Maintenance purposes.

- Classification to BS EN 12845: As specialist Board schedules.
- Type: As specialist Board schedules and specification.
- Sources: As specialist Board schedules and specification.

- Distribution below ground: As specialist Board schedules and specification.
- Distribution above ground upstream of alarm valve: As specialist Board schedules and specification.
- Distribution above ground downstream of alarm valve: As specialist Board schedules and specification.
- Outlets: Sprinkler heads.
- Accessories: As specialist Board schedules and specification.
- Completion: As specialist Board schedules and specification.

SYSTEM PERFORMANCE

All sprinkler pipework exposed to the frost will be insulated or trace heated to prevent freezing.

All drain valves will be fitted at each lowest point of the sprinkler pipe work. These valves will be equipped with a padlock and a Leather straps.

The installation will be subdivided into zones in accordance with regulations. Each zone valve arrangement will comply with the Life Safety requirements and each zone will not exceeded 2400 m2. The drain on each branch will be connected to a 50mm drain collector.

Each zone valve arrangement will comprise a zone valve, a flow switch and a test and drain valve complete with a strap and padlock.

Where sprinkler main pipework runs within fire escape routes, as defined by the Fire Consultant, the pipework shall be clad in fire resistant insulation to maintain the integrity of the system to that of the fire compartment that it is running through.

210 DESIGN

- Standard: To BS EN 12845.
- Design: Complete the design of the sprinkler system.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

220 EXTENT OF SPRINKLER PROTECTION

All as identified in fire engineering report.

240 PIPELINE SIZES

- Sizing: Calculate sizes to BS EN 12845.
- Method:

The sprinkler pipework will be hydraulically sized in accordance with L.P.C. Standards.

The pipework for the sprinkler installations will be black coated steel medium weight to B.S. 1387 or BS EN 10255.

Valves will be black steel or galvanised heavyweight, depending on the requirements of the local water authority.

The fittings would be malleable iron, cast iron or welded.

From 65 mm diameter and above grooved coupling will be used.

The necessary pipe support brackets for hanging the pipework are included and will comply with the BS EN 12485 requirements for spacing and size of the components. .

- Proposals: Submit.

PRODUCTS

The Boards shall submit proposals for the Sprinkle system to the Consultant, Fire Officer, and building control for comment.

310 WATER SUPPLY

A mains water supply shall provide water to the sprinkler storage tank(s) and be provided as part of the combined fire/domestic water main to the site. The sprinkler water storage shall be contained in the tank room located in the basement of the main hospital building. The sprinkler system installation control valve, sprinkler pumps, valve sets, etc, shall also be housed within the basement tank room.

Standard: To BS EN 12845.
Reliability: Ensure reliability and continuity of water supply.
Quality: Free from suspended fibrous or other matter, which may accumulate in the system pipework.

- Isolating valves on ring main: Interlocking key type.

320 SPRINKLER HEADS

Sprinkler heads shall be pendant bulb type with brass finish in plant and other associated areas, and chrome or white finish in hospital areas.

- Standard: To BS EN 12259-1.
- Sprinkler pattern: As specialist Board schedules and specification.
- Element: As specialist Board schedules and specification.
- Temperature rating: Normally 68C, In areas of high ambient temperatures, sprinkler heads with a higher temperature will be used. .
- Manufacturer: Main reception and Security office..
  - Product reference: As specialist Board schedules and specification.
- Size: As specialist Board schedules and specification.
- Accessories: As specialist Board schedules and specification.
- Corrosion protection: As specialist Board schedules and specification.

330 ALARM DEVICES

All the monitored sprinkler equipment such as pumps valves and flow switches will be wired to an addressable panel. A flow alarm switch will be provided on the alarm valve riser to give remote alarm indication.

A water motor alarm gong will be supplied with the alarm valve. All the stop valves will be completed with a tamper switch.

Each zone valve and flow switch will be connected to an I/O box wired to the addressable panel and fire detection system.

- Standard: To BS EN 12845.
- Type: As specialist Board schedules and specification.
- Manufacturer: As specialist Board schedules and specification.
  - Product reference: As specialist Board schedules and specification.
- Alarm indication: On BMS panel, Fire Panel, Main reception and Security office. .

340 ALARM VALVES

The Sprinkler System will be controlled by wet pipe control valves tested and approved to L.P.C. standards each comprising a 150mm alarm valve with flanged or grooved connections, a 150mm butterfly valve, two 100mm diameter dial pressure gauges and cocks, an alarm trim, a drain valve and butterfly valve and flow switch.

- Standards: To BS EN 12845 and BS EN 12259 -2,-3 and -4.
- Type: Match sprinkler system type.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Application: Submit proposals.

350 INDICATOR PANELS

All the monitored sprinkler equipment such as pumps valves and flow switches will be wired to an addressable panel. A flow alarm switch shall be provided on the alarm valve riser to give remote alarm indication.

A water motor alarm gong shall be supplied with the alarm valve. All the stop valves will be completed with a tamper switch.

Each zone valve and flow switch will be connected to an I/O box wired to the addressable panel and fire detection system.

- Standard: To BS EN 12845.
- Indication: Submit proposals.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

360 PRESSURE GAUGES Gauges to be installed as per SHTM/HTM 05 and LPC Rules for Automatic Sprinkler Installations

- Standard: To BS EN 837-1.
- Manufacture: Submit proposals.
  - Product reference: Submit proposals.
- Diameter: 100 mm .
- Scale subdivisions: Submit proposals.
- Material: Submit proposals.
- Connections: Submit proposals.

EXECUTION

The Board shall Test, flush and clean the system as per regulations, SHTM/HTMs, this specification and Fire officer requirements.

620 INSTALLING WATER SUPPLY

- Frost protection (minimum): Maintain water temperature at 4°C.
- Connections supplying water for other services: Separate from hydrant system and water source.

630 INSTALLING ALARM VALVES

- Location: Immediately downstream of the main stop valve.
- Water temperature (minimum): 4°C.

640 INSTALLING SPRINKLER HEADS

- Orientation: Install upright or pendant, with the deflector parallel to the slope of the roof, ceiling or pitch line of the stairs.
- Coverage, location and spacing: To BS EN 12845.
- Corrosion protection: Submit proposals.

650 INSTALLING ALARM DEVICES

- Location: At each installation main control valve set.
- Gong and water motor: Install gong on the outside of an exterior wall.
- Position of gong: Centre line not higher than 6 m above the point of connection to the alarm valve.

660 INSTALLING INDICATOR PANELS

- Position: As agreed with Fire officer and Architect. .

670 INSTALLING PRESSURE GAUGES

Location:

- Immediately downstream of the tail end valve but upstream of any subsidiary stop valve;
- Between the supply pipe stop valve and the check valve on a town main connection; and
- Downstream of outlet check valve and upstream of outlet stop valve on pump supply.

680 IDENTIFICATION AND LABELS

- Generally: To BS 1710, BS 5499-1 and BS EN 12845.
- Location plate: Provide on external wall as close as practical to the entrance nearest the installation main control valve set.
- Signs for stop valves: Provide to the main and any subsidiary stop valves.
- Sprinklers: Mark orifice size on sprinkler body or deflector.

COMPLETION

O& M documentation shall be issued at least three months before completion of any part of the contract.

The contents and format shall be agreed with the Board. The document shall be issued/ uploaded on Acconex.

The Specialist shall provide instruction to the clients Engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the Manufactures recommendations and best practice.
The Specialist shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

910 FLUSHING

- Operation: Fill the system with water and discharge it via the flushing valves. Flush out debris.

920 TESTING

- Notice (minimum): 3 days.
- Dry pipework: Charge the system with water to a pressure of 2.5 bar (250 kPa). Maintain for 24 h. During this period inspect the system to check that no water leaks at joints or valves.
- All pipework: Charge the system with water to a pressure of 15 bar (1500 kPa). Maintain for 2 h. During this period inspect the system to check that no water leaks at joints or valves.

930 SETTING TO WORK

- Tests: To BS EN 12845.

940 DOCUMENTATION

- Certificate of compliance: Submit.
- Test records: Submit a record of inspections and tests.
- Record drawings: Submit drawings showing location of pipe runs, sprinklers and valves.
- Operation and maintenance instructions: Submit.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical**	Sheet	**WW AP.1.2.8 SMcK G1547**
Performance Specification Title	**Hot and Cold Water Supply Systems**	Date	**August 2014**
Prepared By	**DW**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Update for Financial Close	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
HOT AND COLD WATER SUPPLY SYSTEMS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The development of the design, manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by the Mechanical and Electrical Installer and is referred to in this document as "".

To carry out the development of the design, Project Co. shall obtain the necessary supporting documentation.

This specification relates to the Domestic Hot and Cold water services serving the RHSC-DCN Building and the adjacent Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the architectural drawings.

Pumps

All pumps shall be fitted with IE2 efficiency motors to EN 60034-30:2009 as standard, and suitable for operation in ambient temperatures of 40 degrees C.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this specification shall include, but not be limited to the following:

- Site wholesome water mains.
- The domestic cold water service
- The domestic hot water service.

3.0 SPECIFIC EXCLUSIONS

The following are specifically excluded from the scope of this specification:

- RO Water for Renal use
- RO Water for Endoscopy use
- Fire Hydrant Main
- Water Treatment Equipment

4.0 INTERFACES AND DEMARCATIONS

The domestic hot and cold water services shall be provided as complete working systems serving the RHSC-DCN Building. Project Co. shall provide information to other parties including for power supplies and BMS interfaces.

The site water mains shall be provided as complete working systems serving the RHSC-DCN Building and Energy Centre.

5.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

The domestic hot and cold water systems shall accord with all appropriate Scottish Hospital Technical Memoranda, Codes of Practice and relevant British and European Standards, Scottish Water Regulations *(Byelaws)* and to the approval of the local Water Authority.

The site wholesome water mains shall comply with the requirements of Water for Scotland
2nd Edition 2007, and to the requirements of the Water Authority.

6.0 DESIGN CRITERIA

General the domestic hot and cold water systems shall comply with the Scottish Water Regulations and current Codes of Practice

7.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of *Parts A, B and C of this specification,* Project Co. shall include for close liaison with Health and Safety professionals including the Hospital Board's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety Regulations.

Other Specialist Project Co. shall liaise with other Specialists as necessary to ensure that all interfaces between the domestic hot and cold water supply installations and other systems are allowed for.

The Local Water Supply Undertaker. Project Co. shall liaise with the Local Water Supply Undertaker or their licensed agents to ensure that all aspects of the installation comply with the Scottish Water Regulations.

8.0 SYSTEM DESCRIPTION

Incoming Water Supply

Wholesome cold water will be derived from the separate incoming water main supply entering the basement tank room. The supply will be capable of isolation by valves within the building. A water meter will be incorporated on the supply within the tank room with direct reading and a BMS interface.

The domestic water main shall feed the raw cold water break tanks in the basement plantroom. A connection shall also be provided for the landscape/ planter cold water storage tank. Duty/ standby transfer pumps will pump water to the main run water storage tanks in the roof plantroom.

Cold Water Storage Tanks

Bulk potable quality water storage tanks will be located within the roof plant room. The tanks will store 100% of the total main hospital water storage.

The tanks will be insulated and complete with raised ball valve housings, self-draining bases, flushing drain and all necessary connections to comply with Water Authority requirements. Each tank shall have a central division plate.

Ball valves shall be of the delayed action type valve.
Separate connections will be made from the main cold water storage tank header to the booster sets.

The whole of the domestic water services installation will be boosted in pressure to ensure adequate flow at outlets points, such as showers, etc.

Water Filtration

Twin filtration plant in compliance with SHTM 04-01 shall be served from the 2 No. break tanks and shall supply filtered water to the 2 No. main filtered water storage tanks.

Wholesome Water Booster Sets

Two separate packaged wholesome (potable) grade water booster sets will be provided within the roof plantroom and one in the basement tank room.

Each booster set will comprise:

- Dedicated control panel
- Multiple variable speed duty pumps to maintain a constant discharge pressure.
- Accumulator vessel

Laboratory Cold Water Storage Tanks

Category 5 cold water storage tanks will be located within the roof plantroom.

Water Booster set for Dental Chairs

A small packaged booster set with integrated break tank shall be provided to serve the dental chairs in the Children's Hospital. The unit shall be suitable for locating in a cupboard.

Domestic Cold Water System

From the bulk storage tanks, the wholesome boosted cold-water service will be routed to the basement heat stations to serve the calorifiers and rise in vertical riser to feed the various departments.

Subject to compliance with SHTMs or with Board approval, cold water service outlets which may be subject to misuse, or for clinical convenience, or temperature maintenance, and BREEAM compliance, may use proximity switching, timed flows, automatic flushing system for legionella control shut off valves and flow regulation to serve this purpose.

Flexible Supply Hoses for Final Connections

No flexible hoses (or tails) connections shall be used.

Hot Water Service Installation

General

All hot water supply systems will be designed and installed to meet the requirements of SHTM 04-01 Part A and B.

Hot Water System

The hot water distribution system will be designed for 60ºC flow and 55ºC return circulating temperature.

Domestic Hot Water (DHWS) will be generated and stored utilising high output/ low storage calorifiers. The DHWS plant and distribution system will be fed from the boosted water system, and thus be pressurised.

The DHWS plant will be directly heated from the main primary LTHW heating circuit from the Energy Centre. The storage temperature will be controlled through the BMS by 2-port control valves on the primary heating system, along with 2-port direct acting control valves to provide protection override in the case of high hot water flow temperatures.

The DHWS plant system will be capable of achieving higher storage temperatures for carrying out a pasteurising process to minimise contamination from Legionella bacterium within the storage buffer vessel. Each storage buffer vessel and plate heat exchanger will be isolated from the distribution system while the process is carried out.

The DHWS distribution system will be configured with a pumped return to maintain temperatures within the system in accordance with SHTM 04-01. The pumped return system will minimise "dead legs" and reduce water consumption by providing the correct temperature of water at the outlet with minimum delay.

The system will have isolating valves generally as the cold water system. In addition, the return water pipework will be provided with valves that isolate and automatically regulate the flow rate, in order to maintain satisfactory temperatures throughout the system.

The hot and cold water system pressures will be equalised at each service outlet for successful blending of hot and cold water through anti-scalding devices prior to use.

The anti scalding devices will be used throughout the hospital where service outlets provide water for personal hygiene washing. Designated outlets will use unmixed hot water at system temperatures where utensils or garment washing is required.

Subject to compliance with the SHTMs or with Board approval, hot water service outlets which may be subject to misuse or for clinical convenience may use proximity switching, timed flows and flow regulation for water conservation purposes as described for cold water services.

Separate water heaters shall be provided for the laboratories.

Thermostatic Mixing Valves

These valves are provided on each sanitary fitting that requires the hot water delivery temperature to be limited to a safe working maximum. All valves shall comply with the requirements of NHS Specification DO8; NHS Health Guidance Note (HGN) entitled “Safe Hot Water and Surface Temperatures” and be a WRAS listed pattern.

Where the thermostatic mixing valves are not provided the Board shall affix a permanent label adjacent to the unprotected hot tap clearly stating “VERY HOT WATER”.

Valves shall be factory pre-set to provide maximum delivery water temperatures as follows:

Bidet	-	38°C
Shower	-	41°C
WHB	-	41°C
Bath	-	44°C

Upon completion of the installation, each valves performance shall be checked in accordance with the requirements of Section 5 of the HGN for commissioning, including all necessary paperwork.

HWS Secondary Pumps

All the domestic hot water systems shall be provided with return water circulation pumps. These shall be run continuously with the standby pump supplied loose to allow removal and replacement of operational unit in the case of a fault.

Thermostatic Balancing Valves

Each HWS return loop shall be provided with a thermal balancing valve to ensure the HWS return temperature is maintained at 55°C.

The tamper-proof multi-function thermostatic balancing valves shall be suitable for use in domestic hot water circulation systems and shall include drain point, temperature gauge point and automatic disinfection point.

The valves shall provide a thermal balance in the hot water installation by keeping a constant temperature in the system, thus limiting the flow in the circulation pipes to the minimum required level. The valves shall have a minimum flow rate no greater than 0.02 litres/second.

Water Meters

Water meters shall be provided as indicated on the drawings to measure cold water consumption to various systems and parts of the building.

DOMESTIC WATER FLOW REGULATION

To reduce the overall water consumption of the development, all sanitary fittings shall be furnished with flow regulating devices to both hot and cold supplies to the fitting. These devices shall be factory fitted into the outlet side of the fitting isolating valves, and shall regulate the flow (and thus pressure) of each fitting.

MATERIAL & WORKMANSHIP CLAUSES

S10 HOT AND COLD WATER SUPPLY SYSTEMS

GENERAL

All domestic stored water shall be of wholesome quality.

The main domestic water supply tanks shall be sized for 24hr storage unless otherwise directed by the Board.

The tanks shall be joined at a header arrangement with each tank capable of being isolated for repair or maintenance.

From the raw cold water storage tanks, the water will pass through the filtration plant to the filtered clean water storage tanks. A boosted cold water supply from the tanks will be routed via the main distribution routes to the vertical risers to feed the various departments. In the basement, the filtered (potable) boosted cold water service will feed un-vented HWS calorifiers in the heat stations, and a number of direct connections to demand points within the building, including system pressurisation units, and dedicated water service systems storage tanks for laboratories, via type AB air gaps for prevention of backflow.

All specific department areas will be provided with isolation provision, with draining down facilities for maintenance and shutdown.

All main distribution and dropper connections will be provided with isolating valves, with local isolation valves installed to isolate and shut down individual ward/department areas.
It should be noted that domestic supplies can only connect to outlets and equipment that are suitable for potable quality water supplies, in accordance with the Scottish Water Byelaws.

All items of hot and cold water plant and system controls must be capable of being fully interrogated by the building management system through the independent network protocol.

The hot water distribution system will be designed for 60ºC flow and 55ºC return circulating temperature.

Anti scalding devices shall be used throughout the hospital where service outlets provide water for personal hygiene washing. Designated outlets will use unmixed hot water at system temperatures where utensils or garment washing is required.

110 INCOMING WATER SUPPLY

- Water company: Scottish Water/Business Stream
- Volume flow rate: 25 l/s from 1No incoming main supply for fire hydrants.
- Position of incoming mains water supply: As indicated on the drawings. The main supply shall be taken from the existing Scottish Water main in Craigmillar Castle Road.

Site water mains shall be installed in accordance with Water for Scotland 2nd Edition and NJUG requirements for utility .apparatus with regards to depth, colour coding, identification markers, and position, and to the requirements of Scottish Water. Site water mains shall be ductile iron suitable for the site contaminated ground conditions and approved by Scottish Water. All backfill shall be from a clean source. A water meter linked to the BMS will be incorporated with direct reading and a BMS interface the both incoming main supply at the location identified by Scottish Water. Leak detection meters shall be provided at the boundary and at the entry point to the basement on the domestic water main. All water meters will be fitted with isolation valves and be linked to the BMS.

130 PUMPED COLD WATER SUPPLY SYSTEM

Bulk wholesome quality water storage tanks and break tanks will be located within the roof plantroom of the hospital building. The tanks will store 100% of the total main hospital water storage.

The whole of the domestic water services installation will be boosted in pressure to ensure adequate flow at outlets points, such as showers, etc. duplicate packaged wholesome water grade booster sets will be provided within the tank room.

A separate general purpose water booster set will serve Category 5 outlets.
Each booster set will comprise:-
Dedicated control panel
Multiple variable speed duty pumps to maintain a constant discharge pressure including a standby pump
Accumulator vessel

Water supplies for vending machines, ice makers and chilled drinking water points shall be installed with valved-off connections for final connection by others. All incoming water for wholesome storage will pass through a filtration system with a 0.5 micron capacity.

The filtration plant will be in duplicate and served by duplicate break tanks of one third of total capacity.

Each filtration plant will be capable of supplying full peak water demand to the bulk cold water storage tanks.

- Type: Flooded suction or suction lift to directly pressurize hot and cold water systems.
- Water meters: As shown on drawings.
- Pressure booster sets: As section Y20.
- Pumps: As schedule.

- Storage tank or cistern: Glass fibre reinforced cisterns, as section Y21.
  - Accessories: As schedule and requirement for wholesome water.
- Pipelines:
  - Below ground: As section Y10 and NJUG.
  - Above ground: As section Y10.
- Pipeline ancillaries: As section Y11.
- Thermal insulation:
  - Pipelines: As section Y30.
  - Tanks: As section Y30.
- Vibration isolation: Inertia bases, to acoustic consultant recommendations.
- Sanitary appliances: All taps, shower mixers, and sanitary ware shall be as Architects schedules.
- Drinking water outlets: All domestic water shall be wholesome. Drinking water points shall be shown on drawings..
- Flush control devices: As schedules.
- Water coolers: As schedule and drawings.
- Controls: All items of Cold water plant and system controls must be capable of being fully interrogated by the building management system through the independent network protocol..
- Accessories: As schedule.
- Completion:
  - Cleaning and chemical treatment: Flushing and chemical treatment, as section Y12.
  - Plant and equipment identification: As section Y32 and as SHTM/HTM 04 .
  - Commissioning: Commissioning of cold water supply systems, as section Y50 and as SHTM/HTM 04.

160 INDIRECT HOT WATER STORAGE SUPPLY SYSTEM

Hot water storage shall be provided by high output/ low storage calorifiers. The DHWS distribution system will be configured with a pumped return to maintain temperatures within the system in accordance with SHTM/HTM 04-01, associated HGN Safe Hot Water and Surface Temperatures and SHTM/HTM 04-01. The pumped return system will minimise dead legs and reduce water consumption by providing the correct temperature of water at the outlet with minimum delay.

Capacity: As schedule.
Primary heat source: LTHW system Comprising of dual fuel hot water boiler and CHP units, as section T20.

- Primary: Sealed.
- Storage unit: Hot water storage shall be via the Storage calorifiers supplied with the plate heat exchangers.
- Pumps:
  - Primary hot water supply: Close coupled in line, as section Y20. All parts in touch with the wet system shall be stainless steel.
  - Secondary hot water supply: Close coupled in line, as section Y20 All parts in touch with the wet system shall be stainless steel.
- Pipelines: As section Y10.
- Pipeline ancillaries: As section Y11.
- Thermal insulation:
  - Pipelines: As section Y30.
  - Cylinders: As schedule.

- Controls: All items of Hot water plant and system controls must be capable of being fully interrogated by the building management system through the independent network protocol.
- Sanitary appliances: All taps, shower mixers, and sanitary ware shall be as Architect's schedules.
- Accessories: As schedule.
- Completion:
  - Cleaning and chemical treatment: Flushing and chemical treatment, as section Y12.
  - Plant and equipment identification: As section Y32.
  - Commissioning: Commissioning of Hot water supply systems, as section Y50 and as SHTM/HTM 04.

SYSTEM PERFORMANCE

The hot and cold water supply system shall be install, flushed, cleaned, tested and commissioned as per Water Regulations SHTMs and HTMs. Where any standards or documents contradict one another Project Co. shall contact the Board for further guidance.

220 COLD WATER SUPPLY

- Incoming mains water supply:
  - Site factors: The water mains from the external water main shall run separately in the ground. The main shall enter the basement of the RHSC-DCN Building and run at high level in the basement corridor to enter the basement cold water storage tank room. The supply will connect to the duplicate break tanks.

A pumped supply shall feed the bulk storage tanks in the roof plantroom.

From the bulk storage tanks, the wholesome boosted cold-water service will be routed via the main distribution routes and vertical risers to feed the various departments. See drawings for details.

- Type of system: Pumped from a storage tanks.
- Design parameters: To SHTM/HTM 04-01.
- Daily consumption: As schedule.
- Storage capacity: The main domestic water supply tanks shall be sized for 24hr storage.

250 PIPELINE SIZES

- Sizing: Calculate sizes to meet simultaneous demand for the building in accordance with BS 6700 Appendix D or BS EN 806-3. Submit proposals.
- Performance:
  - Water velocity (maximum): 1.3 m/s for hot water and 1.5 m/s for cold water.
  - Filling time (maximum) for cold water storage cistern: 8 hours.

PRODUCTS

Project Co. shall supply and install services and equipment to perform as per specification. The Board shall submit details of all mechanical equipment for comment and place orders in a timely fashion to ensure delivery as per programme.

Where a particular manufacture is specified, the Board shall include for that manufacturer. Where considered appropriate, provide for equivalent standard alternatives to be offered for consideration. This must be done in a timely manner and Project Co. shall provide all details including but not limited to:

- detailed description
- Cost comparison
- Technical comparison
- References to standards
- References to SHTM/HTMs

310 DEZINCIFICATION

- Fittings, pipelines and equipment located below ground or in concealed or inaccessible locations: Resistant to dezincification, e.g. gunmetal.

320 WATER METERS

Water meters shall be installed as indicated on drawings. Stool pieces between isolating valves will be provided for temporary removal of the meters during the flushing of the system or when meters are removed for repair.

- Standard: To ISO 4064-1.
- Type: In-line meters. Shall be capable of being read by the clients BMS system. .
- Manufacturer: As schedule.
  - Product reference: As schedule.
- Size: To suit service.
- Pressure class: As schedule.
- Temperature class: To suit service.
- Metrological class: As schedule.
- Connections: As schedule.
- Indicating device: Type 2 - digital.
- Features: Pulsed output for remote monitoring.
- Accessories: To BS EN 14154-2.

480 FLUSH CONTROL DEVICES

All taps, shower mixers, and Sanitary ware shall be as Architect's schedules.

- Manufacturer: All taps, shower mixers, and sanitary ware shall be as Architect's schedules.
  - Product reference: All taps, shower mixers, and sanitary ware shall be as Architect's schedules.
- Flush rate: All taps, shower mixers, and sanitary ware shall be as Architect's schedules.
- Water supply valve: All taps, shower mixers, and sanitary ware shall be as Architect's schedules.

- Sensor unit:
  - Material: All taps, shower mixers, and sanitary ware shall be as Architect's schedules. Movement detector: All taps, shower mixers, and sanitary ware shall be as Architect's schedules. Power supply: All taps, shower mixers, and sanitary ware shall be as Architect's schedules.

490 WATER COOLERS

- Manufacturer as Architects Schedules

Water coolers, drinks and vending machines shall be supplied and installed by others.
Project Co. shall supply services to the coolers and vending machines at locations shown on drawings and agreed with the Board.

- Product reference: Supplied by others.
- Type: Supplied by others.
- Flow rate: Supplied by others.
- Temperature of delivered water: As SHTM/HTM 04-01.
- Water inlet: As required.
- Power supply: As required.

EXECUTION

Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety Regulations. This shall include clean and tidy working and working in confined spaces. Due to the size of the water systems being installed all pressure testing and commissioning equipment shall be cleaned and chlorinated before each use. This is to prevent the systems from being contaminated with pseudomonas.

620 INSTALLATION GENERALLY

- Installation: To BS 6700.
- Performance: Free from leaks and the audible effects of expansion, vibration and water hammer.
- Fixing of equipment, components and accessories: Fix securely, parallel or perpendicular to the structure of the building.
- Preparation: Immediately before installing tanks and cisterns on a floor or platform, clear the surface completely of debris and projections.
- Corrosion resistance: In locations where moisture is present or may occur, avoid contact between dissimilar metals by use of suitable washers, gaskets, and the like.

630 INSTALLING WATER METERS

- Standards: To BS EN 14154-2.
- Interconnection to Building Management and Monitoring System (BMMS): Required.

660 UNVENTED HOT WATER STORAGE DISCHARGE PIPES

- Fall (minimum): 1 in 80.
- Discharge: Via an air break and tundish.
  - Size: At least the diameter of the outlet of the safety device.
  - Tundish discharge: At least one diameter larger than the outlet of the safety device.
  - Discharge point: As shown on drawings.

COMPLETION

Project Co. shall protect the system from damage or interference during the works.

Project Co. shall Test, flush and clean the system as per section Y12, Y50, SHTM/ HTM's and TR/20.

Project Co. shall submit O&M's as required by The Board

Project Co. shall provide training as per section Y12, Y40 & Y50.

Project Co. shall provide spares as per section Y12, Y40 & Y50.

Project Co's. defects and liability period shall be as the contract prelims.

910 HYDRAULIC PRESSURE TESTING OF HOT AND COLD WATER SUPPLY SYSTEMS

- Standard: To BS 6700.
- Notice (minimum): 1 week.
- Pressure: 1.5 times working pressure.
- Duration of test: 1 h.

980 DOCUMENTATION

O& M documentation shall be issued at least three months before completion of any part of the contract.

The contents and format shall be agreed with the Board. The document shall be issued/uploaded on ZUTEC.

Project Co. shall provide instruction to the clients engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the manufactures' recommendations and best practice. Project Co. shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

990 OPERATING TOOLS

- Tools: Supply tools for operation, maintenance and cleaning purposes.
- Keys: Supply keys for valves and vents.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical**	Sheet	**WW AP.1.2.13 SMcK G1547**
Performance Specification Title	**Natural Gas Supply System**	Date	**August 21014**
Prepared By	**MM**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Update for Financial Close	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
NATURAL GAS SUPPLY SYSTEMS

CONTENTS

1.0 GENERAL INTRODUCTION

Purpose of Document

The development of the manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by the installer and is referred to in this document as “Project Co”.

To carry out the development of the design, the Specialist shall obtain the necessary supporting documentation.

This specification relates to the mechanical services related to the gas supply system.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include, but not be limited to the following:-

- Gas supply system from incoming meter outlet to final points of consumption

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Specification:-

- Automatic controls & BMS
- Fire detection and alarm system

4.0 INTERFACES AND DEMARCATIONS

The gas supply system shall be provided as a complete working system.

Project Co. shall provide information to other parties for power supplies and fire alarm system interfaces.

5.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

The gas supply system shall accord with all appropriate Scottish Health Technical Memoranda, Codes of Practice and relevant British and European Standards.

The equipment supplied shall conform with all relevant standards and regulations in force. The equipment shall be supplied with relevant Declarations of Conformity to certify compliance with the EMC directive 89/336/EEC-92/31/EEC and the Machinery Safety Directive 89/392/EEC-91/368/EEC-93/44/EEC. Also the equipment and installation shall comply with all relevant statutory requirements in force at the time.

The gas supply and distribution systems shall comply with the relevant clauses of BS6644, IGE Guidance, Clean Air Act, and descriptions and requirements set out below.

6.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

Gas pressures

Low pressure supply at outlet of meter: 65mbar

7.0 LIAISON

Project Co. shall include for liaison with:-
Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Specialist Installers. Project Co. shall liaise with other specialist Installers as necessary to ensure that all interfaces are allowed for.

Building Control. Project Co. shall liaise with, and adhere to, the requirements of the Building Control Officer.

Any other member of the Project and Board teams concerned with the planning and administration of the gas supply system.

8.0 SYSTEM DESCRIPTIONS

Gas Mains Installation

The gas supply for the RHSC-DCN Building shall run from Old Dalkeith Road to a new meter position adjacent the Energy Centre oil tanks and run as a medium pressure supply (65mbar) in a soft dig trench alongside other site piped services to the Energy Centre.

All meters shall provide pulsed outputs for monitoring of the BMS.

Energy Centre

The medium pressure supply into the Energy Centre shall be taken to the heating boilers and CHP unit for direct use at this pressure, thus avoiding the need for individual plant gas boosters. All gas/dual fuel boilers and CHP plant shall be individually metered and linked to the BMS system.

Gas pipework below ground shall be medium density polyethylene PE80 with fusion joints. Pipework above ground shall be in heavy duty mild steel with screwed/welded joints.

S32 NATURAL GAS SUPPLY SYSTEM

110 INCOMING GAS SUPPLY

- Gas transporter: Medium pressure main.
- Gas supplier: Smart Metering Systems UK Gas Connection.

120 NATURAL GAS SUPPLY SYSTEM

Individual supply branches shall be complete with a manual isolating valve and gas solenoid valve as required on the drawings and within the specification.

All gas pipework shall be routed through ventilated service routes to prevent the build up of gas in the event of any leak.

Project Co. shall supply, install and commission an energy centre automatic gas safety system comprising electro-thermal links over each boiler burner and CHP unit (fire melting temperature as advised by manufacturers), wired to emergency knock off buttons at each exit door to each plant area.

The system shall include natural gas detection sensors, the incoming gas solenoid valve and an interlink with the fire control panel.

The complete gas safety system shall be compliant with BS 5839 as a minimum requirement.

The gas safety circuit shall also interface with the oil fuel safety circuit where serving the boiler plant.

The safety valves shall be suitable for the Gas system in which they are installed.

Safety valves shall be provided in accordance with BSEN161.

Activation of the emergency knock off buttons, detection by any of the thermal links or natural gas detection sensors shall close the associated shut off valve. This shall also close the associated oil shut off valves. The systems shall be interlinked with the fire alarm and BMS installations as detailed in the controls specification *and include an automatic reset facility*.

- Metering: Secondary gas meters shall be installed as per drawings.
- Gas pipelines: Low pressure pipelines.
- Gas valves: Valves shall be installed as per regulations, SHTMs and as shown on drawings.
- Gas equipment: As per regulations, SHTMs and as shown on drawings.
- Gas outlets: Combined heat and power plant, as section T25 and Gas fired boiler, as section T20.
- Completion:
  - Plant and equipment identification: As section Y32

PRODUCTS

All elements of the work shall be in accordance with the requirements of current legislation, regulations and industry standards.

The natural gas installation shall also comply to the SHTM, code of practices and relevant British standards.

A proposed drawing list shall be submitted by .

Project Co. shall provide working drawings for the installation and issue them for comment before work commences.

310 SECONDARY GAS METERS

Secondary Gas meters shall be installed as detailed on drawings and in this specification. Gas meters shall be installed with isolation valves for maintenance.

- Standard:
  - Gas meters: To BS EN 1359.
  - Unions and adaptors: To BS 746.
  - Low pressure meters: In accordance with IGE/GM/6.
  - Electrical connections: In accordance with IGE/GM/7.

- Project Co. shall submit technical details of the proposed meter.
- Accessories: Pulsed output for BMS monitoring.
- Housing type: To suit gas meter type.

330 LOW PRESSURE GAS SUPPLY PIPELINES

Over ground pipes 15 mm to 50 mm nominal size inclusive (internal) shall be black mild steel to BS1387 heavyweight grade, screwed fittings if installed in a ventilated space, otherwise fully welded. Over ground pipes greater than 50mm shall be Black mild steel to BS1387 heavyweight grade welded throughout its length. All above ground natural gas pipe shall be painted yellow ochre.

- Standards: To BS EN 1775 and in accordance with IGE/UP/2.
- Materials: Steel, heavy weight.

335 INDUSTRIAL GAS SUPPLY PIPELINES

- Standards: In accordance with IGE/UP/2.
  - Up to and including 0.5 bar: To BS EN 1775.
  - From 0.5 bar up to 60 bar: To EN 15001-1.
- Material: Indoor above ground shall be Black mild steel to BS1387 heavyweight grade welded throughout its length and painted yellow ochre, Underground pipe shall be Yellow medium density polyethylene thick wall pipes (PE80).
- Jointing method: Steel pipe wielded throughout its length, Fusion jointing of polyethylene.

340 GAS SOLENOID VALVES

Project Co. shall supply, install and commission an energy centre automatic gas safety system comprising electro-thermal links over each boiler burner and CHP unit (fire melting temperature as advised by manufacturers), wired to emergency knock off buttons at each exit door to each plant area. The system shall include battery back up to maintain the solenoid valves open in the event of loss of power.

The system shall include natural gas detection sensors, the incoming gas solenoid valve and an interlink with the fire control panel.

The complete gas safety system shall be compliant with BS 5839 and BS EN 161 as a minimum requirement.

The gas safety circuit shall also interface with the oil fuel safety circuit where serving the boiler plant. Should the gas safety circuit be activated both the related gas and oil safety valves shall shut.

Activation of the emergency knock off buttons, detection by any of the thermal links or natural gas detection sensors shall close the associated shut off valve. The systems shall be interlinked with the fire alarm and BMS installations as detailed in the controls specification.

- Manufacturer: to submit proposals.
  - Product reference: to submit proposals.
- Type: to submit proposals.
- Mounting: In Line
- Speed of opening: Submit proposals.
- Connections: Manufacturer's standard.
- Pressure rating to BS EN 1333: Suitable for gas pipe pressure.
- Solenoid supply voltage: Submit proposals.
- Actuation method: Sensor above each burner, knock of button and fire alarm.
- Reset: Manual.
- Accessories: Submit proposals.

390 GAS PROVING SYSTEMS & EMERGENCY VALVES

Project Co. shall supply and install, in the locations shown on the drawings, a combined gas proving system and emergency shut off valve on the natural gas supplies.

The system shall provide an automated means of proving the integrity of the downstream natural gas installation prior to opening the emergency shut off valve on a regular and routine basis.

The system shall be key switch operated and be interlinked with the BMS system in order to repeat and log alarm conditions.

- Manufacturer: to submit proposals.
  - Product reference: to submit proposals.
- Pressure application: Detection of positive pressure changes.
- Accessories: Submit proposals.

400 SAFETY AND CONTROL DEVICES

- Standard: To BS EN 13611.

410 BALL VALVES, MANUALLY OPERATED

Valve shall be suitable for type of gas pipe in which they are installed.

- Standard: To BS EN 331.
- Type: Lever operated.
- Manufacturer: choice.
  - Product reference: choice.
- Material: Bronze or dezincification resistant brass (DZR).
- Connections: Threaded.

420 PLUG VALVES, CAST IRON

Valve shall be suitable for Medium pressure gas main

- Standard: To BS 5158.
- Type: Regular.
- Manufacturer: choice.
  - Product reference: choice.
- Connections: To suit pipework.
- Options: Wrench.

425 PLUG VALVES, STEEL

Valve shall be suitable for Medium pressure gas main

- Standard: To BS 5353.
- Type: Regular.
- Manufacturer: choice.
  - Product reference: choice.
- Connections: To suit size of pipework.

430 PLUG VALVES, TAPER

Valve shall be suitable for type of gas pipe in which they are installed.

- Standard: To BS 1552.
- Type: choice.
- Manufacturer: choice.
  - Product reference: choice.
- Material: Dezincification resistant brass (DZR) copper alloy
- Connections: Threaded.

EXECUTION

Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety regulations. This shall include clean and tidy working and working in confined spaces.

620 INSTALLATION GENERALLY

- Installation: In accordance with IGE/UP/10 and ICE/UP/2.

625 GAS SAFE REGISTRATION REQUIREMENTS

- Type of service: Non-domestic.
- Type of gas: Natural gas.
- Area of work: The installation, testing and commissioning of the natural gas system shall be undertaken by a registered installer. A copy of the installer's certificate shall be attached to the test and commissioning documents.

630 INSTALLING GAS METERS

- Secondary gas meters:
  - Low pressure: In accordance with BS 6400-1.
  - Medium pressure: In accordance with BS 6400-2.
  - Non-domestic: In accordance with IGE/GM/8.

650 INSTALLING GAS PIPELINES

- Installation: In accordance with BS EN 1775.

660 INSTALLING INDUSTRIAL GAS PIPELINES

- Standard: In accordance with EN 15001-1.

COMPLETION

Project Co. shall protect the system from damage or interference during the works.

Project Co. shall submit O&M's.

Project Co's. defects and liability period shall be as the contract.

930 COMMERCIAL AND INDUSTRIAL GAS INSTALLATIONS

- Soundness testing and purging: In accordance with IGE/UP/1.
- Testing, purging and commissioning pipelines: In accordance with BS EN 1775 and BS EN 15001 2.
- Commissioning gas fired plant: In accordance with IGE/UP/4

940 PRESSURE TESTING OF NATURAL GAS SUPPLY SYSTEMS

- Notice (minimum): 1 week.
- Pressure: 1.5 times working pressure.
- Duration of test: 1 h.

960 DOCUMENTATION

O& M documentation shall be issued at least three months before completion of any part of the contract.

The contents and format shall be agreed with the Board. The document shall be issued/uploaded on Aconex.

The Specialist shall provide instruction to the clients Engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the Manufactures recommendations and best practice.

The Specialist shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

970 OPERATING TOOLS

- Tools: Supply tools for operation, maintenance and cleaning purposes.
- Valve keys: Supply keys for valves and meter housing.
  - Quantity: 4 of each type.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical**	Sheet	**WW AP.1.2.6 SMcK G1547**
Performance Specification Title	**Cooling Systems**	Date	**August 2014**
Prepared By	**MM**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Update for Financial Close	SMcK
FC	August 2014	All	Comment Incorporated	SMcK

RHSC and DCN EDINBURGH
COOLING SYSTEMS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by the Mechanical and Electrical Installer and is referred to in this document as "".

To carry out the development of the design, Specialist shall obtain the necessary supporting documentation.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Fans & Pumps

All fan assemblies shall incorporate fan impeller and motors selected to provide the most energy efficient solution conforming to Section 6 regulations. All fans and pumps shall be fitted with IE2 efficiency motors to EN 60034-30:2009 as standard, and suitable for operation in ambient temperatures of 40 degrees C.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include, but not be limited to the following:-

- Cooling System, comprising:

  Chillers, pumps, pressurization units. Pipework, valves and ancillaries, cooling terminal devices.

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Specification:-

- BMS and automatic control systems

4.0 INTERFACES AND DEMARCATIONS

The cooling system shall be provided as a complete working system serving the RHSC-DCN Building.

Project Co. shall provide information to other parties for power supplies and fire alarm system interfaces.

5.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

The cooling system shall accord with all appropriate Scottish Health Technical Memoranda, Codes of Practice and relevant British and European Standards.

The equipment supplied shall conform with all relevant standards and regulations in force. The equipment shall be supplied with relevant Declarations of Conformity to certify compliance with the EMC directive 89/336/EEC-92/31/EEC and the Machinery Safety Directive 89/392/EEC-91/368/EEC-93/44/EEC. Also the equipment and installation shall comply with all relevant statutory requirements in force at the time:

6.0 DESIGN CRITERIA

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

External Design Conditions		
Winter	-	-6°C sat
Sizing for AHU plant		-10 °C
Summer	-	26.2°C db 18.5°C wb
Sizing for refrigeration plant	-	30°C
Chilled Water Operating Pressure	-	2.5 Bar
Limiting Noise Criteria at Boundary		Refer to Acoustic Consultant's report

7.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety Regulations.

Specialist Installers. Project Co. shall liaise with other Specialist Installers as necessary to ensure that all interfaces between the Fire Detection and Alarm System and other systems are allowed for. This shall include but not be limited to:-

- Building Management System specialist
- Fire Alarm and Detection specialist

Building Control. Project Co. shall liaise, with and adhere to, the requirements of the Building Control Officer.

Any other member of the Project and Hospital Board teams concerned with the planning and administration of the cooling system.

8.0 SYSTEM DESCRIPTION

Cooling Plant Arrangement

The total cooling load shall be met by 3 air cooled chillers at 800kW each. The total installed chilling capacity shall therefore be 2,400kW. Three air cooled chillers shall be located in the level four external chiller plant area.

Chilled water shall be used as the main cooling medium for the ventilation and air conditioning systems.

The total load to be supported by the chiller system shall therefore be some 2,400kW, which shall be met by chillers. Therefore, each cooling plant shall approach a capacity of 33% of the total building load, which shall be sufficient to allow the hospital to continue to function in the event of a catastrophic failure on one system.

Each chiller shall be provided with acoustic attenuation packages to meet not only the day/night boundary sound level limitation, but also the intrusive noise level limits into the hospital. The acoustic treatment shall be in accordance with the recommendations of the acoustic consultant.

All items of cooling plant and system control shall be capable of being fully interrogated by the building management system through the independent network protocol (open protocol). Water pumping and pressurisation equipment shall be located in level 4 plantroom. From the plantroom, the chilled water pipework systems shall run to serve air-handling equipment in the various plantroom areas, and terminal cooling equipment in selected spaces.

The chilled water system shall be 100% water with trace heating protection where the pipework is exposed on the roof. Primary chilled water circuits shall emanate from the chilled water plantroom.

The primary circuit shall operate at nominal design flow and return temperatures of 6ºC and 12ºC respectively scheduled to outside air temperature.

The Primary chilled water system shall include the following elements:

- Chilled water pressurisation plant with twin pump make-up pumps and expansion vessels to maintain the pressure in the primary chilled water system.
- Multiple circulation pumps.
- A dirt separator unit on the main flow pipework.
- An active deaeration unit on the main flow

The system shall be capable of being treated with corrosion inhibiting chemicals via a manual-dosing unit.

It is proposed to provide 2-port control valves with differential-pressure-control valves (DPCV's) on all of the major load centres to allow the use of variable volume control of the primary chilled water circuit. The circulating pumps shall be controlled by the BMS in sequence as needed to match the varying load demand. This shall maintain the pressure differential between flow and return pipework within set limits with sensors located within the main sub-distribution pipework. The system shall not permit any of the primary circuit pumps to operate at less than 40% of their design maximum. A motorised bypass valve shall be provided on each pump set to ensure that a minimum of 40% is achieved. The DPCVs shall protect the downstream control valves from excessive pressures and nullifying the effects of pressure variations caused by the movement of control valves in other branches. This shall also aid commissioning. Care should be taken not to over tighten the DPCVs during commissioning.

The chilled water system shall include the following elements:

i) Chilled water pressurisation plant with twin pump make-up plant expansion vessel to maintain the pressure in the secondary chilled water system.

ii) Run and stand-by secondary circulation pumps serving air handling plant cooling coils and fan coil units.

iii) An active deaeration and dirt separator unit on the main flow pipework.

iv) The system shall be capable of being treated with corrosion inhibiting chemicals via a manual-dosing unit.

It is proposed to provide 2-port control valves on all the air handling unit cooling coils. This shall allow the use of variable speed control on the secondary circulation pumps, achieved by inverter motor control units located within the plantroom area. These shall be controlled by the BMS to maintain the pressure differential between flow and return pipework within set limits with sensors located in the main sub-distribution pipework. The system shall not permit the secondary circulation pumps to operate at less than 40% of their design maximum.

All circuits shall have Differential-pressure-control valves (DPCVs) to protect the two port valves from excessive pressures and nullifying the effects of pressure variations caused by the movement of control valves in other branches.

The systems shall be divided into sections to allow individual areas to be isolated from the main system for maintenance or shutdown.

All main and subsequent department branches shall be provided with balancing/measurement, DPCV's and isolation valves along with drain cocks, air vents etc. to ensure proper control and regulation of water flow rates under design load condition with flushing, draining and re-filling facilities.

Local cooling, where required, shall be provided via ceiling mounted fan coil units.

Buffer Vessel

A buffer vessel shall be provided on the cooling water system to provide sufficient cooling capacity within the system to provide five minutes of full cooling output in the event of a power failure and before the standby generators are available to supply the main chilled water circulation pumps and chillers.

T50 CHILLED WATER SYSTEMS

110 CHILLED WATER SYSTEM

- System: Two pipe.
  - Pipeline circuits: Variable flow.
- Cooling source: Air cooled liquid chillers.
- Pressurization units: As section Y20.
- Pumps: Close coupled in line pumps, as section Y20.
- Pipelines: As section Y10.
- Pipelines ancillaries: As section Y11.
- Thermal insulation: As section Y30.
- Vibration insulation: Inertia bases in accordance with acoustic consultants recommendations.
- Emitters:
  - Air handling units, as section U81;
  - Cooling coils and fan coil units.
- Controls: As specification Y40.
- Accessories: As schedule and specification.
- Completion:
  - Cleaning and chemical treatment: Flushing and chemical treatment as section Y12.
  - Plant and equipment identification: As section Y32.
  - Commissioning: Commissioning of chilled water systems, as section Y50.

SYSTEM PERFORMANCE

Project Co. shall supply and install services and equipment to perform as per specification. Project Co. shall submit details of all mechanical equipment for comment and place orders in a timely fashion to ensure delivery as per programme.

Where a particular manufacture is specified, Project Co. shall include for a product of that quality and performance.

Where considered appropriate, provide for equivalent standard alternatives to be offered for consideration.

This must be done in a timely manner and the Board shall provide all details including but not limited to:

- Detailed description
- Cost comparison
- Technical comparison
- References to standards
- References to SHTM's

265 VARIABLE FLOW PIPEWORK SYSTEMS

Where chilled water systems utilise variable volume control systems they shall have differential pressure control valves (DPCV) installed as indicated on the drawings, and supplied and installed by .

The purpose of the DPCV is to automatically compensate for the rise in differential pressure across the circuit that it services, as the circuit flow rate falls under the dictate of the 2-port control valve(s), and vice versa.

DPCVs used in conjunction with motorised control valves and TRVs shall be arranged to maintain a constant differential pressure across the circuit.

Project Co. shall, in conjunction with the BMS Specialist, liaise with the DPCV supplier to ensure the correct motorised control valve selections are made and the whole system is compatible in terms of operating pressure ranges, etc.

Similarly, Project Co. shall, in conjunction with the BMS Specialist also liaise with the pump supplier, to ensure that the pump speed control system is totally compatible between the 3 elements, i.e. DPCV, motorised/thermostatic valves and pump characteristic and control.

It shall be noted that the minimum pressure drop across combination of control valve, coil and interconnecting pipework system and accessories shall be 25kPa to suit operation of DPCV.

The maximum operating pressure of the control valve, coil and interconnecting pipework/accessories shall also be reviewed against the selection of the DPCV.

EXECUTION

Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety Regulations. This shall include clean and tidy working and working in confined spaces.

Due to the size of the water systems being installed all pressure testing and commissioning equipment shall be cleaned and chlorinated before each use.

This is to prevent the systems from being contaminated with pseudomonas.

COMPLETION

O& M documentation shall be issued at least three months before completion of any part of the contract.
The contents and format shall be agreed with the Board. The document shall be issued/uploaded on Acconex.

Project Co. shall provide instruction to the clients engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the manufactures recommendations and best practice. Project Co. shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

Project Co. shall protect the system from damage or interference during the works. Project Co. shall test, flush and clean the system as per section Y12, Y50, SHTMs

Project Co. shall submit O&M's.

Project Co. shall provide training as per section Y12 & Y50.

Project Co. shall provide spares as per section Y12 & Y50.

905 HYDRAULIC PRESSURE TESTING OF CHILLED WATER SYSTEMS

- Testing: In accordance with HVCA TR/6.
- Notice (minimum): 1 week.
- Pressure: 1.5 times working pressure.
- Duration of test: 1 h.

920 OPERATING TOOLS

- Tools: Supply tools for operation, maintenance and cleaning purposes. Quantity: Supply tools for operation, maintenance and cleaning purposes. Supply keys for valves and vents.

T60 CENTRAL REFRIGERATION PLANT

320 SAFETY AND ENVIRONMENTAL REQUIREMENTS

- Standard: To BS EN 378-1, -2, -3 and -4.
- Leak detection: Gas detection and alarm system.

The Unit control system shall provide the unit with protection against the following:

- Loss of refrigerant charge.
- Reverse rotation.
- Low chilled water temperature.
- Low oil pressure (per compressor).
- Current imbalance.
- Compressor thermal overload
- Automatic compressor unloading in case of excessive air temperature
- High condensing pressure.
- Electrical overload.
- Loss of phase.

Fan motors shall be individually protected by a circuit breaker. Controls shall provide a separate general alert (minor incident) and alarm (circuit shut down) remote indication.

330 AIR COOLED LIQUID CHILLERS

Standards: To BS EN 14511-1, -2, -3 and -4.
Type: The chillers shall be of the fully packaged air-cooled type complete with multiple screw compressors.

Chillers shall have variable speed head pressure control with load and efficiency optimised head pressure and chilled water flow temperature control to improve seasonal efficiency.

Project Co. shall provide acoustic treatment to the chillers to meet the Limiting Noise Criteria in accordance with the recommendations of the acoustic consultant.

The chillers shall be fitted with a water flow switch to prevent damage to the chillers in the event of pump failure.

The chillers shall be factory assembled single piece air-cooled liquid chiller. Each unit shall comprise all factory wiring, piping, controls, refrigerant charge (HFC-134a), multiple refrigeration circuits, screw compressors, electronic expansion valves and equipment required prior to field start-up. Each unit shall be rated in accordance with EN14511 and certified by Eurovent (where applicable).The packaged air cooled chillers shall be of the high efficiency type provided an ESEER exceeding 3.9. The compressors shall utilise Chlorine free refrigerants with zero Ozone Depletion Potential values and offering refrigerant coefficient of performance values of 95% or better.

The chiller construction shall comply with European directives:

" Pressurised equipment directive (PED) 97/23/EC
" Machinery directive 98/37/EC, modified.
" Low voltage directive 73/23/EEC, modified
" Electromagnetic compatibility directive 89/336/EEC, modified, and the applicable
recommendations of European standards:
" Machine safety: electrical equipment in machines, general regulations, EN 60204-1
" Electromagnetic emission EN 50081-2.
" Electromagnetic immunity EN 50082-2.

Unit shall be designed, manufactured and tested in a facility with a quality assurance system certified to ISO 9001 and an environmental management system certified to ISO 14001.

Units shall be run tested and witnessed at the factory.

The frame shall be made of galvanized steel U beam and protected by two layers of protection (primer and final coating) with an average thickness of 200 microns. The control / electrical cabinets shall be steel with an oven-baked polyester-paint finish, and be capable of withstanding a 500-hour salt spray test in accordance with the ASTM B-117 standard (U.S.A.).

Condenser fans shall be direct-driven, shrouded-axial type, shall be statically and dynamically balanced, and made of recyclable material with inherent corrosion resistance.

Air shall be discharged vertically upward. Fans shall be protected by coated steel wire safety guards. Condenser-fan motors shall be 3-phase, IP55, with permanently lubricated bearings and Class F insulation Units shall have semi-hermetic twin-screw compressors with internal relief valve and check valve to avoid reverse rotation on shut down.

Each compressor shall be equipped with a discharge shut-off valve.

Capacity control shall be provided by a variable speed operation capable of reducing compressor capacity down to 15% of full load. Compressor shall start in unloaded condition.

Motor shall be cooled by suction gas and protected by internal winding temperature sensors. Compressor bearings shall be oil free magnetic type.

The oil separator, separated from the compressor, shall not require an oil pump and shall incorporate an internal muffler to reduce discharge gas pulsations.

Each compressor and oil separator shall be installed within an insulated acoustic enclosure. Enclosure access panels can be readily removed for service using ¼ turn fasteners.

Evaporator shall be tested and stamped in accordance with applicable European pressure code for a refrigerant-side operating pressure of 2100 kPa and for a maximum water-side pressure of 1000 kPa (standard).

The evaporator shall be mechanically cleanable, shell-and-tube type with removable heads. Tubes shall be internally and externally enhanced, seamless-copper, and shall be rolled into tube sheets. Shell shall be insulated with 19 mm closed-cell foam with a maximum K factor of 0.28. Evaporator thermal insulation shall be factory fitted with aluminium cladding to provide mechanical protection and ensure protection against UV rays.

The evaporator shall have a drain and vent in each head.

The evaporator shall incorporate an active refrigerant level control system to ensure optimum heat transfer performance under all load conditions.

Chiller shall have only one water inlet & one water outlet connection using victaulic couplings to provide vibration isolation and to accommodate minor pipe-work misalignment.

Evaporator shall be fitted with an electronic water flow switch. Paddle switches or differential pressure switches shall not be acceptable.

The condenser shall be made of multiple coils in V configuration to provide protection against hail damage. Coil shall have integral sub cooler, and shall be constructed from a single material throughout to eliminate the risk of galvanic corrosion. Condenser coils shall be capable of being cleaned with a medium-pressure jet washer (up to 69 bar).

Condenser coils shall be leak tested with helium and shall be pressure tested at 3400 kPa. Condenser shall be 3 years factory guaranteed against leaks and corrosion (according to warranty policy).

Refrigerant circuit components shall include; compressor, oil separator, high and low side pressure relief devices, liquid line shutoff valves, refrigerant economizer, filter driers, moisture indicating sight glasses, long stroke electronic expansion device, and complete operating charge of refrigerant HFC-134a. To facilitate service and maintenance and avoid refrigerant charge transfers, it shall be possible to isolate the following components and systems independently: filter driers, oil filters, expansion devices and compressor (with compressor suction service valve option fitted). Pressure and temperature sensors may be replaced without the need to pump-out the refrigerant charge Unit controls shall include as a minimum: microprocessor with non-volatile memory, picture guided unit/operator interface, LOCAL/OFF/REMOTE/CCN selector and a touch-screen display with multiple language capability.

Pressure sensors shall be installed to measure suction, discharge, and oil pressures. Thermostats shall be installed to measure cooler entering and leaving temperatures and outside air temperature.

- Unit shall be capable of performing the following functions:
- Automatic change-over and cycling of compressors to equalize running hours and number of starts.
- EXV control to optimise evaporator refrigerant level, control discharge superheat and condenser sub-cooling.

- Capacity control based on leaving chilled fluid temperature with return fluid temperature sensing.
- Limit the chilled fluid temperature pull-down rate at start-up to an adjustable range of 0.1°C to 1.1°C per minute to prevent excessive demand spikes at start-up.
- Enable reset of leaving chilled water temperature according to the return water temperature
- Provide a variable set point for the leaving chilled water temperature activated by a remote contact closure signal or by the built in time clock.
- Enable a 2-level demand limit control (between 0 and 100%) or a maximum current drawn limit activated by a remote contact closure or by the built in time clock.
- Control evaporator water pump and, if installed, stand-by pump operation.
- Allow two time scheduling programs to enable unit start-up control, demand limit and setpoint changes.
- Enable lead lag control of two *or more* chillers running in series or parallel.

Display module shall be capable of displaying set points, system status including temperatures and pressures, current for each compressor, run time and percent loading.

The control system shall allow a quick test of all machine elements to verify the correct operation of every switch, circuit breaker, contactor and sensor before the chiller is started.

Unit shall be capable of starting and running at full or part load at outdoor ambient temperatures from –10°C to 55°C.

Unit shall be capable of starting up with 45°C entering fluid temperature to the evaporator. Leaving chilled water set point may be between 3.3°C and 15°C.

Unit shall operate on 400 volt (+ 10%), 3-phase power supply without neutral. A factory-installed transformer shall provide control power.

Unit shall be supplied with factory-installed fused isolator(s). Compressors shall be fitted with inverter drives as standard to limit electrical inrush current.

- Output: As chiller schedule.
- Refrigerant: R134a.
- Evaporator fouling factor: As chiller schedule.
- Energy efficiency ratio (EER): as schedule
- Sound pressure level: As chiller schedule.
- Electrical supply type: As chiller schedule.
- Number of refrigerant circuits: As chiller schedule.
- Evaporators: As chiller schedule.
- Condenser coils: Internally enhanced, seamless copper tubes mechanically expanded into aluminium alloy fins with full height collars. Integral sub cooler circuit.
- Condenser fan discharge: Vertical.
- Warning indication: As schedule.
- Accessories: Anti-vibration mountings.

EXECUTION

Project Co. shall protect chillers from damage or interference during the works. shall include for the services of the manufacturer's skilled services engineers to start up, test and check all the chillers and dry air coolers and controls.

This shall include all tests to prove that all the cooling equipment is working with and responding to the clients BMS network and head end. The units when commissioned shall be "Set Up" to give maximum efficiency. The Energy Centre cooling equipment shall be witnessed by the Board's representative before the cooling plant is accepted from the Board. Project Co. shall allow for instruction of the clients representative on the working of the equipment.

610 INSTALLATION GENERALLY

- Fixing of equipment and components: Fix on purpose made bases or supports.
- Pressure testing of joints: Immediately before installation of lagging and casing.

  - Results: Submit.

620 INSTALLING CHILLERS

- Location: Provide adequate space around chillers: Access around all cooling plant shall be as manufactures instructions.
- Access: Provide for inspection and servicing of chiller and ancillary equipment.

640 INSTALLING REFRIGERANT PIPEWORK

- Standards: To BS EN 378-3 and -4.
- Refrigerant lines: Short and straight.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical**	Sheet	**WW AP.1.2.17 SMcK G1547**
Performance Specification Title	**Energy Centre Oil Fuel Supply**	Date	**August 2014**
Prepared By	**MM**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Update for Financial Close	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
FUEL OIL SUPPLY SYSTEMS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The development of the manufacture, supply, installation, setting to work and commissioning of the works described in this document shall be undertaken by the Mechanical and Electrical Specialist and is referred to in this document as “the Specialist”.

To carry out the development of the installation drawings and details, Project Co. shall obtain the necessary supporting documentation.

This Specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include, but not be limited to the following:-

- Oil tanks
- Oil pipework
- Associated oil equipment (such as pumps, pipeline accessories, and oil fill point)

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this performance specification:-

- Power supplies to plant
- Fire and BMS interface connections
- All controls wiring

4.0 INTERFACES AND DEMARCATIONS

The fuel oil system shall be provided as a complete working system serving the Energy Centre.

Project Co. shall provide information to other parties for power supplies and fire alarm system and BMS interfaces.

5.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated. This includes those related to Scotland in particular.

The fuel oil supply shall accord with all appropriate Scottish Health Technical Memoranda, Codes of Practice and relevant British and European Standards.

The equipment supplied shall conform to all relevant standards and regulations in force. The equipment shall be supplied with relevant Declarations of Conformity to certify compliance with the EMC directive 89/336/EEC-92/31/EEC and the Machinery Safety Directive 89/392/EEC-91/368/EEC-93/44/EEC. Also the equipment and installation shall comply with all relevant statutory requirements in force at the time.

Project Co's. shall comply with the Water Environmental (Oil Storage) (Scotland) Regulations 2006, to which the fuel oil system must adhere.

6.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

7.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this Specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety Regulations.

Other Specialist. Project Co. shall liaise with other specialists as necessary to ensure that all interfaces are allowed for. This shall include but not be limited to:-

- Building Management System specialist
- Fire Alarm and Detection specialist

Building Control. Project Co. shall liaise, with and adhere to, the requirements of the Building Control Officer.

Any other member of the Project and Trust teams concerned with the planning and administration of the fuel oil system.

8.0 SYSTEM DESCRIPTION

The fuel oil is to provide supplies for the new generators and boilers in the new Energy Centre. The oil is to be as required by BS 2869, Class D with a maximum sulphur content of 1000 ppm (0.1%).

Two tanks shall be located externally at ground level adjacent to the Energy Centre sized at 185m³ each and are to serve the Energy Centre boilers and Generators.

Each tank of the tanks is to have its own individual oil fill connection complete with oil fill indicator.

Two pump and filter sets are to be provided to serve respectively:-

- Boilers - Energy Centre
- Generators - Energy Centre

Class D 35 sec oil has been selected as the fuel for the standby diesel generators and emergency (dual fuel/standby) for the main boiler plants. The storage tank volumes are based on the generators and boilers operating at full load and for a period of 200 hours for the generators and 120 hours for the boilers.

Each generator shall have an individual 8 hour gravity feed day tank complete with filling line and level alarms that shall be linked to the BMS. The boilers shall be duel fuel with the fuel oil used as a back-up for the natural gas installation. The main tanks located externally on the ground floor shall be in a common bund capable of retaining a minimum of 25% of the total fuel oil brimful storage capacity.

The bund will incorporate a rainwater sump and a base with angle fillets at any junction with a vertical face to deflect ice. The sump must not connect directly with any drain or sewer.

All electrical equipment, motors, switches, lighting, etc. installed within the oil storage tank areas shall be explosion proof.

Oil check meters shall be installed, as indicated on the drawings. Each meter shall incorporate a 'Y' type strainer to suit the oil meter size and have a mesh not less than 100 micron. Oil meters shall be suitable to provide a pulsed output to the BMS system

Each tank shall be complete with all necessary fill and outlet components, level indicators etc. and access ways.

Leak detection shall be provided below each tank, main tank and day tank linked to the BMS.

A sump unit complete with a float switch shall be provided in the oil pump room to form part of the safety circuit to shut the fire valves on the daily service tanks and stop the generator oil transfer pump should the sump unit become flooded due to leakage from the flow and return pipes to each generator.

is to provide and fit on the wall adjacent to the oil sump in the main oil storage tank area a semi-rotary hand pump suitable for handling oil fuel which has leaked and drained into the sump.

A foot valve shall be fitted to the end of the suction pipe in the sump and the discharge pipe shall be routed through the external wall to terminate at a suitable height to empty into a collection vessel.

Overflows shall be as follows:-

- From the generator day tanks to the ground floor sumps

The vents shall be as follows:-

- From the generator day tanks to their own integral bund
- From the external bulk oil tanks to within the bund

S41 FUEL OIL SUPPLY SYSTEMS

110 FUEL OIL SUPPLY SYSTEM

Storage capacity
- Diesel Generators 200 hours and
- LTHW Boilers 120 hours

- Type: Fuel oil transfer from the bulk oil storage tanks to serve the oil main system for the Boilers and generators shall be provided by a duplex (duty and standby) packaged pump set situated in the Energy Centre.

Each packaged duplex pump set shall incorporate the following:-

- Manifold pressure relief valve, control panel, pressure gauges and isolating cocks connected to the suction and discharge side of the pumps
- Suction strainers/filters
- All assembled on a drain pan bed plate
- Each pump fitted with an integral relief valve
- Differential pressure switch piped across the common suction and discharge
- Automatic changeover in fault condition and duty sharing.

The oil transfer pumps shall be capable of manual or automatic operation. The pumps shall be interlocked to the level sensors in the main and daily storage tanks. The oil transfer pumps serving the generators and boilers shall automatically transfer oil when the engines/burners run and level switches dictate.

- Storage tanks: Carbon steel.
  - Tank accessories: Contents gauges and Overfill alarms and overfill prevention devices
- Oil heating methods: Not required.
- Pipelines: As section Y10.
  - Pipeline accessories:
    Electronic shut off fire valves shall be provided on inlets to each daily service tank and bulk tank which shall operate in the event of a fire alarm situation, or on a signal from the gas alarm system. The day tanks shall be provided with an extra low level sensor which shut the generators down.
  - Filters;
  - Remote acting fire safety valves
  - Strainers.
- Oil pump: Burner pump and duel Transfer pump, as section Y20.
- Outlet: Dual fuel fired cast iron boiler, as section T20 and generators.
- Controls: A central control panel shall be provided by the BMS Specialist which shall be interfaced with the fire alarm system and provide a common alarm to the BMS via volt free contacts. For details of controls and interlocks with plant, see BMS Specification. All controls shall be capable of being fully interrogated by the building management system through the independent network protocol.
- Completion:
  - Plant and equipment identification: As section Y32.

PRODUCTS

Project Co. shall ensure that all equipment is ordered to arrive in a timely fashion and to meet the programme, with particular reference to the main fuel oil tanks.

330 OIL STORAGE TANKS, CARBON STEEL

Tanks shall be single skinned tanks of equal capacity. Each tank shall be complete with all necessary fill and outlet components, level indicators etc and access ways as required by British Standards and SHTM

The external bulk tanks are to be in a bunded sump. Tanks to be single piece connected with a header arrangement.

The tanks shall be manufactured in accordance with BS 799: Part 5.

- Single skinned
- Oil fill pipe and connection
- Vent pipe and connection with vent pipe pressure relief valve and vent guard
- Drain connections with drain valves
- Supply outlet connection
- Spare plugged connection
- 600 mm dia. raised manhole access with cover
- Suitable number of connections for contents gauge sensors
- Suitable number of connections for level control/alarm sensors
- Earthing points
- Caged access ladder with platform and handrail
- Tank details notice showing BS, Type, capacity, date of manufacture, manufacturer and fuel type.
- Inspection openings.

The contents/oil level of the bulk tank shall be monitored by the BMS via the contents gauge sensor.

- Standards:
  - Tank: To BS 799-5 and OFS T200.
- Type: Single skinned
- Manufacturer: Submit proposals
  - Product reference: Submit proposals
- Number of manholes or inspection covers: To suit statutory requirements
- Fittings: As required by the drawings and specification
- Accessories: As required by the drawings and specification

350 CONTENTS GAUGES

Each Tank shall have a contents gauge showing the actual contents not just full/empty.

- Standards: To BS 799-5 and OFS E103.
- Type: Submit proposals.

- Manufacturer: Project Co. choice.
  - Product reference: Project Co. choice.

360 OVERFILL ALARMS AND OVERFILL PREVENTION DEVICES

A labelled oil fill cabinet shall be provided for each of the main bulk storage tanks.

The cabinet shall have a top hinged front door complete with a glass observation panel, a supporting strut for use in the open position, and a car type level lock with 2 No. keys. The
whole unit is to be weatherproof and finished internally and externally with a durable paint. The cabinet is to house a gun-metal cap with a retention chain padlock and 2 No. keys and plainly labelled with the tank identification number and grade of oil.

The cabinets shall also include the contents gauge and overfill alarm for the tank and a
Light fitting and switch. The fill cabinets shall contain a 100 mm contents gauge of the hydrostatic continuously reading type, calibrated in litres to suit the tank, and marked 'empty' at the lower limit of usable oil.

The tank transmitter(s) are to be readily replaceable without the need to drain the tank and the connecting tubing is to be armoured and fully supported and clipped on galvanised cable tray throughout its length.

The fill cabinet shall contain a tank overfill alarm(s) connected to the tank to give an
Audible warning when the tank has been filled to 95% of its total volume with a muting and test switch.

The float detector units associated with these tanks are to be completely weatherproof and are to be fixed in suitable connections at the top of the tank, close to the manholes and access platforms.

The overfill alarm shall have a connection for an alarm to the BMS.

The cabinets shall be complete with drip tray capable of containing 110% of the fill pipe volume to contain any spillage.

- Standard: To OFS E105.
- Manufacturer: Project Co. choice
  - Product reference: Project Co. choice

430 FILTERS

Duplex oil filters – 1st and 2nd stage - shall be provided in the suction lines to each oil transfer pump set as shown on the drawings, also upstream of the oil meters.

- Standard: To OFS E104.
- Manufacturer: Project Co. to submit proposals.
- Product reference: Project Co. to submit proposals.

440 REMOTE ACTING FIRE SAFETY VALVES

A solenoid shut off valve shall be installed in the main diesel oil supplies to the boilers and diesel daily service tanks. The valve shall be interlocked with the emergency knock off button.

- Standards: To BS 799-5 and OFS E101.
- Type: Electrical with battery back up to maintain valve open in the event of loss of power Manufacturer: Project Co. to submit proposals.
  - Product reference: Project Co. to submit proposals.

450 STRAINERS

Strainers shall be provided with meters

- Standard: To OFS E104.
- Manufacturer: Project Co. to submit proposals.
  - Product reference: Project Co. to submit proposals.

EXECUTION

Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety Regulations. This shall include clean and tidy working and working in confined spaces.

620 TANK INSTALLATION

- Standards: To BS 799-5 and in accordance with BS 5410-2.
- Steel tanks: Support on masonry piers built on concrete foundations. Run piers across the shortest base dimension of the tank.
  - Pier width: Slightly wider than the tank.
  - Fall: Arrange tank to slope slightly to drain off cock end.

630 OIL SUPPLY PIPELINES INSTALLATION

- Installation: In accordance with BS 5410-2 and OFTEC Technical Book 3.
- Buried pipelines: To OFTEC Technical Book 3.

COMPLETION

Project Co. shall protect the system from damage or interference during the works. Project Co. shall commission the fuel oil system as per section Y50 and 910 this shall include proving the pumps for auto change over and level indicators and alarms on all of the fuel oil system/fill system.

Project Co. shall submit O&M's. Project Co. shall provide training as per section Y50. Project Co. shall provide spares as per section Y50. 's defects and liability period shall be as the contract prelims.

910 COMMISSIONING

- Commissioning: In accordance with OFTEC Technical Book 2 and 5.

920 DOCUMENTATION

- Operation and maintenance instructions: Submit.
- Record drawings: Submit.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical**	Sheet	**WW AP.1.2.9 SMcK G1547**
Performance Specification Title	**Fire Hydrant System**	Date	**August 2014**
Prepared By	**DW**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Update for Financial Close	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
FIRE HYDRANT SYSTEMS

CONTENTS

1.0 GENERAL INTRODUCTION

Purpose of Document

The development of the design, manufacture, supply, installation, setting to work and commissioning of the works described in this document shall be undertaken by the Project Co..

To carry out the development of the design, Project Co. shall obtain the necessary supporting documentation.

This specification relates to the fire hydrants.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include, but not be limited to the following:-

- External Fire Hydrant System

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Performance Specification:-

- Incoming water mains to site
- External potable water supply pipes

4.0 INTERFACES AND DEMARCATIONS

The fire hydrant shall be provided as a complete working system serving the RHSC-DCN Building.

5.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

The Fire Protection Systems shall accord with all appropriate Hospital Technical Memoranda, Codes of Practice and relevant British and European Standards.

The equipment supplied shall conform with all relevant standards and regulations in force. The equipment shall be supplied with relevant Declarations of Conformity to certify compliance with the EMC directive 89/336/EEC-92/31/EEC and the Machinery Safety Directive 89/392/EEC-91/368/EEC-93/44/EEC. Also the equipment and installation shall comply with all relevant statutory requirements in force at the time:

The hydrant mains supply and fire hydrants shall comply with the requirements of BS 9990:2006; BS 9999:2008; Water for Scotland 2nd Edition 2007; Scottish Building Standards: Technical Handbook: Non-domestic Section 2.12, 2.13, and 2.14; and the requirements of the local Fire Authority and Water Authority respectively.

- The fire hydrant main services systems shall comply with the relevant clauses of SHTM 2023, 2027, 2040, SHTM 04-01, BS 9990, Scottish Water Byelaws 2004, and descriptions and requirements set out below.

6.0 DESIGN CRITERIA

To meet the requirements detailed in Water for Scotland 2nd Edition Section 2.3.9 and building control requirements.

7.0 LIAISON

The Specialist Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, the Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Other Specialist. The shall liase with other Specialists as necessary to ensure that all are allowed for.

Building Control. The Project Co. shall liase, with and adhere to, the requirements of the Building Control Officer, Fire Officer, Fire Engineering Consultant and any other member of the Project and Trust teams concerned with the planning and administration of the Fire Hydrant System.

8.0 SYSTEM DESCRIPTION

Incoming Fire Main Supply:

A separate fire main will run from the site boundary to serve fire hydrants and sprinkler tanks.

The fire mains will be unmetered.

The fire mains shall run around the main hospital building with 6No. 80mm DI minimum sub branches to serve the underground fire hydrants, and a 150mm DI branch to serve the sprinkler tanks.

The fire hydrants shall be in purpose made chambers below the ground in accordance with the requirements of Water for Scotland 2Nd Edition and the local Fire Authority and be fitted with a sluice valve.

The hydrant cover shall be as required by Strathclyde Fire & Rescue and badged fire hydrant.

A separate 150mm fire main branch from the site hydrant main shall enter the Acute/Children's Hospital at basement level and run within the basement corridor and water tank room to serve the Sprinkler tanks. This supply shall be unmetered.

Fire Cladding

The incoming fire main shall be fire clad where is passes through any non sprinklered areas on its route to the fire tank room.

S65 FIRE HYDRANT SYSTEMS

General

Fire hydrants shall be located as close as practicable to the main, preferably directly above the main, to reduce dead leg lengths to an absolute minimum.

The fire hydrant shall conform to BS 750: 2006 Specification for underground fire hydrants and surface box frames and covers and BS EN 14339: 2005 Underground fire hydrants

Hydrant main pipework shall be light weight ductile iron to BS EN 545 installed in accordance with the pipe manufacturers requirements.

Pipe in trenches shall be laid on a minimum of 100mm bed of <20mm gravel or coarse sand and trenches shall ensure 900mm cover, measured from the crown of the pipe.

Pressure testing shall be undertaken in accordance with the requirements of the pipe manufacturer, the local Fire Authority and Water Authority.

Backfilling shall be undertaken in such a manner so as to avoid any deformation of the pipe. Heavy compaction equipment shall not be used with less than 300mm of cover. A marker tape shall be laid 300mm above the crown of the pipe.

110 FIRE HYDRANT SYSTEM

This underground fire hydrants shall:

a) be installed in a water distribution system;
b) be size DN 80;
c) be suitable for a maximum allowable operating pressure (PFA) of 1.6 MPa or 2.5 MPa (16 bar or 25 bar);
d) be fitted with screw-down type valves; and with one outlet.

Comply with BS 750.
WRC approved materials of construction.
Standard outlet - 2½" male hydrant round thread (other options available).
Universal inlet flange (3" BS10 Table E or 80mm BS 4504 NP16)
Blank cap, chain and frost valve provided.

- Water source: Dedicated water storage and pumping facility.
- Distribution: High density (HPPE) polyethylene 100 to SDR 11 pipelines.
- Outlets: Underground fire hydrants.
- Accessories:
  - Indicator plates;
  - Surface boxes; and
  - Warning marker tape.
- Completion: The Board shall Test, flush and clean the system as per regulations, SHTM/HTM's, this specification and Fire officer requirements.

System Performance

All fire hydrant pipework exposed to the frost will be insulated or trace heated to prevent
freezing.

210 DESIGN

- Standards: To BS EN 806-2 and in accordance with BS 9990.
- Design: Complete the design of the fire hydrant system.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.
- Mains water supply to hydrants: Provide an independent water supply.
  - Evidence of capacity of mains water supply: Submit.

320 DUCTILE IRON PIPELINES

- Standard to BS EN 545
- Manufacturer: Saint Gobain
  - Product reference: Pam Natural Blutop
- Jointing: Anchor gasket

340 UNDERGROUND FIRE HYDRANTS

- Standards: To BS EN 1074-6 and BS 750.
- Hydrant type to BS EN 1074-6: Underground.
- Valve type to BS 750: Screw-down (type 2)
  Valve shall be
  Fully maintainable.
  " Ductile iron construction.
  " 2½_ London round thread gunmetal outlet to BS 750.
  " Exceeds flow requirements:
  -Kv = 92 minimum, 2000l/min,
  -Kv = 101 maximum, 2200l/min.
  " Corrosion resistant construction, compliant with BS EN 1074-6 for disinfection products.
  " Universal drilled inlet flange BS EN 1092-2:1997, BS 10 Table D/E.
  " Inlet is of a proprietary type.
  " Auto-frost drain valve as standard.
  " Draining stopper.
  " Kite marked.
  " Low weight design.
  " WRAS approved. .
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Duckfoot bend: Not required.
- Outlet material: Submit proposals.
- Plug: Submit proposals.
- Accessories: Spindle cap, outlet cap and frost valve.

350 INDICATOR PLATES Shall be installed adjacent Hydrant

- Standard: To BS 3251.
  - Class: A.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals .

- Material: Cast iron.
- Finish: Vitreous enamel.
- Colours:
  - Characters: Black.
  - Front surface: Reference number 309 (Canary yellow) to BS 381C.
- Accessories: As specification and schedule.

360 SURFACE BOXES Shall be suitable for application e.g. footpaths, heavy traffic.

- Standard: To BS 750.
  - Grade: Submit proposals.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Grey cast iron (CI).
- Finish: As structural Engineers specification.
- Marking: 'FIRE HYDRANT' in 30 mm high letters.
- Accessories: Lifting keys and Marker posts.

370 WARNING MARKER TAPES

- Manufacturer: Board's choice.
  - Product reference: Submit proposals.
- Type: Continuous colour coded, heavy gauge polyethylene identification tapes.
- Wire detection aid: Required.

Execution

The Board shall Test, flush and clean the system as per regulations, SHTM/HTM's, this specification and Fire officer requirements

610 ISOLATION

- Connection to existing fire hydrant systems: Provide an isolation valve and non-return valve.

630 INSTALLATION GENERALLY

- Fire hydrant position: Unobstructed by the parking, loading and unloading of vehicles.
- Protection: Protect from damage, e.g. by frost, traffic loads or vibration.

640 INSTALLING PIPELINES

- Depth of cover: As NJUG.
- Set out: Lay in straight lines.
- Concealment: As drawings.
- Trench excavations: Carefully prepare to a firm even base. Remove sharp objects and replace with pea gravel to give 100 mm (minimum) cover above and below the pipe.
- Installation: Thoroughly clean lengths of pipe internally before laying. Temporarily cap until jointing takes place. After laying and jointing keep leading end capped.
- Thrust blocks: Install at changes of direction and blank ends.

- Backfilling: Excavated material free from large stones and sharp objects. Leave joints exposed until after pipeline pressure test. Lay and compact in 300 mm maximum layers.
- Do not use heavy compactors before backfill is 600 mm deep.

650 INSTALLING UNDERGROUND FIRE HYDRANTS

- Installation: In accordance with BS 9990.
- Depth (maximum): 300 mm from hydrant outlet to finished ground level.
- Details of pit construction: Submit proposals.

660 INSTALLING SURFACE BOXES

- Clear openings: To BS 750.
- Frame depth:
  - Grade A: 100 mm.
  - Grade B: 75 mm.
- Frame width: 75 mm.
- Fit of frames and covers: Set top of cover flush with top of frame.

670 INSTALLING INDICATOR PLATES

- Aluminium plates: Aluminium alloy, zinc coated steel or copper alloy screws.
- Plastics plates: Zinc coated steel screws or adhesive.
- Ferrous plates: Zinc coated steel screws or bolts.

680 INSTALLING WARNING MARKER TAPES

- Installation: During backfilling, lay along the route of the hydrant main.
- Location, depth, colour and markings: To requirements of service undertaker.

Completion

910 FLUSHING

- Operation: Fill system with water and discharge it via the hydrant. Flush out debris.

920 TESTING

- Standard: To BS 6700.
  - Notice before commencing testing (minimum): 1 week.
- Static pressure test: Charge the system with water twice the maximum pressure to which the installation is designed to be subjected in operation. Maintain for 1 h. During this period check that no water leaks from joints or valves.
  - Results: Submit.
- Flow test: Pass water through the system under pressure and record flow and pressure readings.
  - Timing: After static pressure test.
  - Results: Submit.

930 SYSTEM DISINFECTION

- Standard: To BS 6700.
- Certification: Submit disinfection certificate.

940 SETTING TO WORK

- Operation: Check operation of hydrant valves.
- Make ready: Check operation of frost valve and leave ready for use.

950 DOCUMENTATION

O& M documentation shall be issued at least three months before completion of any part of the contract.
The contents and format shall be agreed with the Board. The document shall be issued/uploaded on Acconex.

The Specialist shall provide instruction to the clients Engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the Manufactures recommendations and best practice.
The Specialist shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

- Manufacturers' operating and maintenance instructions: Submit.
- Test records: Submit a record of inspections and tests.
- Record drawings: Submit drawings showing location of pipe runs, hydrants and valves.

960 OPERATING TOOLS

- Tools: Supply for operation, maintenance and cleaning purposes.
- Keys: Supply for hydrants.
  - Quantity: as per contract requirements.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical**	Sheet	**WW AP.1.2.16 SMcK G1547**
Performance Specification Title	**Water Treatment Equipment**	Date	**August 2014**
Prepared By	**DW**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
FC	July 2014	All	Update for Financial Close	SMcK
FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
WATER TREATMENT EQUIPMENT

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The development of the design, manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by the Mechanical and Electrical Installer and is referred to in this document as

To carry out the development of the design, the Specialist shall obtain the necessary supporting documentation.

This specification relates to the Water Treatment Equipment serving the RHSC-DCN Buildings.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include, but not be limited to the following:

- The Water Filtration Plant for the raw incoming mains water supply
- The Endoscopy washer plant

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Specification.

- The domestic cold water service
- The domestic hot water service
- Site Water Mains

4.0 INTERFACES AND DEMARCATIONS

The Water Filtration plant shall be provided as complete working systems serving the RHSC-DCN Building. The Project Co. shall provide information to other parties including for power supplies and BMS interfaces.

5.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

The water treatment plants shall accord with all appropriate Scottish Health Technical Memoranda, Scottish Health Technical Notes, Codes of Practice and relevant British and European Standards, Scottish Water Regulations and to the approval of the local water authority.

6.0 DESIGN CRITERIA

Generally the water filtration plant shall comply with the Scottish Water Regulations and current Codes of Practice

7.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of Parts A, B and C of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Trust's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Other Specialist. Project Co. shall liaise with other Specialists as necessary to ensure that all interfaces between the water treatment equipment installations and other systems are allowed for.

The Local Water Supply Undertaker. Project Co. shall liaise with Scottish Water or their licensed agents to ensure that all aspects of the installation comply with the Scottish Water Regulations.

Any other member of the Project and Board teams concerned with the planning and administration of the Water Treatment Equipment.

SYSTEM DESCRIPTION

General

Water treatment equipment shall be provided to meet user requirements and shall include membrane filtration. Separate plants shall be provided to the following areas:-

Roof Plant Room (Water Filtration plant)

Basement Tank Room

Water Filtration Plant Equipment

Twin packaged membrane filtration plant units shall be housed in the basement tank room and shall be served from the raw cold water storage tanks connected to the incoming water mains. The filtration plant shall filter the water to the criteria set out in SHTM 04-01 with 0.5 micron filtration.

The twin package filtration plant shall supply the storage tanks also housed within the basement tank room. Each package unit shall be capable of supplying 50% of the total flow required to the main tanks.

Each of the two package filtration plants shall be supplied and fitted with their respective air receivers and compressors, internal pumps, and control panels. These items are to be fitted as part of the package unit and shall be supplied by the filtration unit manufacturer.

Hourly backwash of the filter membranes shall be by a compressed air/water mix and shall discharge to a sealed holding tank within the main tank room prior to pump discharge to drain.

The twin filtration units shall be connected to the BMS and shall be fitted with a shut down warning and alarm.

MATERIALS AND WORKMANSHIP CLAUSES

S12 WATER TREATMENT EQUIPMENT

330 FILTRATION UNITS

All Incoming water for wholesome storage shall pass through a low pressure filtration system. This system shall be duplicated and served by duplicate break tanks. Each filtration unit shall be capable of supplying 50% peak water demand to the bulk cold water tanks.

Each filtration unit shall be a complete package unit including air compressor/receiver, control panel and integral pump.

Manufacturer: [TBC].
Product reference: [TBC].
Water flow rate: [TBC].
System pressure: [TBC].
System temperature: [4C-15C].
Particle removal capability: [0.5 micron].

All pipework to be in PVC.

EXECUTION:

The Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety regulations.
This shall include clean and tidy working and working in confined spaces.

COMPLETION:

The Project Co. shall protect the system from damage or interference during the works.
The Project Co. shall Test, flush and clean the system.
The Project Co. shall submit O&M's as per section
The Project Co. shall provide training as per section Y12, Y40 & Y50.
The Project Co. shall provide spares as per section Y12, Y40 & Y50.
The Project Co. defects and liability period shall be as the contract prelims.

910 DOCUMENTATION:

O& M documentation shall be issued at least three months before completion of any part of the contract.
The contents and format shall be agreed with the Board. The document shall be issued/uploaded on Aconex.

Project Co. shall provide instruction to the clients engineers and maintenance staff in the safe operation of all systems and items of equipment for an adequate and reasonable period of time based on the manufactures' recommendations and best practice. Project Co. shall provide adequate and qualified staff in order to carry out their maintenance and repairs during the defects liability period.

920 SPARES AND CONSUMABLES:

Required spares:
- Filters: [2 of each type].

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.7 SMcK G1547**
Performance Specification Title	**Computer Room Cooling Systems**	Date	**August 2014**
Prepared By	**MM**	Checked By	**SMcK**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	SMcK
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FC	August 2014	All	Comments Incorporated	SMcK

RHSC and DCN EDINBURGH
COMPUTER ROOM COOLING SYSTEM

CONTENTS

1.0 GENERAL INTRODUCTION

Purpose of Document

The development of the manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by the Mechanical and Electrical Installer and is referred to in this document as “”.

To carry out the development of the design to form the installation, the Specialist shall obtain the necessary supporting documentation.

This specification relates to the single computer room cooling services for the RHSC-DCN Building.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Fans & Pumps

All fan assemblies shall incorporate fan impeller and motors selected to provide the most energy efficient solution conforming to Section 6 regulations. All fans and pumps shall be fitted with IE2 efficiency motors to EN 60034-30:2009 as standard, and suitable for operation in ambient temperatures of 40 degrees C.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this specification shall include, but not be limited to the following:-

- Computer room cooling equipment
- Power distribution to all equipment associated with the installation
- BMS interfaces

3.0 PERFORMANCE SPECIFIED SYSTEMS

The following is specifically excluded from the scope of this specification:-

- BMS and automatic control systems

4.0 INTERFACES AND DEMARCATIONS

The computer room cooling systems shall be provided as a complete working system serving the NHS-DCN Building. Project Co. shall provide information to other parties for BMS and fire alarm system interfaces.

5.0 APPLICABLE STANDARDS

All elements of the works shall be in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

The Fire Protection Systems shall accord with all appropriate Health Technical Memoranda, Codes of Practice and relevant British and European Standards listed in SHTM2009.

The equipment supplied shall conform with all relevant standards and regulations in force. The equipment shall be supplied with relevant Declarations of Conformity to certify compliance with the EMC directive 89/336/EEC-92/31/EEC and the Machinery Safety Directive 89/392/EEC-91/368/EEC-93/44/EEC. Also the equipment and installation shall comply with all relevant statutory requirements in force at the time.

6.0 DESIGN CRITERIA

Mains Chilled Water System

Mains Chilled Water Flow Temp	-	6°C
Mains Chilled Water Return Temp	-	12°C

Computer Room Cooling Water System

Cooling Water Flow Temp	-	6°C
Cooling Water Return Temp	-	12°C

7.0 LIAISON

The Specialist Installer shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Specialist Installers. Project Co. shall liase with other specialist Installers as necessary to ensure that all interfaces between the Fire Detection and Alarm System and other systems are allowed for. This shall include but not be limited to:-

- Building Management System specialist
- Fire Alarm and Detection specialist

The Electrical Services Board. Project Co. shall liase with the Electrical Services Installer to provide details of:-

5. Computer room cooling power supply requirements
6. Cable tray requirements

Building Control. Project Co. shall liase, with and adhere to, the requirements of the Building Control Officer.

Any other member of the Project and Trust teams concerned with the planning and administration of the PTS.

8.0 SYSTEM DESCRIPTION

General

There is a single core server room within the hospital located on the second floor of the main building.

The main core server room air-conditioning systems shall be fed from the main chilled water system. The computer room shall be provided with an independent system via a dedicated secondary chilled water circuit having its own plate heat exchanger and circulating pumps.

CRACs shall be floor standing ‘downflow’ type and shall be capable of being fully interrogated by the building management system through the independent network protocol.

To comply with these directives appropriate national & harmonised standards have been applied. These are listed on the Declaration of Conformity, supplied with each product.

Unit cabinets shall be manufactured from galvanised sheet steel coated with epoxy baked powder paint to provide a durable finish. Internal strength and rigidity shall be provided by a welded space frame constructed of channel profile folded steel. Cabinets shall be lined internally with fire resistant 20mm foam (UL94 V0) for thermal and acoustic insulation. Cabinets shall meet the Hospital acoustic and vibration requirements. The cabinet doors are full height, hinged and key lock secured. Door arrangement shall allow flexible door opening/removal for improved access. Doors shall have rubberised door seals reduce sound breakout and eradicate leakage.

The units shall have large surface area coil(s) to optimise airflow and heat transfer, manufactured from refrigeration quality copper tubes with mechanically bonded aluminium fins.

Fins shall be coated with a non-stick acrylic film to provide additional corrosion protection and efficient surface water removal for improved performance.

Coil headers shall be circuited to ensure low water pressure drops. The cooling coils shall be mounted over a full width stainless steel condensate tray. Chilled water flow shall be via a factory fitted 3 port modulating control valve.

All coils shall be Factory pressure tested to 20Bar.

Fans shall be backward curved impellers, direct drive centrifugal fan assemblies with integral rotor mounted motor which is statically and dynamically balanced for quiet operation. Designed for high corrosion resistance, the impellers shall be laser welded aluminium with galvanised rotor and die cast aluminium EC power module. An inbuilt EC fan control module shall allow the fan to modulate from 15-100%.

Filters shall be 97mm pleated disposable panel filters in a rigid frame. Conform to BS EN 779-G4.

Access and removal from unit front. An adjustable diaphragm pressure switch fitted across the filter assembly shall monitor pressure drop which shall initiate a filter dirty alarm.

The control panel shall have fan motor contactors and overloads, transformer, sub circuit protection, volt free contacts, mains and inter-connecting terminals. The panel shall be fitted within the cabinet and be hinged for easy access to other components within the unit. The electrical control panels shall be wired to the latest European standards and codes of practice.

To ensure complete unit isolation of the electrical panel during adjustment and maintenance a door interlocking isolator shall be provided as standard.

Units shall be fitted with the microprocessor controller which shall have a real time clock and a communication port plus networking and Bac Net BMS connections. A backlit LCD door mounted display keypad assembly shall be fitted to view the unit status and allow operator adjustment.

The condensate pump shall have a reservoir with a capacity of 5 l/m at a head of 10.8m.
Leak detection tape suitable for sensing water droplets shall be supplied loose for remote mounting on site.

- Project Co. shall provide technical proposals.
- Arrangement: Vertical.
- Casing: Steel frame with acoustically lined steel panels.
- Finish: Manufacturer's standard.
  - Colour: Manufacturer's standard.
- Controls: All controls must be capable of being fully interrogated by the building management system through the independent network protocol.

Controls

The terminal cooling units shall be fitted with a microprocessor controller which provides analogue and digital control to meet a wide range of monitoring and control features including a real time clock and a communication port plus networking and BMS interface connections.

The cooling units shall be capable of being fully interrogated by the building management system through the independent network protocol.

The cooling units shall be provided with “fail safe” mode: in the unlikely event of failure the units shall automatically switch to maximum cooling output.

The cooling units shall be fitted with a display and local controls to view the status and allow operator adjustment.

The following values shall be monitored:

- Return Air Temperature
- Return Air Humidity
- Supply Air Temperature
- Cooling Water Flow Temperature
- Cooling Water Return Temperature
- Fan Speed Control
- Operating Status
- Audible Alarm

An alarm shall be generated on the BMS system under the following conditions:

- Return air temperature high limit
- Return air temperature low limit
- Return air humidity high limit
- Return air humidity low limit
- Supply air temperature high limit
- Supply air temperature low limit
- Airflow failure
- Filter change alarm
- Manual override
- Power fail reset
- Communications failure
- Maintenance (once hours run limit exceeded)

Metering

The computer room cooling's plant shall be separately metered in order to monitor the operational Power Utilisation Efficiency (PUE).

The computer room chilled water system shall be provided with heat meters in order to monitor the operational Power Utilisation Efficiency (PUE).

Electrical meters monitoring the lighting and general power for the computer rooms shall be provided separately.

Cooling Units

The cooling units shall be supplied with condensate pumps and backup drip tray drainage. The backup drip tray drainage shall fall to drain.

All cooling units shall be supplied with associated control valves which shall be compatible with the hydraulic characteristics of the cooling water system and the BMS system.

All cooling units shall be capable of having their fans replaced without shutting down that particular cooling unit.

The cooling unit shall be provided with EC motor drive fan assemblies in order to minimise the energy usage of the system.

The pipework system from the header to the cooling units shall be installed as a single length of pipe, shall be insulated and be provided with leak protection. Flexible Multi-Layer Composite Pipework (MLCP) is recommended.

Execution

All pipework and headers shall be pressure tested to at least twice the working pressure of the cooling water system.

Project Co. shall ensure all works carried out shall be done is a safe manner and comply with Health and Safety Regulations. This shall include clean and tidy working and working in confined spaces.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.19 JB G1547**
Performance Specification Title	**Small Power Systems**	Date	**August 2014**
Prepared By	**PM**	Checked By	**JB**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	JB
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RHSC and DCN EDINBURGH
SMALL POWER SYSTEMS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The development of the design, manufacture, supply, installation, wiring, setting to work and commissioning of the works described in this document shall be undertaken by the Mechanical and Electrical Installer and is referred to in this document as

To carry out the development of the design, the Specialist shall obtain the necessary supporting documentation.

This specification relates to the Water Treatment Equipment serving the RHSC-DCN Buildings.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include the following:-

- Metal encased prefabricated wiring systems
- Small power installation

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Specification:-

Materials and Workmanship clauses for Small Power accessories (covered by refer to Section Y65; Specification WW AP.1.2.22 Common Electrical Clauses)

4.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of SHTM 06-01, NBS clause V40, IET Wiring Regulations BS 7671 (17th Ed.) IEE Guidance Note 7, MEIGaN v2.0 September 2007, BSEN60601-1-1-2001, current legislation, regulations and standards stated in materials and workmanship clauses.

5.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

Drawings

As part of the development of the design Project Co. shall prepare general arrangement drawings of the Small Power System based on the base drawings and coordinated with other services and building elements. A proposed drawing list shall be submitted with the tender.

6.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Any other member of the Project and Hospital teams concerned with the planning and administration of Small Power installations.

7.0 SYSTEMS

This part of the Specification shall be read in conjunction with the attached NBS clause V40 and the Common Electrical Clauses specification, WW AP.1.2.22 which contains clauses for cables, conduits, trunking, cable supports and wiring accessories.

7.1 Prefabricated Wiring Systems

Project Co. shall supply and install a metal encased prefabricated wiring system installation complete with all necessary components as detailed in the attached NBS clause V40 to provide the required system wiring as detailed on the small power layouts.

Note also that the lighting installation specification WW AP.1.2.30 includes clause V50 which includes specific requirements for metal encased prefabricated wiring systems for the lighting installation.

7.2 Small Power System

Description

Project Co. shall supply and install the complete small power installation, including the following:-

- All cable containment required for the complete small power installation
- All wiring required for the complete small power installation
- All supports necessary for the complete small power installation
- All accessories, sockets, etc, for the complete small power installation
- Connections to equipment
- Connections to local mechanical services equipment outside of the plantrooms e.g. smoke dampers, fan coil units, over door heaters
- Connections to power supplies for specialist low current systems e.g. fire alarms, security, nurse call, etc.

General Requirements

The drawing series WW-PL-531 shall indicate the allocation of circuits to each room, together with a set of wiring 'rules' to be followed. The services drawings shall be read in conjunction with the Distribution Board Schedules which specify breaker ratings and types and cable sizes and types for final circuits. The services drawing shall also be read in conjunction with the loaded 1:50 drawings which indicate locations and ADB codes of all power outlets required by the Hospital.

All areas except where indicated below shall have flush small power installations.

The exceptions to this are:-

- plantrooms
- risers
- switch cupboards
- lift motor rooms
- ceiling voids
- switchrooms
- substations
- FM Workshops
- UPS rooms
- Basement corridors

These areas shall have surface installations.

Surface mounted installations shall have metal clad accessories.

In SHTM 06-01 Clinical Risk Category 1 and 2 areas, accessories for flush or recessed installations shall have white plastic accessory plates.

“Category 1 – Support service circulation. …… The areas include circulation spaces, waiting areas, offices and nonpatient care areas such as laboratories or finance departments.…” extract from SHTM 06-01.

“Category 2 – Ambulant care and Diagnostics. …..The areas may include patients in consultation (excluding examination) or general out-patient areas. Loss of supply may give rise to disruption, inconvenience and a reduced environmental quality but would not directly compromise patient clinical treatment and safety…” extract from SHTM 06-01.

In SHTM 06-01 Clinical Risk Category 3, 4, and 5 areas, socket outlets shall have metal accessory plates.

“Category 3 – Emergency care and Diagnostics …..These areas relate to the patient environment of group 0 under Chapter 10 in ‘IEE Guidance Note 7’. Patients are not generally connected to any electro-medical equipment. However, medical monitoring or medical test equipment may occasionally be used and connected externally to the patient’s body for a short or intermittent time (for example patient monitors or ultrasound machines). ….” extract from SHTM 06-01. Such rooms would include treatment rooms, exam rooms, consultation rooms where examination occurs, Exercise Test Lab, Investigation room, Assessment room and Audiology booths.

“Category 4 – Patients in special medical Locations. These areas will relate to the patient environment of group 1 under Chapter 10 [now 9] in ‘IEE Guidance Note 7’…. “ extract from SHTM 06-01.

Category 4 circuits will be identifiable by virtue of the fact that they will be RCD protected. Bedded areas in Wards shall be considered to be Category 4 areas, as shall endoscopy rooms, ECG, EEG, nuclear medicine, emergency centre, haemodialysis, parts of category 5 areas outside the patient environment, urology treatment, ultrasound.

“Category 5 – Life support or complex surgery These areas will relate to the patient environment of group 2 under chapter 10 in ‘IEE Guidance Note 7’. The areas are defined as operating theatre suites, critical care areas, cardiac wards, catheterising rooms, accident & emergency resuscitation units, MRI, angiographic rooms, PET and CT scanner rooms. Patients may have electro-medical equipment, medical monitoring or medical test equipment (for example intracardiac procedures) connected externally or internally to their bodies.. “ extract from SHTM 06-01.
Category 5 circuits will be identifiable by virtue of the fact that they will be IPS protected.

Socket outlets fed by IPS units shall be double pole or un-switched, clean earth sockets, with metal front plates, colour-coded blue, engraved in white lettering ‘Medical equipment only’. If white sockets are preferred, they shall be mounted on a blue background, approximately 2 cm larger than the socket. The socket to be engraved ‘Medical equipment only’ in blue. Engraving shall be filled to allow clinical cleaning.

The small power allocation drawings indicate the Clinical Risk Category and MEIGaN grouping of each room.

The finish shall be consistent throughout the installation.

Where accessories are flush mounted within partition walls, Project Co. shall ensure that fire and acoustic integrity are maintained. This also applies to concealed service drops within partition walls. Where services or accessories are installed on both sides of partition walls, back-to-back services drops or recessed accessory boxes shall not be permitted.

A and B side cables shall be run in separate containment up to bedhead trunking unit.

The wiring system shall generally be a metal encased prefabricated system. Armoured flexible conduits shall be run on wire cable baskets.

The small power installation shall be installed by means of metal encased prefabricated wiring systems except in areas of non demountable ceilings, such as Theatre suites, where they shall be wired by means of single core LSZH insulated copper single core cables run in a loop in conduit system whereby access to the wiring system is only at accessories. This shall also apply to conduits provided for power cabling to Theatre panels and Theatre PACS units.

Project Co. shall refer to the Architects general arrangement, wall elevations for detailed mounting locations.

Where several accessory plates are located together, these shall be mounted at the same height in a horizontal row, as appropriate, unless indicated otherwise on Architects drawings. All socket outlet fused connection unit boxes shall be fitted with an earth screw terminal pillar. Project Co. shall bond the socket outlet or fused connection unit to this terminal using green/yellow coloured LSF insulated cable in compliance with BS7671 (17th Ed.).

Note: All power circuits serving patient areas shall be provided with a 30 mA RCD (with Class A characteristics), together with the associated protective MCB at the circuit origin at the distribution board (i.e. an RCBO).

Socket Outlets

Unless otherwise specified, socket outlets shall be switched 13A, 3-pin to BS 1363.

Where socket outlets are required to be inset into cable trunking they shall be of the panel mounted type, unless noted otherwise in later sections of this specification or shown on the drawings. In metal trunking the plastic insets around the socket receptacles shall project above the surface of the metal trunking, in accordance with the British Standard.

In SHTM 06-01 Clinical Risk Category 1 and 2 areas, where sockets are to be mounted in plastic dado trunking, completely recessed plastic faced socket outlets shall be used and a suitable means of maintaining segregation provided.

Trunking in SHTM 06-01 Clinical Risk Category 3, 4 and 5 areas shall be metal, fitted with socket outlets with metal front plates, as required by SHTM 06-01.

Where sparkless switch socket-outlets are specified, they shall have single pole switches (tilting mercury pattern) which shall interlock with the plug.

Switches shall be of the micro gap pattern and sockets shall have insulating sleeves around the pin apertures. Sockets shall be shuttered on the live and neutral outlets so that entry of three pins of the plug is required to open the shutters.

Plug tops of the finger-shield pattern with insulated pins shall be provided for each outlet installed including outlets in floor outlet boxes.

All power circuits shall be provided with high integrity earthing. Refer to WW AP.1.2.25 for earthing requirements.

Small power circuits wired by means of 4mm^2 radial circuits in metal conduits will achieve high integrity earthing as a matter of course without the need for any further special measures.

Fused Connection Units

Fused connection units shall be manufactured in compliance with BS 1363 with captive fuse holder and fuse rated at 13 A, or to suit the item of equipment services, as appropriate. Where switched, the switch shall be of the micro gap pattern.

Fused connection units shall be provided with fuse carriers that remain attached to the frontplate when opened and can be padlocked for safety. Tamperproof screws on fuse carriers shall be provided for fused connection units in public areas.

Concealed conduit shall be provided from any fused connection unit to other accessories served by it (e.g. unswitched socket outlets for refrigerators).

Face plates, boxes, finishes, etc. shall be as specified for socket outlets.

The outgoing cables from fused connection units shall not be rated less than the fuse rating.

Accessories Requiring Ingress Protection

In areas where water is likely to come into contact with electrical services, accessories shall have a suitable degree of protection. In all such areas the minimum degree of protection shall be IP56. Refer to Room Data Sheets for IP protected accessories.

Cleaners Sockets

All cleaner sockets shall be engraved with the legend “CLEANERS USE ONLY” in 4 mm high black uppercase letters. Engraving shall be filled to allow clinical cleaning. Cleaners socket finishes shall match other sockets in the room.

Childproof Socket Outlets

In waiting areas or any other area where small children are likely to be present, 13 A socket outlets shall be childproof. This shall be achieved by at least meeting the requirement that the shutters permit the insertion of pins into the socket only if all three pins are simultaneously inserted.

Imaging Department Supplies

Power supplies to diagnostic imaging and radiotherapy rooms / suites shall be compliant with the MEIGaN V2.0 September 2007 document published by MHRA.

The steel wire armour of supply cables to fixed imaging equipment shall not be used as the mains supply earth conductor. Three phase supplies shall utilise 5 core cables, single phase supplies shall utilise 3 core cables.

Isolators in imaging rooms shall be lockable in the off position.

A remotely operated contactor shall be fitted in the mains supply of three phase medical devices sited adjacent the mains supply isolator and Earth Reference Bar (ERB) (see separate earthing & bonding systems specification, WW AP.1.2.25). ERB, contactor and isolator enclosures shall be white. The contactor shall isolate all three phase contacts, including the neutral, and shall be capable of interrupting maximum load. The contactor control circuit shall be on the same phase as the room socket outlets. The contactor and isolator shall both be of a grade suitable for frequent use.

Three-phase supplies feeding medical devices shall have a phase rotation and voltage monitoring device installed, except where such a device forms part of the installed equipment. This device shall prevent the contactor from energising with:

- under- or over-voltage condition on any phase
- incorrect phase sequence
- phase loss
- neutral loss
- phase-neutral faults.

The under- and over-voltage limits shall be provided by the equipment manufacturer. The monitoring device shall be interlocked to prevent disconnection of the supply during an exposure.

The contactor shall be switched ON by a green momentary push and OFF by a red push. Red emergency OFF buttons shall be located in a suitable location in the room and shall incorporate a protective shroud and key reset.

Illuminated warning signs shall derive supply from the contactor.

All accessory boxes in imaging rooms shall be plastic, including for light switches.

Illuminated warning signs

For all X-ray equipped rooms, the X-ray warning signs external to each room shall be interlocked with the equipment such that when the X-ray power supply in a room is energised the ‘radiation warning’ section illuminates, and when the equipment is in operation the “do not enter” section illuminates.

For all laser equipped rooms, the laser warning signs external to each room shall be interlocked with the equipment such that when the laser power supply in a room is energised the ‘laser in use’ section illuminates, and when the equipment is in operation the “do not enter” section illuminates.

NHS to ensure equipment is compatible with warning signs.

Sockets serving portable equipment to be provided with additional contacts for illuminated warning signs.

Controlled Drugs Cabinet Supplies

Any fused connection unit serving a controlled drugs cupboard alarm shall be installed inside the cabinets so that access to it is possible only when the cupboard is open. These connection units shall be of the unswitched type.

Lead Lined Walls

Project Co. shall review the final layout wall construction drawings and note where lead lined walls are provided. These are normally associated with the imaging department. Where lead lining is provided, all the lead lining shall run behind the recessed accessory box, or a lead plate is to be installed behind the recessed accessory box and oversized as necessary to block all possible beam angles possible through the cut out. In any case, the solution must be agreed with the Radiation Officer.

Lead lining to be bonded to the Earth Reference Bar (ERB) within the associated room.

Provisions for Catering

Freezer/ Cold Room: Kitchen in Basement and Restaurant Kitchen on 4th Floor

The freezer rooms and cold rooms in the main kitchen in the basement and the restaurant kitchen will be provided and partially fitted out by a Specialist. The lighting within the cold rooms will be provided by Catering Specialist. The small power in the cold rooms shall be installed by . Conduits will be provided by the Catering Specialist in the cold room walls terminating above the ceiling for the use of .

Project Co. shall provide a power supply to a connection point for each cold room control panel. Cabling details are indicated on the distribution board schedules.

Project Co. shall provide power supplies to the cold room condenser units.

Kitchens: Restaurant Kitchen on 4th Floor

Power supplies to catering equipment shall be provided by . Generally all fixed outlet wining points shall be installed to within 1m of the point of connection. The Catering Specialist will then be responsible for all final connections and commissioning of the equipment.

Fourth floor and basement kitchen distribution boards shall be fitted with emergency power off contactor and two shrouded knock off buttons provided.

Provisions for Workshops

Circuits serving workbenches within workshops shall be fitted with emergency power off buttons as identified on the architect's fully loaded drawings.

Core Server Room

Small power in the core server room will be provided as detailed on the power and UPS schematics.

In general terms power supplies to each cabinet shall be twin 32A ‘Commando’ sockets derived from a separate A+B side PDU.

Hub room power requirements will generally depend on the quantity of racks/ cabinets provided however as a rule each cabinet will be provided with the following:

- 1 No. 32A ‘Commando’ type socket outlets
- 1 No. 13A switched fused connection unit

Both supplied from within the Node room shall be derived from a single dedicated Node room DB.

V40 Small power systems

To be read with section Preliminaries/ General conditions.

GENERAL

110A HARD WIRED LOW VOLTAGE SMALL POWER SYSTEM WITH CONDUIT

- Origin of supply: Low voltage distribution system, as section V30.
- Final circuit cabling:
  - Types: LSZH singles, as section V32.
  - Sizes: As Circuits schedule.
- Containment: Rigid conduit, as section Y60 and Trunking or ducting, as section Y60.
- Rewireable installation: Required.
- Concealed installation: Required.
- Final connections: Required.
- Partial installation: Not required.
- Outlets:
  - Electrical accessories as section Y65 - refer to specification WW AP.1.2.22

  Common Electrical Clauses;
  - As room data sheets; and
  - As architect's load drawings at 1:50 scale.

  Completion:
  - Electrical identification: As section V80.
  - Testing and inspection: As section V39.

120 LOW VOLTAGE SMALL POWER SYSTEM WITH PREFABRICATED WIRING Generally.

- The Board shall ensure that there is at least one spare circuit available in each home run cable. Origin of supply: Low voltage distribution system, as section V30.
- Standards

  System generally: BS 8488

  Connectors: BS EN 61535 and BS EN 61984 as appropriate

  Final circuit cabling:
  - Types: Prefabricated LSZH insulated singles metal encased in flexible conduit.
  - Sizes: As Circuits schedule.
- Containment: Cable basket, as section Y63.
- Rewireable installation: Required.
- Concealed installation: Required.
- Final connections: Required.
- Partial installation: Not required.
- System components:
  - Connection cables;
  - Extender leads;
  - Home run cables;
  - Master distribution boxes;
  - Slave distribution boxes;
  - Starter leads; and
  - 'T' connector

- Outlets: - Electrical accessories as section Y65 - refer to specification WW AP.1.2.22 Common Electrical Clauses;
  - As room data sheets; and
  - As architect's load drawings at 1:50 scale.
- Accessories: Not applicable.
- Completion:
  - Electrical identification: As section V80.
  - Testing and inspection: As section V39.

PRODUCTS

335 PREFABRICATED CABLING PRODUCTS GENERALLY

- Connectors:
  - Standard: To BS EN 61535 and BS EN 61984 as appropriate. Submit certification
  - Type: Manufacturer's standard.

340 PREFABRICATED LSZH INSULATED SINGLES IN FLEXIBLE CONDUIT

- Standards:
  - Cable: To BS 7211.
  - Flexible conduit: To BS EN 61386-23. Submit certification
- Approval: British Approvals Service for Cables (BASEC) certified.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Flexible thermosetting insulated single core cables (LSZH singles, H07Z-K):
  - Construction: To BS 7211, table 3b.

350 CONNECTION CABLES Prefabricated wiring system.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Cable type: Prefabricated LSZH insulated singles metal encased in flexible conduit.
  - Number of cores: Board's choice.
  - Size: Board's choice.
- Length: Board's choice.
- Connectors:
  - Arrangement: One fully shrouded male connector and one fully shrouded female connector.
  - Poles: Board choice.

355 MASTER DISTRIBUTION BOXES Prefabricated wiring system.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Distribution box: Galvanized sheet steel with recessed input and outgoing connections.
- Rating: Board's choice.
- Connectors:
  - Power input connection: Hard wired via home run cable.
  - Power output connector type: Fully shrouded female connector.
- Outgoing connections:
  - Quantity: Board's choice.
  - Poles: Board's choice.

360 SLAVE DISTRIBUTION BOXES Prefabricated wiring system.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Distribution box: Galvanized sheet steel with recessed input and outgoing connections.
- Rating: Board's choice.
- Connectors:
  - Power input connection: Board's choice.
  - Power output connector type: Fully shrouded female connector.
- Outgoing connections:
  - Quantity: Board's choice.
  - Poles: Board's choice.

365 HOME RUN CABLES Prefabricated wiring system.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Cable type: Prefabricated LSZH insulated singles metal encased in flexible conduit.
  - Number of cores: 6 circuit or 9 circuit.
  - Size: Board's choice.
- Length: Board's choice.
- Connector arrangement: One fully shrouded male connector and one free cable end.

370 STARTER LEADS Prefabricated wiring system.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Cable type: Prefabricated LSZH insulated singles metal encased in flexible conduit.
  - Number of cores: Board's choice.
  - Size: Board's choice.
- Length: Board's choice.
- Connectors:
  - Arrangement: Board's choice.
  - Poles: Board's choice.

375 'T' CONNECTORS Prefabricated wiring system.

- Standard: To BS EN 61535. Submit certification
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Cable type: Prefabricated LSZH insulated singles metal encased in flexible conduit.
  - Number of cores: Board's choice.
  - Size: Board's choice.
- Length: Board's choice.
- Connectors:
  - 'T' arrangement: One fully shrouded male connector and one fully shrouded female connector.

EXECUTION

610 SMALL POWER INSTALLATION

- Standard: To BS 7671.

630 INSTALLING CABLING TO SOCKET OUTLETS

- General: Wire in radial final circuits without spurs as distribution board schedules.

670 INSTALLING PREFABRICATED WIRING

- Connection arrangement: Form circuits using a male connector working away from any master distribution boxes.
- Fixing master/ slave distribution boxes: Board's choice.
- Fixing cabling:
  - Maximum distance between clips:

  Prefabricated LSZH insulated singles metal encased in flexible conduit (home run cables): 1000 mm.

  Prefabricated LSZH insulated and sheathed multi-core: 500 mm.
  - Clipped in accordance with manufacturers recommendations.
  - Bends: Not permitted within 150 mm of connectors.

COMPLETION

920 DOCUMENTATION

- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system
- Operation and maintenance instructions: Submit.
- Kit of parts of prefabricated wiring system: Submit.
- Record drawings: Submit.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.20 JB G1547**
Performance Specification Title	**Low Voltage Distribution**	Date	**August 2014**
Prepared By	**JB**	Checked By	**PM**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	PM
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
LOW VOLTAGE DISTRIBUTION

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

APPENDICES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include, but not be limited to the following:-

- Low voltage distribution system including switchgear and cables
- Installation of transient overvoltage surge suppression devices within the main LV switch boards
- Integration with the LV switchboards of suitable controls for the ENMS (electrical network management system).
- Busbar trunking

- Automatic Power Factor Correction equipment
- Provision for future Harmonic Filtering Equipment.
- Voltage optimisation equipment

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Specification:-

- Low voltage cabling (Materials and Workmanship clause V32 covered by Specification WW.A.P.1.2.22)
- Electrical identification (Materials and Workmanship clause V80 covered by Specification WW.A.P.1.2.22)
- Conduit, trunking and ducting (Materials and Workmanship clause Y60 covered by Specification WW.A.P.1.2.22)
- Cable supports (Materials and Workmanship clause Y63 covered by Specification WW.A.P.1.2.22)
- Medium Voltage Installation (Specification WW.A.P.1.2.23)
- ENMS (Electrical Network Management system) (Specification WW.A.P.1.2.37)

4.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of current legislation, regulations and standards stated in materials and workmanship clauses.

Space for maintenance & access shall be provided in accordance with SHTM 2023.

5.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

6.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Project Co. shall include for liaison in conjunction with the Board with members of the Hospital's team with an interest in the planning and administration of the Low Voltage Distribution System.

Building Control. Project Co. shall liaise, with and adhere to, the requirements of the Building Control Officer.

Any other member of the Project and Hospital teams concerned with the planning and administration of the Low Voltage Distribution installation.

7.0 SYSTEMS

7.1 Low Voltage Distribution

General Description

This Specification should be read in conjunction with all other engineering services & specifications for the development.

And this part of the Specification shall be read in conjunction with NBS clause V31.

The facility shall be provided with 2 pairs of substations, as indicated on the LV schematics. The sub-stations shall be located in the basement plant rooms.

All LV equipment shall be suitable for use with 230 V/400 V single/three-phase 50 Hz four-wire and earth systems, except reduced LV systems.

Each sub-station shall comprise, 11kV ring main unit switchgear, a step down cast resin transformer and a Main LV switchboard. Each pair of sub-stations shall be interlinked on the LV side via cables or bus bar and changeover switches, one on each Main LV switchboard.

Each pair of Main LV switchboards shall be electrically interlocked to prevent the transformers being connected in parallel as indicated on the schematic drawings. The transformers are described in the MV Installation Specification, WW.A.P.1.2.23.

Low voltage air circuit breakers shall be provided on the load side of the transformers before the main LV switchboards. All main LV switchboards shall be constructed to Form 4 Type 6 with MCCBs. All sub LV switchboards shall be panel board format constructed to Form 4 Type 2.

Main LV switchgear shall be provided with electronic protection selected to allow short circuit, over-current and time grading for full co-ordination and discrimination. All ACB's shall be fitted with monitoring units to capture and relay switchgear status, energy consumption, harmonic content, operation counter and fault indication via the Electrical Network Monitoring System, ENMS as described in the ENMS Specification, WW.A.P.1.2.37 though non-critical parameters such as the operation count and harmonic content may be signalled via the BMS.

Specifically, energy metering information shall be routed to and captured by the BMS.

Open protocol industry standard software must be used. All software shall be 'backwards compatible'.

The main LV switchboards shall be provided with the following:-

- Automatic power factor correction to correct to at least 0.95 and provided with a hard wired automatic drop out facility during generator run and reset on return to mains;
- Surge protection; (including MCCB)
- Provision of voltage optimisation unit.
- Provision for future harmonic filters (MCCBs, CTs and sensing wiring plus space for free standing filters to be provided in each switchroom);
- Electronic multi-function meter connected to the BMS system as shown on LV schematics;
- Voltage and current socket for harmonic analyser;
- Thermographic screening; to allow for live thermographic testing.
- Fully rated neutral busbars;
- Spare compartments unequipped;
- Extensibility provision;
- Control section housing change-over logic and load shedding controls;
- IP 2X ingress protection rating (or better)
- Through the ENMS, remote control shall be possible of incomer switches, bus-section switches and those outgoing feeder switches which need be controllable for purposes of the generator load acceptance switching.

The sub-main LV switchboards shall be provided with the following:-

- Electronic multi-function meters connected to the BMS system as shown on LV schematics; (WW-XX-XX-SC-530-002 and 003).
- Thermographic screening; to allow for live thermographic testing.
- Fully rated neutral busbars;
- Spare compartments unequipped;
- IP 2X ingress protection rating (or better).

Motorised breakers shall be controlled and monitored via the Electrical Network Monitoring System, ENMS.

Interfaces for ENMS control shall be provided in the Main LV Switchboards to permit the ENMS to control various circuit breakers for the purpose of load control and matching the loads to the various supply scenarios (various 11kV network configurations, generator start-up or generator testing). The circuit breakers involved shall be motorised as indicated on the drawings and shall principally involve:

- For Main LV switchboards:
  - Incoming ACBs,
  - Bus-Section (Interconnector) ACBs,
  - Various outgoing ACBs and MCCBs (Plant and Lifts and Large Medical Equipment) as detailed on LV schematics (see note below about power factor correction)
- For Sub-main LV Boards:
  - Not applicable (manual operation only)

The power factor correction equipment for each of the individual main LV switchboards shall also be controlled by the ENMS. It shall be arranged such that all capacitor steps are switched out of service if the board is energised wholly by the generators or by the generators in parallel with the mains.

Sub-main LV boards do not provide for automated pick-up or shedding of load, therefore lifts and various equipment shall be controlled in the field by signal from the ENMS directly to the respective drive/control panel or contactor.

The status of all devices controlled by the ENMS (open, closed, tripped, racked out, unavailable, drive blocked, etc) shall be signalled to the ENMS for display by the ENMS on its various graphic display screens.

Control principles, behaviour tables and further details of the ENMS interfaces for Substation LV switchboards and for Sub-Main LV switchboards shall be described during detailed design.

Note that UPS Input Boards are a special case of sub-main switchboards. This is mentioned in the appendices, but the requirements are given in UPS specification.

Thermographic screening facilities shall be provided to the main LV switchboards to permit safe access for thermographic survey of the switchboard without exposure to live components. Busbar cubicles of main LV switchboards shall be fitted with perforated screens with an IP20 mesh of holes, clear Perspex sheeting or proprietary windows.

All floor-mounted switchboards shall be fitted with plinths integral to the switchboard construction.

Where indicated on the LV schematics, the main and sub-main LV switchboards shall include interlocked dual incoming isolators and bus section to permit selection of dual supplies. It shall not be possible to parallel the incoming feeds. For Main LV Switchboards, the incoming isolators and bus-section switches shall be configured as an automatic change-over. In the case of sub-main LV boards, only manual operation need be provided, and the interlocking in this case shall be mechanical and implemented by linkages or keys (Ronis or Castell types or equal and approved)

For the Main LV Switchboards, time delayed phase failure relays shall be fitted to the incomers on the LV switchboards. Similarly, phase failure relays shall be fitted to all bus sections with an adjustable 0-10s UPS module, or a suitable change-over controller shall be provided.

Main LV switchboards shall be provided with front access or alternatively front and back access and top entry provision for cabling.

Sub-main LV switchboards shall be provided with front access and top entry provision for cabling.

Generally, unless shown otherwise on the LV schematics, each department shall be provided with a minimum of two 3-phase combined lighting and power distribution boards fed from the sub-main LV switchboards with one distribution board to be fed from the A side of the LV distribution system and the other to be fed from the B side (the final circuits throughout the department to be split between each distribution board to provide further resilience).

A number of departments do not require A and B side distribution boards as indicated on the schematics. Refer to the LV Schematics as noted above and db location drawings (WW-S2-XX-PL-523 Series) for details of dual / single distribution board provision.

The distribution boards shall be contained within electrical cupboards within each department. Space within each of these electrical cupboards shall be allocated to housing ancillary components such as power supplies to nurse call panels, fire alarm interface units, security control equipment, door hold equipment and if necessary data racks for engineering systems.

Details of the protective devices, settings and fault levels and device settings shall be developed during detailed design stage.

Spare Capacity

The LV distribution network is designed to provide spare capacity in the following ways:

- Transformers – sized to accommodate 25% load growth;
- Main LV switchboards – rated to accommodate 25% load growth and a minimum 1No. spare outgoing way rated to 25% load growth;
- Sub LV switchpanels – rated to accommodate 25% load growth and a minimum 1No. spare outgoing way rated to 25% load growth;
- Departmental distribution boards – rated to accommodate 25% load growth and 25% spare ways, no future spare MCB's provided;
- Cables – sized to accommodate 25% load growth;
- Containment – sized to accommodate 25% future cabling.

Spare space in the switchboards shall be fitted with blanks which can be equipped with a circuit breaker at a later date. Breakers shall be installed in the quantities and of the frame sizes indicated on the schematics. No spare MCB's will be provided within the departmental distribution boards.

The spare ways within the pre-fabricated home run cables serving the departmental distribution boards shall be terminated within an enclosure adjacent to the distribution boards. Spare ways shall be labelled to assist identification.

Auxiliary DC Power Supply for Main LV switchpanels

An auxiliary DC power supply shall be provided for each side of the main LV switchpanel which shall be used to drive the motorised circuit breakers and bus-couplers within the main LV switch panel.

Within each main LV switchroom an A & B circuit from the local distribution board shall feed a 24Vdc battery and charger via a changeover device. The battery will then support a DC distribution board which shall drive the motorised breakers.

The battery shall be sized to provide sufficient capacity to drive all motorised devices on the associated main LV switchpanel for a minimum 6 operations. The batteries shall be VRLA with a life expectancy of 10 years.

The auxiliary DC power supplies shall interface with the BMS system to provide status indication, and mains fail, battery fail, etc. alarms.

Switch Rooms and Risers

Main switch rooms housing the main LV switch boards are sized upon generic manufacturer's data.

Final selection of Main and Sub LV Switchboards and distribution boards shall take cognisance of the space allocated.

The electrical risers have been sized assuming that final selected Sub LV Switchboards will be of a space saving Form 4 Type 2 panelboard type of construction, the smaller examples possibly being wall mounted.

The electrical risers shall be arranged so that space is allocated for Sub LV Switchboards, sub main distribution cables and low current system cables and containment.

Sub-Main Cabling

Refer to Common Electrical Clauses WW.A.P.1.2.22 and WW LV Cable Schedules for cable selection details.

Sub-main cabling shall generally be by means of XLPE/SWA/LSF multi-core armoured cables laid on cable ladders or slotted cable trays as indicated on the containment drawings. Power supply cabling to life safety and fire fighting applications is selected in accordance with the requirements of BS 8518:2010 and shall be as follows, or equal and approved. Refer to the Common Electrical Clauses WW.A.P.1.2.22, section V32, Clause 420 for full technical specification requirements of cables required for each life safety and fire fighting system.

Emergency lighting final circuits. Local central battery system.
- As Prysmian Cables FP Plus or equal and approved

Sprinkler pump and Helipad foam spray system power supplies.
- As Prysmian Cables FP600S or equal and approved

Fire lifts and escape lifts.
- As Prysmian Cables FP600S or equal and approved

Motorised fire and smoke dampers, supply and control cabling
- As Prysmian Cables FP Plus or equal and approved

Power supplies to powered smoke and heat exhaust ventilation, smoke fans, powered smoke shafts, and pressurisation.
- As Prysmian Cables FP600S or equal and approved

Powered sliding doors across escape routes.
- As Prysmian Cables FP Plus or FP600S or equal and approved

Gaseous extinguishing systems.
- As Prysmian Cables FP600S or equal and approved

Power supply cabling to fire fighting applications shall be selected and routed in accordance with the requirements of BS 8519 and LPC Technical Bulletin 210. Note shall be taken that cable cross sectional areas and protective device ratings are determined for these circuits against requirements in the latter document, and which allow for passage of locked rotor current for certain time and for cable selection based on 150% of the largest envisaged full load current. Selections have been made on the basis of provisional pump data, and before installing cables for these circuits, the Board shall submit for cable design review full details of the pumps and other loads to be served, and the measured cable route length intended.

Moulded Case Circuit Breakers

This part of the Specification shall be read in conjunction with NBS clause V31.

The MCCB tripping mechanism shall be as detailed in the Device Settings Schedules.

Where plug-in type MCCB's are used It shall be possible to extract and/or rapidly replace the circuit breaker without touching the connections on the base. The plug-in configuration shall be made by use of a "plug-in kit" with a fixed device. A safety trip shall be fitted to avoid connecting or disconnecting the power circuits under load conditions, the safety trip shall cause automatic tripping if the device is ON, before engaging or withdrawing it.

Except where otherwise indicated or agreed, MCCBs shall have the following number of poles:-

Single phase	-	Single pole (SP)
Three phase	-	Three pole (3P)

Each switch shall be provided with facilities for padlocking in the "OFF" position. In addition, switches serving sprinkler pump supplies and helipad foam spray pump supplies shall have operating handles lockable also in the 'ON' position.

Motorised breakers are shown on the schematics.
Such circuit breakers shall:

- incorporate a motor drive mechanism for closing of the breaker or charging of a spring actuator as applicable
- incorporate an electrical shunt trip coil (so that opening of the breaker can be effected with minimal delay by an electrical signal)
- be configured for local & remote operation through electrical signals
- shall include an interlock to prevent remote closing if the breaker has tripped on a protection/fault operation.

Low Voltage Air Break Switches and Switch Disconnectors

This part of the Specification shall be read in conjunction with NBS clause V31.

Low voltage air break switches shall comply with the following.

Motorised breakers are shown on the schematics.

Air break switches shall have the following number of poles:-

Single phase	-	Double pole (DP)
Three phase	-	Four pole (4P)

Each switch shall be provided with facilities for padlocking in the "OFF" position. In addition, switches serving life safety systems such as sprinkler pumps, helipad foam spray pumps, smoke extract/clearance systems, stair/lift pressurisation systems, fire fighting lifts, etc. shall be lockable also in the 'ON' position.

To prevent accidental contact with live parts, switches of the withdrawable chassis isolating type shall have either fully shrouded fixed contacts or insulated cover plates.

Switches in individual compartments within a switchboard shall have an earth terminal, and the construction and cabling arrangements shall both meet the degree of protection specified for the switchboard and have the operating mechanisms interlinked with the access door.

Switch disconnectors in plant rooms shall have the following features:

- Minimum IP54 protection,
- insulated plastic enclosure,
- fitted with padlockable rotary red handle,
- fitted with 2 x N.O. auxillary contacts,
- earth terminal,
- switch interlocked with cover.

Final selection of switch disconnectors: Project Co. shall utilise manufacturer's switch disconnector co-ordination tables to ensure that his selected circuit protective devices and selected switch disconnectors co-ordinate at the fault levels present at the point of installation of the selected switch disconnector.

Low Voltage AC Contactors and Coils

Contactors shall comply with BS EN60947 and shall be of utilisation category AC-3.

Contactors shall be electro-magnetically operated, suitable for local and remote control via an in-built LOCAL/OFF/REMOTE control selector switch.

Contactor operating coils shall be AC suitable for the phase to neutral voltage of the supply and shall be protected by means of a cartridge fuse.

The number of main poles shall be as indicated on the LV schematics, for feeds from sub LV panels, or distribution board schedules for final circuits. As a minimum one pair of auxiliary contacts shall be provided unless stated otherwise.

Individually mounted contactors shall be fitted with integral isolating switches having a rated duty, a load rating and utilisation category compatible with the respective contactor.

Individually mounted contactors and their associated control operating components shall be housed in pressed steel.

The enclosures for contactors installed inside buildings shall provide a minimum degree of protection of IP4X, and in plantrooms IP54. The enclosures for contactors installed externally shall provide a minimum degree of protection of IP65.

Coils for switching relays, contactors and other applications shall be capable of withstanding a 15% drop in voltage without the armature or switching apparatus dropping out of position. Key resets shall be provided to re-energise the coils following mains failure; unique keys shall be supplied.

Contactors being controlled by the ENMS are identified on the LV schematics and shall be located in the cupboard adjacent to the associated sub LV switchpanel or departmental distribution board. The contactors shall be a latching type and controlled by a pulsed ENMS signal which shall operate in the following manner:

- Load pickup - ENMS pulsed signal closes contacts which remain held closed;
- Load shed - ENMS pulsed signal opens contacts which remain open;
- Loss of mains - contacts open and remain open.

Metering

This part of the Specification shall be read in conjunction with NBS clause V31.

Electronic multi-function meters connected to the BMS system shall be provided at the main LV switchboards and elsewhere as detailed on the LV schematics.

Distribution Boards

This part of the Specification shall be read in conjunction with NBS clause V31.

Final circuit distribution boards shall be Type A or B with miniature circuit breakers (MCB) and residual current breakers with overload (RCBO) located within risers and dedicated cupboards.

Distribution boards shall be surface wall-mounted and shall comprise the components, labels and inter-connections, all as indicated on the design drawings and elsewhere in this Specification. Final selection of distribution boards shall take cognisance of the space allowed upon the architectural layouts. Refer to materials & workmanship clauses for specification details.

All distribution boards shall be provided with fully opening sheet metal doors (wardrobe doors may be required).

Removable gland plates shall be provided on the top and bottom of all distribution boards, suitable for conduit, trunking and cable, except in the case of prefabricated wiring systems for lighting and small power final circuits, prefabricated plug and socket arrangements may be factory fitted to the top of the distribution boards for outgoing home run cables. In this case, distribution boards shall be internally pre-wired to the plug and socket arrangement at the top of the distribution board. Wiring for unused circuits shall be terminated at ‘dummy’ mcbs and shall not be left unconnected. One further three phase unequipped way shall be left spare for future use by non-standard circuits. Distribution boards have been sized on the basis that prefabricated home run cables will be 6 circuit or 9 circuit or a mixture of both.

Neutral and earth bars shall have the same number of terminals for outgoing cables as there are outgoing ways on the board, and these shall be numbered to relate to the outgoing ways. Particular note shall be taken of the quantity of final circuit earths in accordance with Section 543.7 within Chapter 54 of BS 7671 (17th Ed.), and this shall be reflected in the earth bar terminal capacity.

Outgoing devices shall be arranged so that they may be removed with ease.

Distribution board bus bar assemblies shall have switched connectors to connect each outgoing device to the bus bars.

Cable containment requirements routes for final circuits are shown on the drawings. These shall be developed during detailed design stage.

The distribution boards shall accept MCBs, RCDs, RCBOs or MCCBs as indicated on the distribution board schedules. Outgoing devices are specified elsewhere in this Specification.

Distribution boards are sized with capacity for 25% future growth of load. Spare ways will not generally be equipped.

Generally, distribution boards need no automation, and need not transmit any monitoring signals to the ENMS.

However consideration will be given to controlling larger loads e.g. kitchen, restaurant this shall be itemised in the detailed design and a power reinstatement matrix produced.

Miniature Circuit Breakers

This part of the Specification shall be read in conjunction with NBS clause V31.

Miniature Circuit Breakers (MCBs) shall comply with the following.

All MCBs incorporated in distribution boards shall be capable of clearing the prospective short circuit current indicated on the LV Schematics.

All MCBs shall be of the type which provides positive means of isolation.

MCBs shall be padlockable in the OFF position and two isolation devices and padlocks shall be provided for each distribution board.

Residual Current Devices

RCBOs shall be of the type which occupy a single way.

RCDs shall have the same short circuit withstand capability as MCBs and shall be capable of making, carrying and breaking the full short circuit current. This requirement shall apply whether or not the RCD is the sole or main circuit breaker at any point in the system.

Unless used as circuit breakers, RCDs shall be connected in series with the overload and short circuit devices in the system. RCDs shall not be used as the sole means of protection against direct contact.

Every RCD shall be provided with a test button and an engraved, clearly legible label stating **“TEST FREQUENTLY”**.

The residual current characteristic of RCDs and RCBOs shall be A type (not to be confused with type A, B, C, D overcurrent characteristic of MCBs and RCBOs).

Isolated Power Supplies for Areas of Medical Use

General

The Board shall provide isolated power supply units for areas of medical use. These will provide Type IT power supplies to meet the requirements of SHTM 06-01, BS.7671 Guidance Note 7 Chapter 9 and MEIGaN guidance published by MHRA.

The medical locations covered by isolated power supplies are as indicated on the LV schematics and small power circuitry drawings.

Each isolated power supply unit shall incorporate:-

- A safety isolating transformer to DIN VDE 0551: Part 1 (minimum efficiency 95%)
- A local alarm and test module
- Remote alarm and test stations (normally in staff bases or operating theatre surgeon's panels)
- Transformer insulation temperature monitor
- A load monitor
- A distribution board, ratings and numbers of outgoing 20A type B miniature circuit breaker ways as indicated on the distribution board schedules (Note that MCBs serving IPS circuits shall be DP therefore the DB shall be purchased with the appropriate number of ways)
- Output 230 V, 50 Hz, single phase, earth free
- Protective Earth Terminal
- Earth Fault Detection System

kVA ratings of IPS units shall be as indicated on the LV schematics.

The units shall comply with EN 60439-1: Part 1, DIN VDE 0107:1994-10, DIN VDE 0660 Part 500 and IEC439-1: Part 1. The insulation monitor shall comply with DIN VDE 0413:T2/01.73 or ASTMF 1209-89.

Each isolated power supply unit shall monitor the insulation impedance to earth of the transformer secondary circuit. It shall raise an alarm if this falls below an adjustable pre-set value and shall trip the IPS unit if it falls below a second lower pre-set adjustable limiting value.

Each isolated power supply insulation monitor shall continuously indicate the insulation impedance by means of a bar graph LED indicator.

A load monitor shall raise an alarm if the load rises to a pre-set adjustable limit and a temperature monitor shall alarm if the transformer temperature rises above a pre-set limit.

It shall be possible, locally and at the remote stations, to test the operation of the above monitors from the appropriate remote station.

It shall be possible to operate any isolated power supply unit for 4 hours at 150% rated load without tripping the thermal protection.

The remote alarm/test stations shall incorporate indication of the operational status of the appropriate unit. The Earth Fault Detection System shall identify which outgoing circuit is in fault, both locally and at the remote alarm/indicator unit. The status of the UPS supporting the IPS shall also be indicated at remote alarm/indicator units. Remote indication of IPS circuit faults and UPS status at staff bases shall be incorporated within an integrated panel which shall include nurse call and fire alarm indication. UPS and IPS alarms shall also be available at the BMS.

For the operating theatres, the remote alarm/indicator units shall be provided in the theatre.

The alarm/indicator units in the theatres shall be built into the surgeon's panel. shall allow for providing this free issue to the surgeon's panel manufacturer and wiring to them when installed in the theatres.

The operational status of the mains supply to each isolator power supply shall be relayed to the building management system. NO/NC Volt-free contacts and terminals shall be provided to allow connection of the building management system wiring into isolated power supply unit.

The isolated power supplies shall be contained within metal floor standing cabinets having an ingress protection rating of at least IP42. They shall have lockable front covers and shall incorporate suitable ventilation facilities for the designed duty. They shall be provided as single, dual or triple units as indicated on the schematic drawings. Within each dual or triple unit, each module shall be totally electrically independent of the others and shall be electrically and physically segregated.

The design has been based on the following Bender/ Starksroom supplied dimensions:-

Single:	375 W x 425 D x 1900 H
Dual:	625 W x 425 D x 1900 H
Triple:	875 W x 425 D x 1900 H

Alternative manufacturers may be used if equal & approved and alternative units can be accommodated within the space allocated.

IPS Distribution Boards

IPS Distribution boards shall comply with the following:-

- Distribution boards and MCBs with the requirements of NBS clause V31.

- All distribution boards shall be covered by the doors of the Isolated Power Supply Unit, which shall have locks of an approved make. All live parts shall be fully shrouded by an insulated mask fitted internally giving access to MCB toggles only, with the doors open.

Note that circuit wiring fed from IPS units is earth free and as such both lines are designated as live (+115V and -115V) conductors and shall be colour identified as such.

MCBs shall be double pole.

Transient Overvoltage Surge Suppression Systems

Transient overvoltage surge suppression devices shall be installed within the main LV switch boards as detailed within this specification and LV schematics.

The Lightning Protection Specialist shall undertake a risk assessment to determine if any additional transient overvoltage surge protection devices are required elsewhere; this is out with the scope of this specification. Refer to the Lightning Protection Performance Specification, WW-218, for further details.

Imaging Department Supplies

Power supplies to diagnostic imaging and radiotherapy rooms / suites shall be compliant with the MEIGaN V2.0 September 2007 document published by MHRA.

Supplies to fluoroscopy machines and those imaging machines used for invasive procedures shall be provided with dual final sub-circuit cables via automatic changeover devices as described elsewhere within this specification. Single final sub-circuit cables shall be provided to all other imaging machines as detailed on the LV schematics.

The steel wire armour of the final sub-circuit cables to fixed imaging equipment shall not be used as the mains supply earth conductor. Three phase supplies shall utilise 5 core cables, single phase supplies shall utilise 3 core cables. Distribution circuit cables from the main LV switchboards to sub LV imaging switchpanels shall not be provided with an integral earth conductor.

Isolators in imaging rooms shall be lockable in the off position.

A remotely operated contactor shall be fitted in the mains supply of three phase medical devices sited adjacent the mains supply isolator and Earth Reference Bar (ERB) (see separate earthing & bonding systems specification, WW.A.P.1.2.25). ERB, contactor and isolator enclosures shall be white. The contactor shall isolate all three phase contacts, including the neutral, and shall be capable of interrupting maximum load. The contactor control circuit shall be on the same phase as the room socket outlets. The contactor and isolator shall both be of a grade suitable for frequent use.

Three-phase supplies feeding medical devices shall have a phase rotation and voltage monitoring device installed, except where such a device forms part of the installed equipment. This device shall prevent the contactor from energising with:

under- or over-voltage condition on any phase
incorrect phase sequence
phase loss
neutral loss
phase-neutral faults.

The under- and over-voltage limits shall be provided by the equipment manufacturer. The monitoring device shall be interlocked to prevent disconnection of the supply during an exposure.

The contactor shall be switched ON by a green momentary push and OFF by a red push. Red emergency OFF buttons shall be located in a suitable location in the room and shall incorporate a protective shroud and key reset. Locations are indicated on the 1:50 loaded drawings.

Illuminated warning signs shall derive supply from the contactor.

7.2 Busbar Trunking

Description

This part of the Specification shall be read in conjunction with NBS clause V33.

Distribution of LV power within the risers shall be by three-phase vertical bus-bar trunking with full size phase, neutral and earth conductors. Should a full size earth conductor not be provided then the metal casing shall be utilised to provide the required cross sectional area in excess of that required. A minimum of 3No tap offs shall be provided at each floor to serve distribution boards for lighting and power.

Each tap off shall contain a circuit breaker to provide full electronic time graded fault protection.

7.3 Automatic Power Factor Correction Equipment

This part of the Specification shall be read in conjunction with NBS clause V36.

Power factor correction units complete with multiple automatic detuned capacitor banks shall be provided for each side of each main LV switchboard, refer to LV schematics for details. The unit shall correct to at least 0.95 and be provided with a hard wired automatic drop out facility during generator run and reset on return to mains.

The Board shall perform the capacitor bank selection and scheme design, based on the following:

- Capacitors shall be rated at higher voltage than the system voltage to account for increased voltage being expected on the capacitors due to the presence of detuning reactors. If no other proposal is made by the Board and accepted, the capacitor rated voltage shall be no less than 110% of the system voltage.
- On each side of the main LV switchboard an automatic detuned power factor correction scheme shall be installed. Capacitor bank sizes shall comprise 4 to 6 steps of capacitors, but subject to there being no need to use capacitor step sizes below 25kVAr (this step size equating to the equivalent reactive power rating at nominal system voltage).

Each bank has been sized for the respective ‘A’ or ‘B’ side loads, with summation CT’s on bus-section and incomers so that each bank responds to the net load on each section of the board (i.e. each relay responds to the load on its end of the busbar, regardless of whether the power flows through the natural incomer or via the bus-section switch).

- Each bank shall include a reactive power relay, wired to monitor and respond to the reactive content of the current to be corrected (i.e. the current through the respective incomer, or through summated incomer & bus-section paths as appropriate)
- A panel mounted indicating instrument shall be mounted near each reactive power relay to show the corrected power factor of the overall load served by the respective section of busbar,
- The control wiring or control relay itself shall permit manual or automatic operation of each power factor correction scheme (selectable by panel mounted control switch(es) or by switches on the relay facias),
- Under manual control, an operator shall be able to switch individual steps in or out of service, and a timed interlock feature shall prevent energising of a capacitor that has recently been energised and may not be adequately discharged (Indicator lamps shall indicate when a capacitor step is unavailable for such reason),
- Under automatic operation, the reactive power relay shall switch capacitor steps in and out of service as necessary to limit the reactive power drawn (and thereby maintain the target power factor). The relay shall operate with a switching algorithm and/or time delay feature which prevents energising a capacitor step which has not had time to discharge to a safe level.
- Unless otherwise agreed the detuning reactors (inductances) shall be selected with ratings which (when calculated with the power factor correction capacitor steps) correspond to a detuning frequency between 211 and 218Hz.
- Provision shall be made, on each capacitor bank for inputs, status, alarm and quantitative signals from/to the ENMS and/or BMS. The required points/signals list shall include at least the following:
  - Input signal – Generator operation
  - Output signal (status) - Bank active/inhibited
  - Output signal (status) - Bank selected off Auto
  - Output signal (alarm) – General alarm
  - Output signal (quantity/measureands) – VARs compensation (or, if agreed, Power factor. Envisaged port RS485 Modbus, but final selection to be made to suit the ENMS equipment).

7.4 Harmonic Filtering Equipment (Future)

Refer to NBS clause V37.

7.5 Labels to Life Safety Systems

This part of the Specification shall be read in conjunction with NBS clause V31, section 970.

For electrical circuits serving fire sprinkler pumps, fire-fighting foam spray system, fire alarm panels and fire-fighters' lifts, prominent labels shall be affixed to the switchpanel from which the power supply is derived, indicating the function of the circuit and warning against it being switched off. Additionally, if the circuit will remain live even after the board's main incoming switch is opened, such fact shall be similarly communicated.

7.6 Automatic Transfer Switches for Life Safety Circuits

7.6.1 Introduction

This part of the Specification shall be read in conjunction with NBS clause V31 (in particular its sub-clause 380) and with BS EN 60947-6.1.

For circuits supplying fire-fighters' lifts and sprinkler systems, and for other life safety functions as may be indicated or necessary (e.g. helipad lighting, smoke vents, smoke extract fans, etc.) dual supplies shall be provided by means of diverse routes to an automatic transfer switch to be installed in the same fire compartment as the life safety equipment/plant itself.

The automatic transfer switch shall be a change-over device fed from two sources and which latches into either position without the need for continued application of electrical control power. It shall be a 4-pole change-over device, with the neutral breaking after (and making before) the corresponding phase switching operation. A bypass/isolator switching arrangement shall be provided to permit manual connection of the load to either source and isolation of the transfer switch itself for test or maintenance

7.6.2 Automatic Transfer and Bypass-Isolation Switch

a) General, Make and Standards:

The required ratings and configurations shall be as indicated on the drawings and in any schedules applicable. The expected manufacturer & range is ASCO (Emerson) 7000 series, (or Schneider Series or equivalent)

Each automatic transfer switch shall, as denoted on the drawings, be either:

- a basic automatic transfer switch with open transition (i.e. break before make), or
  a delayed transition automatic transfer switch,

Automatic Transfer switches shall comprise withdrawable switch units and preference will be given to types where:

- for the basic transfer switch a single operator drives a double throw power transfer switch mechanism, or
- for the delayed transition transfer switch two operators drive independently two single throw power switch mechanisms and these are arranged to introduce a deliberate delay between disconnecting one source and connecting the other (for applications where out-of-phase conditions between the two sources might affect the loads if switching took place)

The entire switch shall be factory assembled and tested.

b) Latching/mechanically-held Transfer Switch:

The transfer switch shall be electrically operated and mechanically held (positively latched) in either position and unaffected by momentary outages. The switch shall be mechanically interlocked to ensure that the load can be energised from only one of the two possible sources.

Auxiliary contacts on the switch mechanism, and signal contacts at the controller, shall permit transmission of status information to a remote fire control room, remote lamp indicator panel, local lamp indication and a data acquisition network (BMS or ENMS).

c) Bypass-Isolation Switch

A bypass-and-isolation switch system shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch for test or maintenance. Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts).

After switching into a bypass condition, it shall be possible to isolate the transfer switch mechanism by withdrawing the switch mechanisms/carriage from the fixed part of the enclosure. For the purpose of testing all aspects of the switch operation, a method shall be provided for retaining/reconnecting the control connections to the transfer switch after the main (power) circuit has been isolated. It shall also be possible to isolate all power, control and auxiliary circuits should full isolation be required.

d) Controller

A microprocessor based controller shall be provided to sense and analyse the voltage supply conditions on each incomer (voltage, frequency, phase & rotation) and operate the transfer switching equipment. It shall be equipped to communicate to an electrical network monitoring system through volt-free contacts and a serial communication module, and shall drive two remote lamp indicator panels (the latter for firefighters' information). All external connections shall be wired to a common terminal block.

The controller shall include a phase co-incidence monitor which, by permitting or delaying transitions according to degree of synchronisation between the two sources, shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources.

All controller settings shall be readily accessible and displayed and shall be easily adjustable.

The controller shall include rechargeable battery back-up (using a 10-year life battery) to safeguard all important information (programme, setting parameters, real time clock & calendar, etc.).

e) Enclosure

The enclosures shall be suitable for the areas in which they are to be installed, and the requirements shall be taken as:

- Plantrooms IP54
- Elsewhere IP 30

Labelling shall be in accordance with Section 7.5 of this specification.

f) Operational Behaviour

Transfer from primary source to reserve, and retransfer from reserve source to primary shall be effected according to principles and timing delays along the following lines:

Automatic transfer & retransfer:

i. On interruption of supply on either incomer (source) a timer powered from stored energy shall allow an adjustable time delay up to 6 seconds during which no transfer shall occur. The delay is intended to prevent the switch responding to momentary power outages, and to allow time for the various substation switchboards to effect their own auto change-overs on the LV distribution system (to select between substation 'A' & 'B' sides and route a healthy supply to the primary side input on the automatic transfer switch).

ii. On detected loss of supply on the primary source, and if the reserve supply is available and within satisfactory limits, the switch shall wait for an adjustable period and then transfer the load to the reserve supply. The waiting period (adjustable between 0 and 3000 seconds, but envisaged as being set between 1 and 9 seconds) is intended to allow controlled take-up of load on the reserve supply (staggered take-up across various ATS units).

iii. If the reserve supply is not immediately available, transfer need not take place until the reserve supply has:

- become live and been measured as within acceptable limits, and
- been allowed an adjustable time to stabilise (0 to 6 seconds range, initially likely to be set at 3 seconds), and
- been subjected to the deliberate waiting period as described in (ii) above.

iv. If after waiting for the time delays set above at (i) & (ii), however, there is no supply on either the primary source or the reserve source, the transfer switch shall simply await the appearance of supply on one of the inputs, and shall respond to the first to appear, subject to the 0-6 second confirmation time delay to check that the returned supply is stable. In the event that both sources return simultaneously to healthy conditions, the logic shall select the primary source as the preferred choice and behave as if retransferring the loads to the primary source. (See (iv) below).

v. On restoration of power supply to the primary source, the control scheme shall allow a 0 – 6 second confirmation delay to assess the restored supply as healthy, and then retransfer the load to the primary source, subject to any intentional delays introduced for retransfer operations. Two time delay modes (which are independently adjustable) shall be provided on re-transfer from reserve source to primary source. One time delay shall be for actual primary power restoration and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes, but are envisaged as being set initially in the range 2 minutes for the real condition and 0.1 minutes for the test condition. The intentional time delay shall be automatically bypassed if the reserve source fails during the retransfer process, in which case the primary source shall then be reconnected immediately.

vi. If, in the absence of the primary source, the reserve source fails while carrying the load, the control scheme shall automatically prepare the switch for retransferring the load to the first source to become available, as per (iii) above.

Manually initiated transfer:

Where transitions from one source to the other are to be manually initiated, transitions and retransfers shall be effected, using delay periods and checks as above.

g) Additional Features

One or more test switches shall be provided to permit simulation of a primary source failure, and restoration to normal conditions after completion of the test.

LED indicating lights shall be provided on the operating fascia to show as appropriate:

- Primary source available & healthy
- Reserve source available & healthy
- Primary source connected to load
- Reserve source connected to load

Repeat signals for the same conditions shall be transmitted to a remote fire control room, and in the case of firefighters' lifts additionally to lamp indicator panels installed adjacent to the firefighters' lift shafts at the Ground Floor.

In addition to signal contacts mentioned already, the automatic transfer switch shall provide signal contacts for communicating to a remote monitoring system (the ENMS or Electrical Network Management System) at least the following. All signal contacts shall be wired to an easily accessible terminal block.

- Alarm - ATS Controller alarm (power supply fail, watchdog timer, extended time on non-auto operation, etc.)
- Alarm – Primary source fail/out-of-limits
- Alarm – Reserve source fail/out-of-limits
- Status indication – Primary source available & healthy
- Status indication – Reserve source available & healthy
- Status indication – Primary source connected to load
- Status indication – Reserve source connected to load
- Status indication – ATS test switch(es) active
- Status indication – ATS bypassed to primary supply
- Status indication – ATS bypassed to reserve supply
- Status indication – ATS Isolated

A full duplex RS485 interface shall be installed in the ATS controller to enable serial communications. The serial communications shall be capable of a direct connect or multi-drop configured network. This module shall allow for the seamless integration of existing or new communication transfer devices. The interface shall allow transmission of all setting data, operating parameters, and status & alarm conditions.

h) Remote indicator panels:

For each instance where an automatic transfer switch is applied to serve a firefighters' lift, a remote IP44 indicator panel shall be supplied, installed and commissioned to provide illuminated lamp indication to firefighters regarding the status of the supplies serving said lift:

- Primary source available & healthy
- Reserve source available & healthy
- Primary source connected to load
- Reserve source connected to load

The indicator panel shall be located in accordance with and provide the functions required of it under BS 9999 (clause 29) and BS 5588-5 (clause 14.3).

All interconnecting cabling shall be run within the respective fire protected lift/stair core or shall be fire resistant, rated for 120 minutes fire survival time according to BS 8519 (as Prysmian Cables FP600S) or equal and approved.

V30 Low voltage distribution systems

To be read with Preliminaries/ General conditions

GENERAL

110 LOW VOLTAGE DISTRIBUTION SYSTEM

- Connection to low voltage supply: at transformer secondary of step down transformers. Refer to LV schematic diagrams.
- Switchgear: Cubicle switchboards, as section V31.
- Cable type: Single-core XLPE/ AWA/ LSZH and Multi-core XLPE/ SWA/ LSZH, as section V32 - refer to Specification WW.A.P.1.2.22 Common Electrical Clauses.
- Rewireable installation: Required.
- Concealed installation: Required in occupied spaces.
- Containment: Cable ladders and Cable trays, as section Y63 - refer to Specification WW-532-247 Common Electrical Clauses.
- Accessories: Cable cleats, as section Y63 - refer to Specification WW-532-247 Common Electrical Clauses.
- Transient over-voltage surge suppression devices for mains power supplies, as section Y67 - refer to Specification WW.A.P.1.2.27 Lightning Protection Systems.
- Completion:
  - Electrical identification: As section V80 - refer to Specification WW.A.P.1.2.22 Common Electrical Clauses.
  - Testing and inspection: As section V39 - refer to Specification WW.A.P.1.2.21 Electrical Testing and Inspection.

SYSTEM PERFORMANCE

220A GRADING STUDY

The calculations forming the basis of the design of the LV distribution system are theoretical based upon cable lengths measured from drawings, theoretical fault levels, voltages and impedances and Schneider Electric protective device data which may or may not correlate with those finally selected. Project Co. shall undertake a grading study based upon the actual installed measured characteristics of the LV distribution system and actual equipment selected.

The study shall be undertaken under all ‘worst case’ conditions i.e. mains healthy, on minimal generator supply, mains and generators in parallel, and taking into account the effect of the CHP units on fault levels.

- Scope: Complete low voltage distribution system.
  - Qualifications of study author: Member of the Institute of Electrical Engineers (IEE).
- Fault calculations: Include fault impedance, and short circuit fault current analysis.
- Protective devices: Coordinate the selection and adjustment of protective device settings to achieve discrimination throughout the fault level range. Grade so that a fault on any outgoing branch circuit is cleared by the switching device installed in the faulted branch circuit without affecting the other outgoing branch circuits. Demonstrate discrimination using time-current coordination curves with single line diagrams, in the study report. See also V31 clause 375A for co-ordination of switch disconnectors with circuit protective devices.

- Manufacturers' details and recommended settings: Include in study report.
- Study report: Submit.
  - Format: A4 hard copy.

EXECUTION

420 INSTALLING LOW VOLTAGE DISTRIBUTION SYSTEMS

- Standard: To BS 7671.
- Layout: Position cabling and equipment to provide safe and easy access for operation and maintenance.

COMPLETION

920 DOCUMENTATION

- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with proposed document management system
- Operation and maintenance instructions: Submit.
- Record drawings: Submit.
  - Number of copies: 2.

V31 Low voltage switchgear

To be read with Preliminaries/ General guidance

PRODUCTS

310 LOW VOLTAGE SWITCHGEAR GENERALLY

- Switchgear: Factory built.
- Free standing switchgear: Provide lifting bolts within reinforced top frame.
- Neutral terminations: Match current carrying capacity of phase conductor.
- Insect proofing: Cover assembly openings with non-combustible and non-corroding insect proof mesh.

320 DISTRIBUTION BOARDS AND CONSUMER UNITS Generally

- Standard: To BS EN 60439-3.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Distribution board and consumer unit type tests: Fully type tested.
  - Approval: ASTA certified.
  - Evidence of certification: Required.
- Enclosure:
  - Ingress protection to BS EN 60529: IP31 generally, and IP54 in plantrooms.
  - Material: Metal.
  - Finish: Powder coated.
  - Colour: Manufacturer's standard.
- Locking mechanism: Cylinder locks with the same key for all distribution boards.
- Incoming device:
  - Type: Switch-disconnector.
  - Rating: As Circuit schedules.
  - Poles: 2P or 4P.
- Busbars and connections: Fully shrouded.
  - Position within enclosure: Locate in same position relative to protective device for each pole.
- Neutral and earth bars: Individual terminal for each outgoing circuit.
- Outgoing devices:
  - Type: As Circuit schedules.
  - Poles: As Circuit schedules.
  - Quantity: As Circuit schedules.
- Spare current carrying capacity (minimum): 25%.
- Identification:
  - Neutral and earth bar terminals: Label with the outgoing circuit reference.
  - Cable terminations: Label with circuit reference, with push-on plastics markers.
- Accessories:

330 CUBICLE SWITCHBOARDS Main LV Switchboards

- Standard: To BS EN 60439-1.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.

- Switchboard type tests: Fully type tested.
  - Approval: ASTA certified.
  - Evidence of certification: Required.
- Short-time withstand current (1 s): 50kA.
- Enclosure: Manufacturer's standard.
- External design type: Multi-cubicle.
- Intended location: Indoors.
- Mobility: Stationary.
- Internal separation: To BS EN 60439-1 National Annex.
  - Form: 4 type 6.
- Busbar and connections: Required.
- Incoming device: W (withdrawable).
  - Type: As drawings.
  - Rating: As drawings.
  - Poles: 4.
- Outgoing devices: D (disconnectable).
  - Type: Circuit breakers.
  - Poles: 4.
  - Quantity: As drawings.
- Spare current carrying capacity (minimum): 25%.
- Spare plug-in MCCB bases to be provided as indicated on LV schematics.
- Auxiliary circuits: D (disconnectable).
- Terminals: Suitable for the connection of copper conductors.
- Service conditions:
  - Pollution degree category: 2.
  - EMC environment: B.
  - Special conditions: None.
- Anti-condensation heater and thermostat: Required.
- Full length copper earth bar mounted on top of switchboard: Required.
  - Size: Board's choice.
- Mounting arrangement for Electricity Distributor's metering equipment: Not applicable.
- Identification:
  - Neutral and earth bar terminals: Label with the outgoing circuit reference.
  - Cable terminations: Label with circuit reference, with push-on plastics markers.
- Accessories:
  - Digital multi-function metering equipment;
  - Safety matting; and
  - Switchgear tripping units

  Where indicated on the LV schematics outgoing MCCBs shall be metered. Incoming ACB’s shall be metered.
- ENMS & BMS control modules to be provided
- Protective devices to be AC with the exception of bus-couplers which shall be 24Vdc capable of 6 operations.

330B PANEL BOARDS Sub Switchboards in Risers

- Standard: To BS EN 60439-1.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Switchboard type tests: Fully type tested.
  - Approval: ASTA certified.
  - Evidence of certification: Required.
- Short-time withstand current (1 s): 36kA.
- Enclosure: Manufacturer's standard.
- External design type: Panel board.
- Intended location: Indoors.
- Mobility: Stationary.
- Internal separation: To BS EN 60439-1 National Annex.
  - Form: 4 type 2.
- Busbar and connections: Required.
- Incoming device: D (disconnectable).
  - Type: As drawings.
  - Rating: As drawings.
  - Poles: 4.
- Outgoing devices: D (disconnectable).
  - Type: Circuit breakers.
  - Poles: 4.
  - Quantity: As drawings.
- Spare current carrying capacity (minimum): 25%.
- Spare plug-in MCCB bases to be provided as indicated on LV schematics.
- Auxiliary circuits: D (disconnectable).
- Terminals: Suitable for the connection of copper conductors.
- Service conditions:
  - Pollution degree category: 2.
  - EMC environment: B.
  - Special conditions: None.
- Full length copper earth bar mounted on top of switchboard: Required.
  - Size: Board's choice.
- Mounting arrangement for Electricity Distributor's metering equipment: Not applicable.
- Identification:
  - Neutral and earth bar terminals: Label with the outgoing circuit reference.
  - Cable terminations: Label with circuit reference, with push-on plastics markers.
- Accessories:
  - Digital multi-function metering equipment;
  - Safety matting; and
  - Switchgear tripping units: Where indicated on the LV schematics outgoing MCCBs shall be metered.

360 PROTECTIVE DEVICES GENERALLY

- Operation:
  - Power factor: Continuously monitored.
  - Handles: Not to be removable.
  - Locking: Provide for padlocking in the OFF position.
  - Rated duty: Uninterrupted.

365 CIRCUIT BREAKERS- ACB

- Standard: To BS EN 60947-2.
- Manufacturer: Board's choice.
- Door interlocks: Prevent enclosure doors being opened while circuit breakers are closed.
- Properties:
  - Short-circuit breaking capacity: As Circuit schedules.
  - Where practicable, circuit breakers shall be selected so that their service breaking capacity Ics is equal to their ultimate breaking capacity Icu.
  - Where the characteristics of the selected circuit breaker are such that Ics < Icu then Ics shall exceed the prospective short circuit current at the point of installation of the circuit breaker.
  - Rating: As Circuit schedules.
  - Utilization category: B.
  - Interrupting medium: Air.
  - Design: Moulded case.
  - Operating mechanism: Independent manual operation.
  - Isolating type: Required.
  - Provision for maintenance: Maintainable.
  - Method of installation: Withdrawable.
  - Ingress protection to BS EN 60529: IP40.
  - With RCD: No.
  - Mechanical interlocking: refer to clause V31 560.
  - To be supplied with auxiliary contacts/control module for ENMS/BMS monitor/control.

365A CIRCUIT BREAKERS- MCCBs (GENERALLY)

- Standard: To BS EN 60947-2.
- Manufacturer: Board's choice.
- Door interlocks: Prevent enclosure doors being opened while circuit breakers are closed.
- Properties:
  - Short-circuit breaking capacity: As Circuit schedules.
  - Where practicable, circuit breakers shall be selected so that their service breaking capacity Ics is equal to their ultimate breaking capacity Icu.
  - Where the characteristics of the selected circuit breaker are such that Ics < Icu then Ics shall exceed the prospective short circuit current at the point of installation of the circuit breaker.
  - Rating: As Circuit schedules.
  - Utilization category: B.
  - Interrupting medium: Air.
  - Design: Moulded case.
  - Operating mechanism: independent manual operation.
  - Isolating type: Required.
  - Provision for maintenance: Maintainable.
  - Method of installation: Plug-in. 4 pole
  - Ingress protection to BS EN 60529: IP40.
  - With RCD: No.
  - Mechanical interlocking: refer to clause V31 560.

365B CIRCUIT BREAKERS- MCCBs (ENMS/BMS)

- Standard: To BS EN 60947-2.
- Manufacturer: Board's choice.
- Door interlocks: Prevent enclosure doors being opened while circuit breakers are closed.
- Properties:
  - Short-circuit breaking capacity: As Circuit schedules.
  - Where practicable, circuit breakers shall be selected so that their service breaking capacity Ics is equal to their ultimate breaking capacity Icu.
  - Where the characteristics of the selected circuit breaker are such that Ics < Icu then Ics shall exceed the prospective short circuit current at the point of installation of the circuit breaker.
  - Rating: As Circuit schedules.
  - Utilization category: B.
  - Interrupting medium: Air.
  - Design: Moulded case.
  - Operating mechanism: independent manual operation.
  - Isolating type: Required.
  - Provision for maintenance: Maintainable.
  - Method of installation: Plug-in. 4 pole
  - Ingress protection to BS EN 60529: IP40.
  - With RCD: No.
  - Mechanical interlocking: refer to clause V31 560.
  - To be supplied with auxiliary contacts/control module for ENMS/BMS monitor/control.

375A SWITCH-DISCONNECTORS Loose gear.

- Standard: To BS EN 60947-3.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Properties:
  - Short-time withstand current (1 s): will vary depending upon fault level and device nominal rating. Grading study to confirm co-ordination of selected switch disconnectors and circuit protective devices.
  - Rating: as indicated on LV schematics and plans.
  - Poles: as indicated on LV schematics and plans.
  - Utilization category: AC-23 generally or AC-3 for starting, accelerating and stopping of motors.
  - Operation: Frequent (category A).
  - Isolating type: Required.
  - Terminals: Suitable for the connection of copper conductors.
- Enclosure: Required.
  - Ingress protection to BS EN 60529: IP31. (IP54 in plant rooms)
  - Material: Polycarbonate.
  - Finish: Manufacturer's standard
  - Colour: Manufacturer's standard.

380 AUTOMATIC TRANSFER SWITCHING EQUIPMENT (TSE) FOR LIFE SAFETY EQUIPMENT.

- Standard: To BS EN 60947-6.1.
- Manufacturer: ASCO (Emerson), though others may be considered if supported by declaration of conformity/variance from specification.

- Product reference: Submit proposals, and allow for product model which includes bypass switching from either supply, and for isolation of load if required.

- Rated operational current (Ie): As Circuit schedules and drawings - unless otherwise indicated these will be for AC 50Hz current and 4-pole configuration.
- Classification:
  - Short circuit capability: CC.
  - Method of controlling transfer: ATSE.
- Properties:
  - Method of operation: Electromagnetic.
  - Operating sequence: Refer to Section 7.6 in the M&E Specification.
  - Operating mechanism: Interlocked to prevent simultaneous connection to both primary and alternative supplies.
  - Utilization category: AC-33A.

390 RESIDUAL CURRENT CIRCUIT BREAKERS WITH INTEGRAL OVERCURRENT PROTECTION

- Standard: To BS EN 61009-1.
- Manufacturer: Board's choice.
- Properties:
  - Short-circuit breaking capacity: As Circuit schedules.
  - Rating: As Circuit schedules.
  - Poles: As Circuit schedules.
  - Sensitivity: 30 mA.
  - Time delay: Not required.

400 MINIATURE CIRCUIT BREAKERS

- Standard: To BS EN 60898-1
- Manufacturer: Board's choice.
- Properties:
  - Short-circuit breaking capacity: As Circuit schedules.
  - Where practicable, circuit breakers shall be selected so that their service breaking capacity Ics is equal to their ultimate breaking capacity Icu.
  - Where the characteristics of the selected circuit breaker are such that Ics < Icu then Ics shall exceed the prospective short circuit current at the point of installation of the circuit breaker.
  - Rating: As Circuit schedules.
  - Poles: As Circuit schedules.

435 DIGITAL MULTI-FUNCTION METERING EQUIPMENT

- To be compatible with MODBUS protocol read over site protocol
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Display: LCD.
- Ingress protection to BS EN 60529: Match assembly enclosure.
- Metering functions:
  - Voltage between phases (V);
  - Voltage between phases and neutral (V);
  - Phase currents (A);
  - Frequency (Hz);

- Power factor;
- Active power (W);
- Reactive power (V·A(r));
- Active energy (kW·h);
- Apparent power (V·A);
- Current demand (A);
- Active power demand (W);
- Apparent power demand (V·A);
- Peak current demand (A);
- Peak active power demand (W);
- Peak apparent power demand (V·A); and
- Pulsed output (kW·h).

- Mounting: Recessed into switchgear assembly or integral to MCCBs if appropriate.

440 INDICATOR LAMPS

- Lamp type: Clustered LED with bezel. Standardize lamp type.
- Lens colour: To BS EN 60073.
- Lamp mounting: Recessed.
- Common lamp test facility: Required.
- Access for lamp replacement: Externally from enclosure front.

445 PADLOCKS AND KEYS

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Locking mechanism: Six lever.
- Material: Brass.

465 SAFETY MATTING

- Standard: To BS 921.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Thickness (minimum): 6.5 mm.
- Width (minimum): 900 mm.
- Length (minimum): Match low voltage switchgear assembly.

470 SWITCHGEAR TRIPPING UNITS

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Enclosure: To BS EN 62208.
  - Material: Manufacturer's standard.
  - Method of fixing: Wall mounting.
  - Intended location: Indoor.
  - Ingress protection to BS EN 60529: IP31.
  - Mechanical protection to BS EN 62262: IK01.
  - Rated insulation voltage: Submit proposals.
  - Lockable hinged door: Required.
  - Finish to enclosure and supporting framework: Board's choice.
  - Colour: Board's choice.
- Incoming supply protection: Miniature circuit breaker to BS EN 60898.
- Charger type: Constant voltage current limiting.
  - Operating temperature range: -10°C to 45°C.

- Battery type: VRLA.
- Output:
  - Type: d.c. (direct current).
  - Voltage: As ENMS/BMS (24Vdc).
- Digital voltmeter: Required.
- Indicator lamps:
  - Mains supply healthy.
  - Mains supply fail.
  - Charger fail.
  - Float charge.
  - Boost charge.
  - Low voltage.
  - High voltage.
  - Positive and negative earth fault alarms.
  - Low electrolyte (vented cells only).
- Common fault relay contact: Volt free.
- Vented battery labelling: Describe the treatment required following contact with the electrolyte and warn of the explosion risk caused by naked flames.

FABRICATION

515 PROPOSALS

- Content: Include the following:
  - Overall dimensions.
  - Degree of ingress protection.
  - Protection against electric shock.
  - Form of internal separation and details of busbar and terminal shrouding.
  - Mounting and fixing details.
  - Builder's work requirements and plinth details.
  - Fault level and rated short circuit characteristics.
  - Functional unit details.
  - Details of internal and external paint systems and colour finishes.
  - Door swings.
  - Access panel details.
  - Schedule of labels.
  - Dimensioned general arrangement drawings, plans, elevations and sections.
  - Shipping sections.
  - Gland plate details.
  - Routing of cabling within assembly.
  - Busbar arrangements, links and supports.
  - Internal controls, instrument and meter wiring diagrams.

540 LAYOUT

- Phase sequence: Set-out phase sequence for phases L1, L2, and L3, from left-to-right, top-to-bottom, and back-to-front when viewed from the front of the assembly.
- Fuseholders: Mount such that fuses can be withdrawn towards the operator and away from live parts.

- Heights of components (from finished floor level to underside of component):
  - Equipment requiring operation or maintenance: 500-1600 mm.
  - Instruments: 1200-2000 mm.
  - Emergency switching devices: 800-1600 mm.
- Busbars and connections:
  - Supports: Insulated.
  - Identification: Provide 25 mm wide colour bands to busbars at 500 mm intervals with a minimum of one band in each compartment.
  - Future extensions: Pre-drill busbars for future extensions and extend busbar droppers into spare functional unit locations.

560 WITHDRAWABLE DEVICES

- Mounting: Mount within assembly on a withdrawable carriage with racking gear for insert and withdrawing.
- Gear to positively fix devices in the following positions: Connected, test-and-isolated, disconnected.
- Interlocking: Interlock to prevent devices being inserted or withdrawn unless in a tripped condition.
  - Closure: Prevent devices being closed unless in either the connected or test-and isolated position.
- Discharge of stored energy: Automatic by racking operation.
- Labelled automatic shutters: Locate over exposed connections.
  - Padlock facility: Required in the closed position.

580 FACTORY INSPECTIONS

- Notice before inspection and testing: 14 d.
- Equipment for inspection and testing: All switchgear assemblies.
- Factory inspections:
  - Fabrication: Inspection required.
  - Assembly completed, busbars exposed and functional units assembled: Inspection required.
  - Factory testing of assembly: Inspection required.

EXECUTION

620A INSTALLING SWITCHGEAR GENERALLY

- Switchgear cubicles: Arrange in modular form to facilitate future extension.
- Clearance (minimum):
  - Front access switchgear: 800mm access space in front, over and above any space required for openable doors or withdrawable gear.
  - Rear access switchgear: 800mm access space in front, over and above any space required for openable doors or withdrawable gear, plus 800mm behind and 800mm at each end.
- Fixing equipment: Fix independently of wiring installation with zinc electroplated fasteners.
  - Indoor equipment: Fix using internal lugs.
  - Outdoor equipment: Fix using external lugs.
- Extension boxes: Provide where necessary.
- Gland plates: Non-ferrous for single core cables.

640 INSTALLING METERING EQUIPMENT

- Digital metering equipment: Connect to building management system.

650 INSTALLING CURRENT TRANSFORMERS

- Identification details: Mount current transformers so that polarity markings and name plate details are easily viewed in situ.

670 INSTALLING SAFETY MATTING

- Front access equipment: Install safety matting in front of the equipment.
- Rear access equipment: Install safety matting in front of and behind the equipment.
- Installation: Fix securely to the floor.
  - Location: In front of main LV switchboards.

COMPLETION

910 TESTING AND COMMISSIONING GENERALLY

- Standard: To BS 7671.

920 TESTING AND COMMISSIONING OF SITE-ASSEMBLED SWITCHGEAR

- Notice before testing and commissioning: 7 d.
- Switches and circuit breakers: Vacuum clean.
- Protective devices settings: Configure to match the grading study.
- Routine testing and commissioning: Submit results.
- Switchboard monitoring: Continuous for 30 minutes following first energizing.
- Additional inspection and testing:
  - Check levelling and alignment of assembly.
  - Check operation of instruments and metering devices.
  - Check and adjust tightness of busbar connections and supports
  - Check tightness of bolted connections.
  - Check busbar joints with ductor resistance measurements.
  - Check earth connections at compartments, switches and earth electrodes.
  - Check clearance of live parts from direct contact.
  - Check polarity and phase sequence of protective devices.
  - Check operation of protective devices using secondary and primary current injection.
  - Manually operate protective devices.
  - Carry out earth fault protection simulation tests.
  - Check functional operation of circuit breakers.
  - Check operation of switch tripping devices.
- Inspection and test results: Submit.

930 TESTING AND COMMISSIONING OF SWITCH TRIPPING DEVICES

- To be tested as per details within WW Electrical Inspection & Testing specification, WW-532-202
- Tripping function: Verify correct operation.
- Indicators: Verify correct operation.
- Results: Submit.

935 SPARES AND CONSUMABLES

- Manufacturer's recommended spares: Supply two sets.
- Operating handles for circuit breakers and switches: One per device.

940 SPARE TOOLS

- Tools: Supply the tools, necessary for maintaining the equipment, including racking handles and a torque spanner.
- Tool cabinet: Include name plate, labelled shelves and non-lockable door. Size for storing racking handles, special tools, spare lamps, spare fuse links and other equipment necessary for satisfactory assembly operation.
  - Location: Board's choice.

960 PADLOCKS AND SPARE KEYS

- Quantity per item of switchgear: 2.
- Padlock keys: Two for each padlock.
- Padlock identification: Stamp padlock (describing its function on schedule).
- Keys for switchgear door locks: Supply 2 of each key type.

970 LABELLING

- Switchgear terminals: To BS EN 60445.
- Anti-condensation heaters: Provide caution notices advising against accidental switching off.
- Standby power: Provide danger warning notices stating that assemblies may be energized from more than one source.
- Indicator lamps: Label each lamp describing its function.
- Fuses, terminal blocks and other assembly components: Label describing their purpose.
- Spare fuses: Label, describe their rating and associated outgoing ways.
- Cabinets for padlocks and spare keys: Label.

980 CALIBRATION CERTIFICATES

- Certificates of calibration for meters and instruments: Submit.

V33 Busbar trunking

To be read with Preliminaries/ General conditions

PRODUCTS

320A POWER BUSBAR TRUNKING HORIZONTAL BUS BARS WITHIN PLANTROOMS

- Standard: To BS EN 60439-2. Submit certification.
- Type: Low voltage.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Assembly: Fully type-tested.
- Current rating: As detailed on LV schematics.
- Configuration: As detailed on LV schematics and plantroom plans.
- Place of installation: Indoor but suitable for plant room environments.
- Attitude: Horizontal.
- Protection against electric shock: Submit proposals.
- Prospective rated short circuit current (1 s): As detailed on LV schematics.
- Casing:
  - Standard: To BS EN 62208.
  - Material: Steel.
  - Finish: Corrosion-resistant paint.
  - Colour: Submit proposals.
  - Ingress protection to BS EN 60529: IP54.
- Conductors: Board's choice.
- Supports: Board's choice.
- Accessories: Sealed jointing sleeves.
  Board's choice.

320B POWER BUSBAR TRUNKING VERTICAL BUSBAR RISERS

- Standard: To BS EN 60439-2. Submit certification.
- Type: Low voltage.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Assembly: Fully type-tested.
- Current rating: As detailed on LV schematics.
- Configuration: As detailed on LV schematics and plans.
- Place of installation: Indoor within electrical risers.
- Attitude: Vertical.
- Protection against electric shock: Submit proposals.
- Prospective rated short circuit current (1 s): As detailed on LV schematics.
- Casing:
  - Standard: To BS EN 62208.
  - Material: Steel.
  - Finish: Corrosion-resistant paint.
  - Colour: Submit proposals.
  - Ingress protection to BS EN 60529: IP4X.
- Conductors: Board's choice.
- Supports: Wall brackets.
- Accessories: Sealed jointing sleeves.
  Board's choice.

320C POWER BUSBAR TRUNKING LINKING MAIN LV SWITCHBOARDS
Included as alternative option to cables.
Busbar trunking which connects two separated main LV switchboards and thus for part of its route leaves the switchrooms shall be fire rated to 2 hours.
Busbar which connects two main LV switchboards in immediately adjacent switchrooms and passes directly through a shared wall need not be fire rated.
Penetrations through fire walls shall be fire sealed.

- Standard: To BS EN 60439-2. Submit certification.
- Type: Low voltage.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Assembly: Fully type-tested.
- Current rating: As detailed on LV schematics.
- Configuration: As detailed on LV schematics and plantroom plans.
- Place of installation: Indoor but suitable for plant room environments.
- Attitude: Horizontal and vertical.
- Protection against electric shock: Submit proposals.
- Prospective rated short circuit current (1 s): 50kA.
- Casing:
  - Standard: To BS EN 62208.
  - Material: Submit proposals.
  - Finish: submit proposals.
  - Colour: Submit proposals.
  - Ingress protection to BS EN 60529: IP54.
- Conductors: Board's choice.
- Supports: submit proposals. For 2 hour fire rated bus bars the supports shall also withstand the effects of fire for 2 hours.
- Accessories: Sealed jointing sleeves.

340 TAP-OFF UNITS GENERALLY: PLANTROOM AND VERTICAL RISING BUSBARS
- Standard: To BS EN 60439-2. Submit certification.
- Type: Plug-in.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Rating: As detailed on LV schematics.
- Phase: Three phase for three phase distribution boards and single phase for single phase distribution boards.
- Assembly: Partially type-tested.
- Circuits: To match busbar trunking.
- Accessories: Each tap off to be sealed with a blanking plate when not in use in order to maintain required IP rating.
- 4 pole circuit-breaker with interlocks to prevent live loads being connected or disconnected.

350 FEED UNITS END FEED UNITS
- Standard: To BS EN 60439-2. Submit certification.
- Type: End feed.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Circuits: To match busbar trunking.

- Accessories: Riser base support unit.
  Submit proposals.
  IP54 rating in plantrooms. IP4X in risers.

370 FIRE BARRIER UNITSFOR BUSBAR TRUNKING RUNNING THROUGH FIRE COMPARTMENTS AND AT EACH FLOOR

- Standard: To BS EN 60439-2. Submit certification.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Fire protection: Submit proposals. To suit fire rating of compartment boundary.
- Circuits: Match busbar trunking.
- Accessories: Submit proposals.

EXECUTION

605 INSTALLING BUSBAR TRUNKING GENERALLY

- Joints: Manufacturer's jointing fittings. Maintain rigidity of trunking across joint.
  - Number of joints: Minimize.
  - Lengths of trunking: Maximize.
  - Open ends: Blank using manufacturer's removable end caps.
  - Electrical continuity: Maintain at each joint with a copper link fitted on the outside of the trunking.
- Connections to trunking covers: Minimize. Submit proposals for lid removal.
- Electrical continuity of covers: Electrically continuous with the trunking or provide protective conductors.
- Access: Provide space around trunking to permit access for installing and maintaining cables. Set out access with covers on a continuous face to allow cabling to be laid in throughout its entire length.
- Trunking passing through building fabric openings: Provide fixed trunking covers and extend these 50 mm from both sides of the opening.

620 INSTALLING POWER BUSBAR TRUNKINGGENERALLY.

- Generally: In accordance with BS 7671.
- Location: As detailed on electrical services layouts.
- Expansion joint interval: At each joint, integral to system design.
- Supports and fixings:
  - Supports: Submit proposals.
  - Finish and colour: Match trunking.
  - Locations where moisture may occur: Corrosion resistant, selected to prevent deterioration by electrolytic action.

630 INSTALLING TAP OFF UNITS HORIZONTAL BUS BARS IN PLANTROOMS.

- Generally: In accordance with BS 7671.
- Location: As drawings.
- Tap-off point intervals: as required by plant layout.

630B INSTALLING TAP OFF UNITS RISING BUS BARS.

- Generally: In accordance with BS 7671.
- Location: As drawings.
- Tap-off point intervals: 3 tap-off outlets per floor, always positioned at the same height above the floor.

640A INSTALLING FEED UNITSGENERALLY.

- Generally: In accordance with BS 7671.

650A INSTALLING FIRE BARRIER UNITSGENERALLY.

- Generally: In accordance with BS 7671.

COMPLETION

910 CLEANING

- Trunking: Clean immediately before energising.

920 TESTING AND COMMISSIONING GENERALLY

- Standard: To BS 7671.

930 TESTING AND COMMISSIONING OF SITE-ASSEMBLED BUSBAR TRUNKING

- Notice before testing and commissioning: 5 working days.
- Protective devices settings: As detailed in electrical specification and LV schematics.
- Routine testing and commissioning: Submit results.
- Additional inspection and testing:
  - Check and adjust tightness of busbar connections and supports.
  - Check tightness of bolted connections.
  - Check busbar joints using ductor resistance measurements.
  - Check earth connections.
  - Check clearance of live parts from direct contact.
  - Carry out earth fault protection simulation tests.
- Inspection and test results: Submit.

950 LABELLING

- Busbar terminals: To BS EN 60445.

960 DOCUMENTATION

- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system
- Drawings: Submit, showing the busbar trunking and tap-off units.

V36 Automatic power factor correction equipment

To be read with Preliminaries/ General conditions

PRODUCTS

310 AUTOMATIC POWER FACTOR CORRECTION EQUIPMENT GENERALLY. Compensation for harmonic content shall be by means of an automatic capacitor bank with blocking reactors (de-tuned filters).

- Operation:
  - Power factor: Continuously monitored.
  - Differences between the required power factor and the actual setting: Rectified by adding or removing capacitor banks.
- Enclosure: Separate.
- Power capacitors: Integral.
- Main isolation: Integral.
  - Type: Circuit breaker.
  - Operating handle: Padlock loop.
  - Mounting: Front of panel.
- Controls: Solid state microprocessor based.
  - Illuminated display: Required.
  - Selection of required power factor: Adjustable between 1.00 and 0.75.
  - Operating modes: On, off and automatic.
  - Power factor sensing and control: Automatic.
  - Capacitor banks: Switched individually.
  - Identification of energized capacitor banks: LED indicating lamps.
  - Undervoltage sensing: Disconnects capacitor banks at pre-set adjustable under voltage and upon supply failure.
  - Alarms:
  - Capacitor overload;
  - Frequency not detected;
  - Loss of capacitance;
  - Low power factor;
  - Overcurrent;
  - Overtemperature;
  - Overvoltage;
  - Undervoltage;
  - Excessive voltage total harmonic distortion (THD).
  - Mounting: Front of panel.
- Remote monitoring output: Connect to central controls and BMS, as section Y40. - Signals: Alarms.
- Current transformers: Type, configuration and ratio to suit sensing and mounting conditions.
- Contactors: Three pole, rated for repetitive high inrush switching duty.

320 CAPACITOR BANK SIZE

- Number of capacitor banks: To suit total requirement, provided in banks of 25kVAr and 50kVAr.

330 PERFORMANCE OF POWER FACTOR CORRECTION EQUIPMENT

- Power factor when corrected: Minimum 0.95 lagging.
- Capacitor bank size and number of stages: Submit proposals.
- Power factor equipment sizing calculations: Submit.

350 SEPARATE ENCLOSURESGENERALLY

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Purpose: To house all power factor correction equipment.
- Material: Board's choice.
- Finish to enclosure and supporting framework: Board's choice.
  - Colour: Board's choice.
- Internal separation to BS EN 60439-1 National Annex: Form 4 type 6.
- Ingress protection to BS EN 60529: IP31.
- Mechanical protection to BS EN 62262: Board's choice.
- Incoming cabling access: Top entry.
- Outgoing cabling access: Top entry.
- Cable termination chambers with gland plates: Required.
  - Conductor termination size (minimum): As detailed in electrical specification and LV schematics.
- Mounting: Floor.
- Doors:
  - Internally hinged with padlock loop.
  - Interlocked with controls or main isolator to de-energize capacitors when door is opened.

370 ILLUMINATED DISPLAYS

- Type: LED or LCD.
- Indicate:
  - Required and actual power factors: Accuracy to within 1% of measured value.
  - Capacitor banks in use.
  - Bank reconnection delay.
  - Real and reactive currents.
  - Voltage THD.
  - System alarms.

410 POWER CAPACITORS

- Standards: To BS EN 60831-1 and BS EN 60831-2.
- Type: Dry, metallized dielectric, self-healing.
  - Encapsulation: Vacuum liquid treated with thermosetting resin within plastic container.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Capacitor housing: Sheet steel enclosure filled with inorganic, inert and fire proof granules.
  - Thermal equalizers: Required.
- Voltage rating: 440 V.
- Dielectric Loss: 0.2W/kVAr.

EXECUTION

610 INSTALLING POWER FACTOR CORRECTION EQUIPMENT

- Separate enclosures: Arrange in modular form to facilitate future extension.
- Clearance (minimum):
  - refer to requirements for switchboards.
- Fixing equipment: Fix independently of wiring installation with zinc electroplated fasteners.
- Indoor equipment: Fix with internal lugs.

- Outdoor equipment: Fix with external lugs.
- Extension boxes: Provide where necessary.
- Gland plates: Non-ferrous for single core cables.
- Close coupled switchgear: Interconnect.
  - Cable type: Multi-core XLPE/ SWA/ LSZH, as section V32.
  - Containment: Cable tray, as section Y63.

620 POWER FACTOR ANALYSIS

- Data logging: As section V30.

680 FACTORY INSPECTIONS

- Not required

COMPLETION

910 INSPECTION, TESTING AND COMMISSIONING GENERALLY

- Standard: To BS 7671.
- Notice before testing and commissioning: 7 d.
- Capacitors, wiring, components, connections and equipment installation: Inspect.
- Operation of instruments and displays: Check and confirm correct operation.
- Controls: Commission and adjust for optimum power factor correction.
- Testing and commissioning results: Submit.

V37 Harmonic filtering equipment (If required)

To be read with Preliminaries/ General conditions

PRODUCTS

310 ACTIVE FILTERS PROVISIONAL ALLOWANCE

Project Co. shall make space allowance plus dedicated breaker, CTs and sensing wiring for the post occupation installation of 2 no. active filters on each of the A and B sides of each main LV switchboard. Refer to clause 620 below for details of post occupation harmonic analysis survey to be carried out by to determine the precise specification of active harmonic filters.

Project Co. shall allow to revisit the site during the post occupancy period to carry out the survey and to fit, whilst planning for minimal disruption, any necessary active filters. The space allowance for the post occupation installation of filters may be wall space or floor space.

EXECUTION

610 GENERAL INSTALLATION

- Standard: To BS 7671.

620 SURVEY

- Objectives: **Post completion. In the period immediately after occupation of the building and the commissioning of client supplied equipment, carry out a harmonic analysis survey. Determine the level of harmonic content within the electrical installation, recommend mitigation measures to comply with Energy Networks Association G5/4-1 and determine specification of active filters if necessary**.
- Scope of survey: Carry out tests without interfering with the plant, including analysis of harmonics from 2nd to 25th order.

630 INSTALLING HARMONIC FILTERS

- Point of installation: Main LV switchboards as detailed on LV schematics.
- Mounting: Floor mounted free standing.
- Clearance (minimum):
  - Front access: Manufacturer's standard.
  - Rear access: Manufacturer's standard.
  - Top access: Manufacturer's standard.
  - Bottom access: Manufacturer's standard.
  - Side access: Manufacturer's standard.
- Gland plates: Form common slot to all holes to prevent eddy currents.

640 INSTALLING CLOSE COUPLED ACTIVE FILTERS

- Close coupled active filters: xxxx
- Close coupled switchgear: Interconnect.
  - Cable type: LSZH singles, as section V32.
  - Cable size: As detailed on LV schematic and electrical specification.
  - Containment: Trunking, as section Y60.
- Control cables between close coupled active filters: Interconnect.

650 INSTALLING CURRENT TRANSFORMERS (CTS)

- Mounting: In direction of current flow as indicated on CT.
- Connection to filter:
  - Cable type: Manufacturer's standard.
  - Cable size: Minimum 0.75 mm².
  - Containment: Trunking, as section Y60.
- Connecting to filters: With cables provided by manufacturer. Where cables are of insufficient length, extend with terminal block and equivalent cable.

COMPLETION

910 INSPECTION, TESTING AND COMMISSIONING GENERALLY

- Standard: To BS 7671.
- Commissioning of filters: By manufacturer.
- Notice before testing and commissioning: 7 d.
- Filters, CTs, wiring, components, connections and equipment installation: Inspect.
- Operation of instruments and displays: Check and confirm correct operation including:
  - Supply current (rms) L1, L2, L3 and neutral current.
  - Load current (rms) L1, L2, L3 and neutral current.
  - Supply THD % L1, L2, L3.
  - Load THD % L1, L2, L3.
  - Supply voltage.
  - Load level % L1, L2, L3.
  - Detailed load current spectrum display.
  - Detailed supply current spectrum display.
  - Reactive compensation.
  - Selection of harmonic orders for mitigation.
  - Number of parallel connected filters.
  - Alarm functions.
  - Communication port function.
  - Identification function.
- Controls: Commission and adjust for optimum harmonic mitigation and reactive power compensation.
- Inspection, testing and commissioning results: Submit.
  - Number of copies: 3.

Y67 Transient overvoltage surge suppression devices

To be read with Preliminaries/ General conditions

PRODUCTS

310 TRANSIENT OVERVOLTAGE SURGE SUPPRESSION DEVICES FOR MAINS POWER SUPPLIESFOR LOW VOLTAGE DISTRIBUTION SYSTEM - MAIN LV SWITCH BOARDS

- Manufacturer: Board's choice.
  - Product reference: Submit proposals.
- Standard: BS EN 61643-11 and IEEE C 62.41.
- Operating voltage and frequency (nominal): 400 V at 50 Hz.
- Operating voltage (maximum): 500 V.
- Phase arrangement: Three.
- Surge current (minimum) between any two conductors: 10 kA/350uS.
- Let-through voltage (maximum): Must not exceed the equipment transient design level (ETDL) supplied by the equipment manufacturer. Submit proposals.
- Current rating: Submit proposals.
- Thermal overload protection: Submit proposals.
- Mode of protection: Lines to earth, lines to neutral, neutral to earth.
- Protection status indicators: Full protection status
- Remote indication of status (including loss of phase/ supply): Required.
- Effect on mains power supplies during normal operation:
  - No corruption to normal mains supply.
  - No break or shutdown of mains supply.
  - No excessive earth leakage current.
- Enclosure: Within switchboard.

340 ENCLOSURES.FOR SEPARATELY MOUNTED DEVICES

- Manufacturer: Board's choice.
  - Product reference: Submit proposals.
- Ingress protection (minimum): Submit proposals.
- Material: Manufacturer's standard.
- Finish: Manufacturer's standard.
- Colour: Manufacturer's standard.

EXECUTION

620 INSTALLATION GENERALLY

- Standards:
  - To BS 7671;
  - DD CLC/TS 61643-12; and
  - DD CLC/TS 61643-22.
- Equipment: Provide electrical supplies to equipment requiring power.
- Fixings: Non-corroding and compatible with the environment where they are installed.

630 INSTALLING TRANSIENT OVERVOLTAGE SURGE SUPPRESSION DEVICES FOR MAINS POWER SUPPLIES

- Point of installation: Main switchboard
- Transient overvoltage suppression devices: Interconnect.
- Control cables between transient overvoltage suppression devices and BMS: Interconnect.
- Interconnecting cable:
  - Cable type: Submit proposals.
  - Cable size: submit proposals.
  - Cable length (maximum): 250 mm.
  - Cable installation: Tightly bind connecting leads together.
- Fuse protection: Provide fuse protection to transient overvoltage surge suppression devices.
- Isolation: Not required.

650 LABELLING

- Electrical equipment: Labels indicating the purpose of the equipment.
- Safety signs: Install where voltages above ELV exist.
- Voltage warning notices: Label equipment where voltage exceeds 230V.
- Format: To BS 5499-5. Include warnings of the voltage present.

APPENDIX A

LV CONTROL PRINCIPLES

B1. SUBSTATION LV SWITCHBOARDS: CONTROL REQUIREMENTS

B.1.1. INTRODUCTION

Each substation shall step down the 11kV 'A' & 'B' supplies for LV distribution, delivering power into 400V 'A' & 'B' systems via two main LV switchboards.

The Main LV Switchboards shall be arranged to provide both

- manual control of the incoming, bus-section & outgoing circuits and
- automatic control of the incoming, bus-section & selected outgoing circuits.

The automatic control scheme should achieve both change-over of incoming supplies under mains failure conditions and remote control by the ENMS for the purpose of load control. In outline, the control functions shall provide:

- changeover to the other supply if either one of the 'A' or 'B' 400V supplies is lost (to be effected by opening the incoming ACB on the failed supply and closing the bus-section switches),
- opening of both LV incomers and the bus-section switches in the event that both 'A' & 'B' supplies fail, in readiness for generator start-up, and closing of the incomers on signals from the Electrical Network Management System (ENMS) that the network is ready to have loads applied.
- progressive or grouped energisation or de-energisation of outgoing feeder circuits for situations where prioritisation of loads is required - typically for matching loads to available network capacity during generator start-up or under abnormal 11kV network conditions.

B.1.2. GENERAL

The LV switchboard and its control scheme shall include at least the following basic features:

- Electrical interlocking (hardwired on breaker auxiliary contacts, not via a PLC) to prevent paralleling of the incoming supplies,
- Functional interlocking and safety interlocks on the switchgear, these remaining active at all times (e.g. trip & close interlocks, anti-pumping arrangements on the closing circuit).
- A three position Master Control Selector Switch to allow choice of control as 'Local Manual', 'Remote ENMS (with auto change-over deactivated)' or 'Remote ENMS (with auto change-over active)' [though alternative control selector switch arrangements may be considered],
- Provision for remote control from, and signalling of status and alarm conditions to, a central control room by means of the ENMS,
- Arrangements such that protection tripping is not disabled by the position of the control selector switches.
- Electrically operated incomer and bus-section switches, and electrically operated feeder switches where the latter are necessary for load acceptance/load shedding under generator capacity controls. This will necessitate motor driven spring wind mechanisms on ACB's and motor driven MCCB's on feeder circuits - note these may need to be DC operated,

- It shall be possible to easily re-programme (or connect /reconnect) the individual circuit breaker controls for activation by any specific one of the load priority signals received from the ENMS,
- Local operator control shall, for ACB incomer and bus-section switches, be via electrical pushbutton action, with all interlocks and safety features active at all times. Any buttons or linkages which act directly on the mechanism shall be shrouded and padlocked to prevent inadvertent access. Manual control of motorised moulded case circuit breakers is not envisaged but, if provided, shall be limited to operation through electrical pushbuttons or switches.

B.1.3. AUTOMATIC CHANGE-OVER

The broad requirements are as follows:

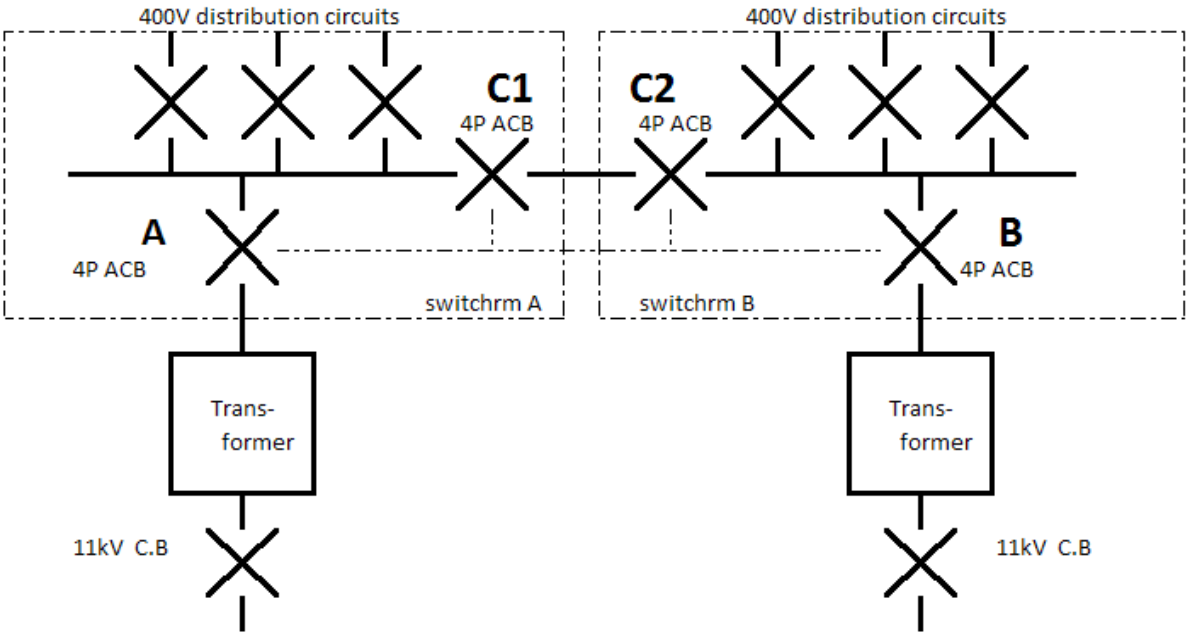
- In the event of loss of one incoming 400V supply, the affected section of the board shall be switched over to the remaining healthy 400V supply by opening the circuit breaker incomer on the failed supply side and closing the bus section switch(es). The change-over shall not however be performed if the loss of supply involves a protection trip by the Incomer ACB serving that section of the board.
- The restoration control arrangement shall provide that upon return of both 400V supplies (both to mains, or both to generator provided there is no priority load constraint at the time) then the Switchboard shall require manual reinstatement if it is desired to return to any preferred configuration. This manual intervention may be at the switchboard (local) or via ENMS (remote) depending on the operational policy. (This is consistent with a policy of the operators having to pre-agree interruptions before reconfiguring supplies from a substation.)

More detailed requirements include:

- Change-over response shall be slugged sufficiently to avoid responding to transient events (including in situations where two incoming supplies are being energised but one is available fractionally before the other).
- Exact timing arrangements shall be agreed later, but it is envisaged that the Main LV switchboards will affect their auto changeovers within 5 seconds [0 – 10 second timer required].
- Reinstatement timing does not apply, on the basis that manual restoration is expected.
- The automatic changeover scheme shall be modified during periods when load pick-up is underway under ENMS control. During such times, the bus-section switches shall be held open and auto change-over blocked, but such blocking condition shall be removed after an enabling signal level has been reached by which both incomers should have been energised.
- The automatic changeover scheme shall be modified during periods when generators are being tested on hospital load. The modified behaviour shall allow switching for a mains supply to pick up loads if they were fed from a generator supply which has just failed, but shall block any changeover which might try to switch additional loads onto the generators under test.

Using the diagram below as a guide, the required operation of the incomers and bus-section switches shall be as tabulated in Table B1.

SUBSTATION MAIN LV SWITCHBOARDS



Refer to TABLE B1: Auto Change-over Behaviour (for conditions where ACB C2 is taken to be the preferred normally open point).

B.1.4. REQUIREMENTS FOR GENERATOR START-UP PERIODS & LOAD SHEDDING

To cater for the possibility that the multiple generators on site may need to pick up load in progressive or grouped stages, and to allow load shedding in the event that available generator or mains capacity is insufficient to match the prospective load, a scheme shall be developed to assign 'load priority' numbers to the various circuits and schedule the pick-up or shedding in favour of the more important loads. The control is expected to apply on the LV Switchboards (and downstream on various electrical & stand-alone plant loads (eg lifts, freezers and possibly some large system components and some kitchen equipment), and via the BMS system to control mechanical plant).

Background design information is provided in subsection B.1.6. Proposals for load priority numbers shall be tabulated in a schedule and shown for ease of reference on the schematics. The scheme assumes that the ENMS will signal to each of the LV Switchboards a number of signals against which the LV Switchboard controls will close or open individual circuit breakers on their outgoing feeders. The LV board shall determine from the combination of signals it receives the nature of the supply, and shall respond accordingly. The scheme further requires that the ENMS and the BMS will be capable of communicating so that mechanical loads can be managed through the BMS system.

A few ‘Condition’ signals will be transmitted to the LV Switchboard by the ENMS to indicate whether the supplies at the 400V incomers are derived from mains or generator, and whether generators on either side are being tested. Signals are expected for these functions, as listed below, but it should be noted that the final signal functions will be determined during detailed design by the ENMS specialist working from the ENMS specification.

- MV incomer A available
- MV incomer B available
- MV incomer A open/ closed
- MV incomer B open/ closed
- Mains Active, Supply A (‘A’ connected to Mains)
- Mains Active, Supply B (‘B’ connected to Mains)
- Generator Active, Supply A (‘A’ connected to Generator)
- Generator Active, Supply B (‘B’ connected to Generator)
- Generators on Test, Supply A
- Generators on Test, Supply B

A number of ‘Enabling’ signals shall be transmitted by the ENMS to give load priority enabling signals.

The scheme will require the assignment of priorities to groups of load across the site (life safety systems, departmental loads, imaging equipment, etc.).

B.1.5. INTERFACE FOR ENMS CONTROL

The LV switchboard shall include facilities as described in the ENMS specification, such that remote control may be implemented and remote detection made of switch status and alarm conditions.

A three position master control selector switch on the board shall provide an overall means of limiting control to one station at a time. This master switch shall provide for selection of control to one of the following:

Manual (Local)
ENMS only
ENMS and Auto Change-Over

Further 3-position control selector switches shall be located on individual ACB or MCCB compartments to block remote or automatic operation of the individual circuit device if an operator at the board selects the control mode for that circuit to ‘Manual’ or ‘off’.
Control switch positions shall be labelled:

Manual (Local)
Off
Auto/ENMS

Unless otherwise agreed, the signals to and from the ENMS shall be provided by means of volt-free contacts, and the LV switchboards shall incorporate isolating terminals (sliding link style) for connections to/from all remote control/signalling contacts.

Unless defined elsewhere, or unless additional signals need be transmitted to suit the ENMS design, the table overleaf shall be taken as showing the requirements for remote control and indication.

Main LV Switchboards & Related Equipment - Interface Requirements to ENMS and BMS Symbols: • To be transmitted via ENMS ○ To be linked to BMS * To be handled by either ENMS (preferred) or BMS. (Board/specialist to submit proposals)		Main LV Switchboards					Related Equipment		
		General	Incomers	Bus-Section(s)	Outgoing feeder circuit (controlled)	Outgoing feeder circuit (uncontrolled)	Power Factor Correction Banks	Harmonic Compensation (Future)	Battery Chargers & DC System
Signal Description									
Input signals	Mains Active on Supply 'A'	•							
	Mains Active on Supply 'B'	•							
	Generators Active on Supply 'A' (1)	•							
	Generators Active on Supply 'B' (1)	•							
	Generators on Test, feeding 'A' side of board (1)	•							
	Generators on Test, feeding 'B' side of board (1)	•							
	(Multiple) Enable Load Connection, priority	•							
Input signals (Commands)	Switch circuit breaker to 'Off'		•	•	•				
	Switch circuit breaker to 'On'		•	•	•				
	Block PF correction during generator						•		
Output signals (status)	Control selected off ENMS	•							
	Control selected off automatic change-over	•							
	Auto Change-over scheme set for auto switching on restoration of failed supply.	•							
	Circuit Breaker is open (off)		•	•	•	•			
	Circuit breaker is closed (on)		•	•	•	•			
	Circuit Breaker racked out/unavailable (2)		•	•	•				
	Circuit breaker control selected off		•	•	•				
	MCCB motor mechanism out of service/off				•				
	Equipment selected off Automatic control						*	*	
	Equipment unavailable or operation inhibited						*	*	

Output signals (alarms)	EPO operated	*							
	Controls alarm (e.g. supply fail, PLC watchdog)	*							
	Incoming supply out-of-limits/failed		*						
	Circuit breaker tripped		*	*	*	*			
	Circuit breaker Trip Supply Failed		*	*	*				
	Springs discharged or auxiliary supplies failed		*	*	*				
	Common/grouped Alarm					*	*	*	*
Outputs (measureands)	kWh signals for metering – on circuits indicated on drawings or to satisfy the metering strategy (impulsing or otherwise to suit BMS)		•		•	•			
	Amps		•	•	•	•	•		
	Operations Count		•	•	•	•			
	kVAr compensation						•		
	Harmonic content (or total harmonic distortion)		•						

Notes:
(1) If these signals cannot be used to initiate blockage of Power Factor control when generators are running, then a separate input signal shall be transmitted via the ENMS.
(2) Term 'racked out' applies specifically to ACBs.

B.1.6. SUPPLEMENTARY DESIGN INFORMATION ON ENMS CONTROL

The control is envisaged as:-

- limiting the application of load during generator start-up (constrained by generator load acceptance limits) in three steps of 46.6%, 44.4% & 9% the combined rating of synchronised generator sets,
- being programmed to switch suitably sized blocks of load for any number of generators between (minimum) and 3 (total installed),
- Switching load blocks in a way which serves the above and always energises or keeps energised the higher priority loads (see the table at the end of this sub-clause),
- Being based primarily on the following concepts:
  - automatic change-overs to be effected at the various substation main LV switchboards,
  - motorised breakers at the main LV switchboards to connect or disconnect downstream loads during generator start-up or incidents on the 11kV network,
  - manually operated sub-panel switchboards (with 2-out-of-3 Ronis key interlocking),
  - ENMS control applied directly to lifts and various other loads, to supplement load control achievable at main LV switchboards,
  - BMS control of mechanical plant, again to supplement other load controls, and in order that motorised breakers can be avoided or minimised at sub-panels.
- Being cabled & connected so the ENMS can enable/disable various loads as follows:-
  - In Regen Kitchens, part of the catering load can be contactor controlled (energised & held on via a contactor, dropping off on loss

of supply or on ENMS disable signal and being re-energised by means of local reset button operable only if an ENMS enable signal is present),

- Lifts, via signal input to the respective controller
- Some large system components, via signal input to the control panel
- Kitchen freezer/refrigeration plants, via signal input to the control panel
- Restaurant main equipment akin to Regen Kitchens above
- Imaging Equipment: Automatic change-overs at each imaging switchpanel or individual imaging equipment (as depicted on schematics) for selection between 'A' & 'B' supplies. Load shed control & supply restoration would be applied at motorised source breakers (upstream, at the main LV switchboards), but ENMS signal to be brought to the imaging board/equipment to serve as permissive signal for the intended managed restart of the imaging suites.

The scheme shall support a feature of the ENMS which should permit:

- Initially, electrical loads to be switched against a 'list' of priority number allocations (diversified demands as estimated to be within the available generator capacity for the number of sets on-line & synchronised)
- After the complete start-up cycle and allowing a stabilising period for plant pick-up, and by reference to the margin between calculated generator capacity and measured generator load, electrical loads to be switched to more closely match the available generator capacity, retaining (where conditions permit) a spare set (i.e. N+1 operation). The envisaged ENMS behaviour would be to call for the next priority level loads if the capacity margin so permitted, or switch out one or more priority levels if the margin were negative. i.e. to 'step-up' or 'step-down' the priority levels.

Based on the assessed size/number of priority groups which must be provided (for combining into the multitude of possible switching steps related to 3-stage load application on any number of operable generators between 1 & 3), the table below indicates the envisaged switching blocks depending on the number of generator sets which start. The priority numbers are tabulated in the Load Priority Schedule and marked on the schematics against the individual electrical loads.

Number of 2MW Generators available	Load Pick-Up (Energising Load Group Priority Numbers as listed)			
	1st Step – [est 15 seconds]. (Simultaneous or rapid sequential application of first 46.6%)	2nd Step. (Simultaneous or rapid sequential application of next 44.4%)	3rd Step. (Simultaneous or rapid sequential application of remaining 9%)	Net loads groups supported without redundancy after generator run-up
One	P1	P2 to P4	P5, P6	P1 to P6
Two	P1 to P2	P3 to P8	P9, P10	P1 to P10
Three	P1 to P3	P4 to P9	P10	P1 to P10

P1-P10 Stage shown for information actual quantity subject to detail design.

B2. SUB-MAIN LV SWITCHBOARDS: CONTROL REQUIREMENTS

B.2.1. INTRODUCTION

Each Sub-Main Switchboard, described hereafter as a panelboard, receives two 400V supplies ('A' & 'B' supplies from the respective main LV Switchboard) and further distributes the electrical power (maintaining the dual 'A' & 'B' supply arrangement) to a number of distribution boards in the various user departments. The distribution boards are generally arranged with lighting and small-power circuits interleaved within the User departments to minimise the inconvenience of a power supply failure.

The panelboards shall be arranged to provide manual control of the incoming, bus-section & outgoing circuits. Neither automatic change-over of the incomers, nor automatic control of any outgoing circuits is required.

B.2.2. GENERAL

The Panelboard shall include at least the following basic features:

- Mechanical interlocking (Ronis or Castell keys, or other mechanical means if agreed) to prevent paralleling of the incoming supplies.
- Signalling of status and alarm conditions to, a central control room by means of the ENMS, but no need for remote control.

B.2.3. AUTOMATIC CHANGE-OVER

Automatic change-over is not required as automatic change over is a db level.

B.2.4. REQUIREMENTS FOR GENERATOR START-UP PERIODS & LOAD SHEDDING

Even during periods of generator start-up, or if load shedding is required during periods when the available generator capacity is insufficient to match the prospective load, no automatic control at the Sub-Main LV Boards (Panelboards) is required. Panelboards will therefore be energised & de-energised from upstream as complete entities, or the load control will be effected downstream by ENMS signal direct to lift controllers, plant control panels or contactors etc.

B.2.5. INTERFACE FOR ENMS CONTROL

The Panelboard shall include facilities as described in the ENMS specification, such that remote detection is made of switch status and alarm conditions.

Unless otherwise agreed, the signals to the ENMS shall be provided by means of volt-free contacts, and the panelboards shall incorporate isolating terminals (sliding link style) for connections to/from all remote control/signalling contacts.

Unless defined elsewhere, or unless additional signals need be transmitted to suit the ENMS design, the table overleaf shall be taken as showing the requirements for remote alarm and indication.

Sub-Main LV Switchboards (Panelboards) - Interface Requirements to ENMS and BMS Symbols: • To be transmitted via ENMS ○ To be linked to BMS * To be handled by either ENMS (preferred) or BMS. (Board to submit proposals.)		General	Incomers	Bus-Section	Outgoing feeder circuit
Signal Description					
Input signals					
Input signals (Commands)					
Output signals (status)					
	Circuit Breaker is open (off)		•	•	•
	Circuit breaker is closed (on)		•	•	•
	Circuit Breaker unavailable		•	•	
Output signals (alarms)					
	Incoming supply out-of-limits/failed		*		
	Circuit breaker tripped		*	*	*
	Common/grouped Alarm (if not covered above)		*	*	*
Outputs (measureands)	kWh signals for metering – on circuits indicated on drawings or to satisfy the metering strategy (impulsing or otherwise to suit BMS)		•		•
	Amps		•	•	•

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.21 JB G1547**
Performance Specification Title	**Electrical Inspection and Testing**	Date	**August 2014**
Prepared By	**JB**	Checked By	**PM**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	PM
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
ELECTRICAL INSPECTION AND TESTING

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this specification shall include, but not be limited to the following:-

- Electrical inspection
- Electrical testing
- Test certificates

3.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of:-

- current legislation:
- SHTM 06-01 Chapter 17;
- Part 6 of the IEE Wiring Regulations; (BS. 7671);
- Annex to MEIGaN 'Healthcare Interpretation of IEE Guidance Note 7...' the initial verification tests specified in section 2.24 'Verification';
- MEIGaN V2.0 Chapter 11; and
- industry standards referred to in the materials & workmanship section.

4.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

5.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

The Board. Project Co. shall liaise with the Board through whom all communications must flow. Drawings and other documentation will be available via the Board. Project Co. shall include for liaison with members of the Board's team with an interest in the planning and administration of the Electrical Inspection and Testing.

The Hospital. Project Co. shall include for liaison in conjunction with the Board with members of the Hospital's team with an interest in the planning and administration of the Electrical Inspection and Testing.

6.0 SYSTEMS

6.1 Electrical Inspection and Testing

This document shall be read in conjunction with all mechanical and electrical specifications for the Sick Children, Child and Adolescent Mental Health Services.

Testing and verification in all areas shall be undertaken in accordance with Chapter 17 and Appendix 2 (Sample Test & Record Sheets) of SHTM 06-01.

In areas covered by the requirements of the Annex to MEIGaN 'Healthcare Interpretation of IEE Guidance Note 7...' the initial verification tests specified in section 2.24 'Verification' shall be carried out and recorded prior to commissioning. Testing and verification in these areas shall also be carried out in accordance with chapter 11 of MEIGaN V2.0.

V39 Electrical inspection and testing

To be read with Preliminaries/ General Conditions.

COMPLETION

910 ELECTRICAL INSPECTION AND TESTING TYPE
- Type: Initial verification.

915 ELECTRICAL TEST ENGINEER: General

- Approval: NICEIC/SELECT.
  - Evidence of approval: Submit.

915A ELECTRICAL TEST ENGINEER: MEIGaN
- Electrical test engineer: The inspection and testing of the installation shall be carried out by a suitably appointed 'Competent Person'. This person shall be assessed and appointed in writing by the 'Authorised Person (LV)' who shall verify that the proposed Competent Person possesses the necessary technical knowledge, skills and experience relevant to the nature of the installation to be tested and includes a knowledge of the requirements of the MEIGaN document. Independent MEIGaN specialist.
- Testing and verification shall be carried in accordance with BS 7671 'Requirements for electrical installations' including latest amendment.
- MEIGaN compliance to be determined against requirements of MEIGaN V2.0 chapter 11.

920 GENERAL
- Standards: To BS 7671 and in accordance with IEE Guidance note 3.
- Notice before commencing tests (minimum): 24 h.
- Installed equipment standards: Verify and confirm compliance with the relevant equipment standards.
- Electronic devices: Isolate to prevent damage during testing.
- Continuity of protective conductors:
  - Parallel earth paths: Isolate before testing.
  - Equipment: Continuity tester with short circuit current of at least 200 mA, and a no load d.c. or a.c. voltage between 4 V and 24 V.
- Insulation resistance (minimum):
  - SELV and PELV circuits: 1 megohm.
  - Other circuits less than or equal to 500 V: 2 megohm.
  - Circuits less than or equal to 500 V: 2 megohm.
- External earth fault loop impedance: Direct measurement.
- Connection of test equipment to existing switchgear: Submit proposals.
  - Timing: in accordance with commissioning programme.
- Earth fault loop impedance:
  - Method: Direct measurement or Calculated from measurement of the sum of the resistance of the phase conductor and the resistance of the circuit protective conductor.
- Measurement locations: Origin, switchgear, fixed equipment and outlets, circuit extremities.
- Prospective fault current:
  - Method: Direct measurement.
  - Location: Origin, and at points where protective devices are required to operate under fault conditions.

- Phase sequence & rotation: Verify.
- Cable containment: Measure electrical continuity and insulating properties of containment. Submit results.

940 TEST EQUIPMENT CALIBRATION

- Test equipment calibration: UKAS approved.

950 INSPECTION AND TEST RESULTS

- Standard: To BS 7671.
- Certificates: Submit.
  - Number of copies: 2.
- Test equipment identity: Record on test certificates.
- Certificates of calibration: Submit for each test instrument.
- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with proposed document management system.

960 ELECTRICAL INSTALLATION CERTIFICATES

- Format: To BS 7671 appendix 6.
- Schedule of test results: Submit.
- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with the proposed document management system.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.22 JB G1547**
Performance Specification Title	**Common Electrical Clauses**	Date	**August 2014**
Prepared By	**JB**	Checked By	**PM**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	PM
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
COMMON ELECTRICAL CLAUSES

CONTENTS

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

1.1 Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

1.2 Life Expectancy & Life Cycle Costing

The building services components shall be designed with materials, components and techniques that are readily available, reliable, sustainable and easily maintainable in use. supports buildings constructed of proven technology components, with high life expectancy, leading to minimum cost in use. Equipment shall be selected and installed match or exceed the indicative life of building services components as listed in CIBSE Guide M Appendix 13.A1.

Project Co. shall demonstrate that the theoretical design life proposed for any element will be achieved

Materials and components forming part of the Works, which require maintenance and replacement within the life of the Works, shall be selected, located and fixed in such a way as to minimise future inconvenience, disruptions and to avoid temporary closure of the Works.

Project Co. shall ensure that all plant and systems are selected and configured to provide high quality, efficient, resilient, modular flexible and maintainable Building Services solution.

1.3 Action following mains failure/generator test conditions

All low current systems to be self-rebooting following mains failure and generator test conditions.

1.4 Low current systems with battery back-up

All battery systems shall be easy to test and change.

1.5 Document Management System

Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Document Management System.

V32 Low voltage cabling

PRODUCTS

310 CABLES GENERALLY

- Standard: To BS 7671.
- Proposed selection of low voltage cables: Submit drawings, technical information, calculations and manufacturer's literature. Submit British Approvals Service for Cables (BASEC), and where appropriate Loss Prevention Certification Board (LPCB), certification for ALL cables.
- Conductor sizes (minimum):
  - Sub main cables: 16 mm².
  - Lighting final circuits (including CPC): 2.5 mm².
  - Power final circuits (including CPC): 4 mm².
  - Spare capacity (percentage of current carrying capacity): 25%.
- Cable sizes as per cable schedules and distribution board schedules

315 CABLES, CORDS AND CONDUCTORS IDENTIFICATION

- Identification: Throughout cable length.
- Colour identification of cores: To BS 7671.
- Phase rotation: Identify with the coding L1, L2 and L3.

330 FLEXIBLE CORDS

- Standard: To BS 6500.
- Third party certification: British Approvals Service for Cables (BASEC) certified.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Light duty PVC insulated and sheathed flexible cords (LD PVC/ PVC cord, H03VV-F):
  - Construction: To table 26.
  - Sheath colour: Board's choice.
- Ordinary duty PVC insulated and sheathed flexible cords (PVC/ PVC cord, H05VV-F):
  - Construction: To table 27.
  - Sheath colour: Board's choice.
- Ordinary duty 90ºC PVC insulated and sheathed flexible cords (HR PVC/ PVC cord, H05V2V2-F):
  - Construction: To table 29.
  - Sheath colour: Board's choice.

340 INDUSTRIAL FLEXIBLE CORDS

- Standard: To BS 7919.
- Third party certification: British Approvals Service for Cables (BASEC) certified.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Heavy duty, heat resisting EPR insulated and sheathed flexible cords (HD HR rubber cord, H07BB-F):
  - Construction: To table 12.

350 PVC INSULATED CABLES FOR SWITCHGEAR AND CONTROL GEAR

- Standard: To BS 6231.
- Third party certification: British Approvals Service for Cables (BASEC) certified.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Single core type CK flexible heat resisting cables (single core tri-rated):
  - Construction: To table 9.

360 SINGLE-CORE HEAT RESISTING INSULATING CABLES

- Standard: To BS 6007.
- Third party certification: British Approvals Service for Cables (BASEC) certified.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Heat resisting rubber insulated cable (HR rubber singles, H07G-U):
  - Construction: To table 3.

370 THERMOSETTING INSULATED CABLES Small power & lighting circuits and earth conductors

- Standard: To BS 7211.
- Third party certification: British Approvals Service for Cables (BASEC) certified.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Rigid thermosetting insulated single core cables (LSZH singles, H07Z):
  - Construction: To table 3a.
- Thermosetting insulated and sheathed single core cables (LSZH/ LSZH singles):
  - Construction: To table 5.
- Thermosetting insulated and sheathed cables with circuit protective conductor (LSZH/ LSZH with CPC):
  - Construction: To table 7.

380 THERMOSETTING INSULATED AND PVC SHEATHED CABLES (XLPE/ PVC SINGLES) FOR BURIED EARTH CONDUCTORS

- Standard: To BS 7889.
- Third party certification: British Approvals Service for Cables (BASEC) certified .
- Manufacturer: Submit proposals .
  - Product reference: Submit proposals .
- Conductors: Copper.

393A THERMOSETTING INSULATED AND LSZH SHEATHED ARMOURED CABLES General low voltage sub mains distribution (excluding 5 core cables).

- Type: Multi-core XLPE/ SWA/ LSZH and Single-core XLPE/ AWA/ LSZH .
- Standard: To BS 6724.
- Third party certification: British Approvals Service for Cables (BASEC) certified.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.

- Insulation: Cross-linked polyethylene GP 8.
- Rated voltage: 600/ 1000 V.
- Conductors: Copper.

393B THERMOSETTING INSULATED AND LSZH SHEATHED ARMOURED CABLES General low voltage sub mains distribution (5 core cables).

- Type: Multi-core XLPE/ SWA/ LSZH.
- Standard: In accordance with the requirements of BS 6724.
- Third party certification: British Approvals Service for Cables (BASEC) certified.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Insulation: Cross-linked polyethylene GP 8.
- Rated voltage: 600/ 1000 V.
- Conductors: Copper.

420 FIRE RESISTANT, INSULATED AND SHEATHED CABLES. Fire detection and alarms cabling.

- Standard: To BS 7629-1.
  BS 8434-2 (enhanced 120 minutes)
  Enhanced grade cable as defined by BS 5839-1:2013.
  BS 8519:2010, 120 minute fire survival.
  SHTM 05-03 Part B
- Third party certification: British Approvals Service for Cables (BASEC) certified and LPCB.
- Manufacturer: As Prysmian Cables FP Plus.
  - Product reference: Submit proposals.

420A FIRE RESISTANT, INSULATED AND SHEATHED CABLES. Emergency lighting final circuits. Central battery system.

- Standard: To BS 7629-1.
  BS 5266-1.
  BS 8519:2010, 120 minute fire survival.
- Third party certification: British Approvals Service for Cables (BASEC) certified and LPCB.
- Manufacturer: As Prysmian Cables FP Plus.
  - Product reference: Submit proposals.

420B FIRE RESISTANT, INSULATED AND SHEATHED CABLES. Sprinkler pump power supplies.

- Standard: To BS EN 12845.
  BS 8519:2010, 120 minute fire survival.
- Third party certification: British Approvals Service for Cables (BASEC) certified and LPCB.
- Manufacturer: As Prysmian Cables FP600S.
  - Product reference: Submit proposals.

420C FIRE RESISTANT, INSULATED AND SHEATHED CABLES. Fire lifts and escape lifts.

- Standard: To BS 9999.
  BS 8519:2010, 120 minute r fire survival.
  SHTM 05-03 Part E
- Third party certification: British Approvals Service for Cables (BASEC) certified and LPCB.

- Manufacturer: As Prysmian Cables FP600S.
  - Product reference: Submit proposals.

420D FIRE RESISTANT, INSULATED AND SHEATHED CABLES. Motorised fire and smoke dampers, supply and control cabling

- Standard: To BS EN 12101
  BS 8519:2010, 120 minute fire survival.
- Third party certification: British Approvals Service for Cables (BASEC) certified and LPCB.
- Manufacturer: As Prysmian Cables FP Plus.
  - Product reference: Submit proposals.

420E FIRE RESISTANT, INSULATED AND SHEATHED CABLES. Power supplies to: powered smoke and heat exhaust ventilation, smoke fans, powered smoke shafts, pressurisation.

- Standard: To BS EN 12101
  BS 8519:2010, 120 minute fire survival.
- Third party certification: British Approvals Service for Cables (BASEC) certified and LPCB.
- Manufacturer: As Prysmian Cables FP600S.
  - Product reference: Submit proposals

420F FIRE RESISTANT, INSULATED AND SHEATHED CABLES. Activation and monitoring of: powered smoke and heat exhaust ventilation, smoke fans, powered smoke shafts, pressurisation.

- Standard: To BS EN 12101
  BS 8519:2010, 120 minute fire survival.
- Third party certification: British Approvals Service for Cables (BASEC) certified and LPCB.
- Manufacturer: As Prysmian Cables FP Plus.
  - Product reference: Submit proposals

420G FIRE RESISTANT, INSULATED AND SHEATHED CABLES. Powered sliding doors across escape routes.

- Standard: To BS 7273-4
  BS 8519:2010, 60 minute fire survival.
- Third party certification: British Approvals Service for Cables (BASEC) certified and LPCB.
- Manufacturer: As Prysmian Cables FP600S.
  - Product reference: Submit proposals

420H FIRE RESISTANT, INSULATED AND SHEATHED CABLES. Gaseous extinguishing systems.

- Standard: To BS EN 12094
  BS 8519:2010, 60 minute fire survival.
- Third party certification: British Approvals Service for Cables (BASEC) certified and LPCB.
- Manufacturer: As Prysmian Cables FP600S.
  - Product reference: Submit proposals

420J FIRE RESISTANT, INSULATED AND SHEATHED CABLES. Sprinkler pumps.

- Standard: To BS EN 12845
  BS 8519:2010, 120 minute fire survival.
- Third party certification: British Approvals Service for Cables (BASEC) certified and LPCB.
- Manufacturer: As Prysmian Cables FP600S.
  - Product reference: Submit proposals

420K FIRE RESISTANT, INSULATED AND SHEATHED CABLES. Suppression system monitoring.

- Standard: To BS EN 12845
  BS 8519:2010, 60 minute fire survival.
- Third party certification: British Approvals Service for Cables (BASEC) certified and LPCB.
- Manufacturer: As Prysmian Cables FP Plus.
  - Product reference: Submit proposals

420L FIRE RESISTANT, INSULATED AND SHEATHED CABLES. Sub mains from Central Battery System to local distribution boards.

- BS 5266-1.
  BS 8519:2010, 120 minute fire survival.
- Third party certification: British Approvals Service for Cables (BASEC) certified and LPCB.
- Manufacturer: As Prysmian Cables FP600S.
  - Product reference: Submit proposals.

440 SPLIT CONCENTRIC, INSULATED AND SHEATHED CABLES

- PVC insulated and sheathed: To BS 4553-1.
- Thermosetting insulated and PVC sheathed: To BS 4553-2.
- Thermosetting insulated and LSZH sheathed: To BS 4553-3.
- Third party certification: British Approvals Service for Cables (BASEC) certified.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Conductor: Copper.

460 INSULATING TAPE

- Standards: To BS EN 60454-1.

470 UNDERGROUND PLASTICS CABLE PROTECTION COVERS

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Polyethylene.
- Size:
  - Width: 150 mm.
  - Thickness: 18 mm.
- Jointing method: Peg.
- Identification: Laminate underground cable marker tape to top face.

480 CABLE ACCESSORIES

- Cold-pour resin compound: To BS 7933-1.
- Heat-shrink joints: To BS 7933-2.
- Glands: To BS EN 50262.
- Terminations for mineral insulated cables: To BS EN 60702-2.

EXECUTION

610 CABLE INSTALLATION GENERALLY

- Standard: To BS 7671.
- Timing: Do not start internal cabling until building enclosure provides permanently dry conditions.
- Preparation: Store cables above 5°C for 24 hours before installation.
- Installation temperature (minimum): 5°C.
- Cables: Install in one length.
- Cable pulling: Do not overstress. Prevent kinks and twisting of the cable.
  - Installation method: Submit proposals.
- Cables passing through walls: Sleeve with conduit or pipe duct. Bush at both ends.
- Cables surrounded or covered by insulation: Derate.
- Jointing: At equipment and terminal fittings only.

620 CABLE ROUTES

- Cables generally: Conceal wherever possible.
  - Concealed cable runs to wall accessories: Run vertically from the accessory.
  - Exposed cable runs: In plantrooms only.
- Distance from other services running parallel: 150 mm minimum.
  - Heating pipes: Position cables below.

630A CABLES CONCEALED IN WALLS AND PARTITIONS: EXTRA LOW VOLTAGE
Protection: Rigid pvc conduit.

630B CABLES CONCEALED IN WALLS AND PARTITIONS: LOW VOLTAGE
Protection: Rigid steel conduit, as section Y60.

640 CABLES IN VERTICAL TRUNKING AND DUCTS

- Supports: Pin racks or cleats at each floor level or at 5 m vertical centres, whichever is less.
- Heat barriers: Required.

660 CABLES ON CABLE SUPPORTS

- Position: Place cables side by side.
- Fastenings: Enable any cable to be individually removed.

670 SURFACE MOUNTED CABLES

- Fastening Minimum 25 mm between cable face and structure.
- Orientation: Dress cables flat, free from twists, kinks and strain.
- Terminating cables when not using glands: Take sheathing of cables into accessory boxes and equipment and protect against abrasion with grommets.

680 CABLES IN TRENCHES

- Base: Newly prepared bedding.
- Multiple cables in same trench: Set 150 mm apart.
  - Cable formation within trench: Space cables apart by a distance of half the cable diameter.

- Trefoil cable groups and protective conductors: Bind at 1 m intervals.
- Cables below roads and hardstandings: Install within duct and derate cable if longer than 10 m. Extend ducts 1 m each side of hard standing.
- Cable identification and protection: Underground plastics cable protection covers and underground cable marker tape.

710 CABLES IN DUCTS

- Cable installation from cable drums: Submit method statement.
- Single core trefoil cable groups and protective conductors: Install within a single duct and bind at 1 m intervals.

720 CABLES IN CONDUIT AND TRUNKING

- Cable installation: Install cables so that they are orderly and capable of being withdrawn.
- Single core wiring: Arrange using the loop-in method.
- Cables within trunking: Tie at 2 m intervals for cables of the same circuit reference. Label ties with circuit reference number at 10 m intervals.
- Cables in vertical conduit: Provide cable clamps in accessible conduit boxes at 10 m intervals.

740 INSTALLING ARMOURED CABLES

- Galvanized steel guards: Provide where cables are vulnerable to mechanical damage.
- Earthing: Bond armour to equipment and main earthing system.
- Connections to apparatus: Moisture proof, sealed glands and shrouds.

750 INSTALLING FLEXIBLE CORDS

- Cords: Grip securely at connections. Where cord grips do not form an integral part of the accessory or equipment, provide separate proprietary cord grips.

760 JOINTING AND TERMINATING ARMOURED CABLES

- Preparation: Cut cable ends immediately before jointing or terminating.
  - Cables left unconnected for more than 24 h: Seal to prevent moisture ingress.
- Cable stripping:
  - Length of exposed cores and conductors: Minimize. Leave no exposed conductor after termination.
  - Strands: Do not damage when stripping cable cores. Twist together. Do not reduce number. Secure at terminations.
- Joints and terminations: Use qualified cable jointers, using jointing materials, components and installation techniques recommended by the cable manufacturer and the jointing accessory manufacturer.
- Tooling certificate: Submit before installing connectors.
- Cable glands: Provide in accordance with BS 6121-5.
- Cold pour resin and heat shrink joints: Provide in accordance with BS 6910-2 or BS EN 50393.
- Plastics sheathed cables: Seal with proprietary shrink-on end caps.
- Bolted terminal connections to equipment and switchgear without integral cable clamping terminals: Compression or solder type lugs, of correct bore.
- Compression joints: Provide in accordance with BS 7609.
- Conductor labelling: Identify cable conductor cores at each end of cable and at joints.
- Unused cable cores: Connect to earth.

770 JOINTING AND TERMINATING ELASTOMER AND PLASTICS INSULATED CABLE

- Cable glands: Shroud.
- Core connections to equipment without integral clamping terminals: Compression lugs.

780 TERMINATING MINERAL INSULATED CABLES

- Standard: To BS EN 60702-2.
- Terminating copper sheaths: Earth to non-ferrous plate fixed to enclosure.
- Connections to vibrating equipment: Loop cables in a complete circle next to the point of connection.
- Connection to equipment and boxes: LSZH shrouded glands.
- Conductor cores: Identify at cable ends.
- Insulation resistance: Test at the time of termination and 24 h later.
  - Test report: Submit.

V80 Electrical identification

PRODUCTS

310 IDENTIFICATION AND NOTICES
- Standards: To BS 7671, HTM 06/02, HTM 06/03 BS 5499-1 and -5.

330 ELECTRICAL SHOCK TREATMENT SIGNS
- Type: Plastics encapsulated.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.

FABRICATION

510A EQUIPMENT LABELS FOR DISTRIBUTION BOARDS
- Material: Face engraved rigid plastic laminate.
- Label size: Submit proposals.
- Colour:
  - Background: White.
  - Lettering: Black.
- Typography:
  - Font: Helvetica medium.
  - Size: submit samples.
- Content:
  Distribution Board reference
  Department served
  Incoming supply cable reference

510B EQUIPMENT LABELS Local isolation switches in plantrooms
- Material: Face engraved rigid plastic laminate.
- Label size: Submit proposals.
- Colour:
  - Background: White.
  - Lettering: Black.
- Typography:
  - Font: Helvetica medium.
  - Size: submit samples.
- Content:
  Reference of equipment served
  Incoming supply cable reference

510C EQUIPMENT LABELS Switch Boards
- Material: Face engraved rigid plastic laminate.
- Label size: Submit proposals.
- Colour:
  - Background: White.
  - Lettering: Black.
- Typography:
  - Font: Helvetica medium.
  - Size: submit samples.
- Content:
  Switchboard reference
  Incoming supply cable reference

510D EQUIPMENT LABELS Functional Units on Main and Sub Switch Boards

- Material: Face engraved rigid plastic laminate.
- Label size: Submit proposals.
- Colour:
  - Background: White.
  - Lettering: Black.
- Typography:
  - Font: Helvetica medium.
  - Size: submit samples.
- Content:
  Description, location and reference of equipment served
  Outgoing cable reference

510E EQUIPMENT LABELS Busbar trunking in risers and in plantrooms

- Material: Face engraved rigid plastic laminate.
- Label size: Submit proposals.
- Colour:
  - Background: White.
  - Lettering: Black.
- Typography:
  - Font: Helvetica medium.
  - Size: submit samples.
- Content:
  Bus bar reference at each floor where in riser and at 5m centres in plant rooms.
  End feed to be labelled with incoming supply cable reference.
  Tap offs to be labelled with description and reference of equipment served.

510F EQUIPMENT LABELS Local isolation switches and fused connection switches in occupied spaces - domestic type

- Material: Face engraved rigid plastic laminate.
- Label size: Submit proposals.
- Colour:
  - Background: White.
  - Lettering: Black.
- Typography:
  - Font: Helvetica medium.
  - Size: submit samples.
- Content:
  Circuit reference.
  Description of equipment served.

520 DIAGRAMS

- Material: Paper print, encapsulated.
- Format: Single line engineering drawings to BS EN 61082-1.
- Information to be included:
  - Supply characteristics.
  - Maximum demand.
  - Cable types and sizes.
  - Switchgear ratings.
  - Protective device types, ratings and function.
  - Prospective fault current values: At each item of switchgear.

- Earth fault loop impedance values: At each item of switchgear.
- Circuits containing equipment vulnerable to testing: Label.

- Mounting: Wall.

EXECUTION

610 LOCATION OF ELECTRICAL IDENTIFICATION AND NOTICES

- Standards: To BS 7671, BS 5499-1 and -5.

620 SAMPLES

- Labels: Submit samples showing material, style, colour, lettering, and fixing method for each label type.

630 ARRANGEMENT

- Location: Submit proposals.
- Fixing: Secure, plumb and level.
  - Type: Rivets.

650 IDENTIFYING SUB-MAIN CABLES

- Labels at both ends: Include circuit reference and cable size.
  - Marker type: Nylon clip-on cable markers.

660 FUNCTIONAL EARTHS

- Labels at cable ends: State the purpose of functional earth cables.
- Instructions for operation and maintenance: Encapsulated card at cable ends.

670 PROTECTIVE CONDUCTORS

- Labelling of busbar and bare conductors: In each compartment or unit and at each accessible position.

680 EQUIPMENT LABELLING AND VOLTAGE WARNING NOTICES

- Electrical equipment: Install labels indicating purpose.
- Safety signs: Install where voltages above ELV exist.
- Voltage warning notices: Label equipment when the voltage exceeds 230 V.
  - Format: To BS 5499-5 8.A.0044, include warnings of the voltage present.

690 CIRCUIT CHARTS

- Location: Distribution boards and consumer units.
- Format: Card within a reusable clear plastics envelope.
  - Size A4.
- Typed information: State outgoing circuit references, their device rating, cable type, cable size, circuit location and number of points served.
- Fixing: Fit to the inside of each unit with nylon hoop and loop self-adhesive pads.
- Switchgear outgoing ways: Label corresponding to the circuit chart.

700A LABELLING OF ELECTRICAL ACCESSORIES BY PROPRIETARY TAPE SYSTEM

- Fused connection units and isolators: Describe function and Identify circuit reference. Socket outlets: Identify circuit reference.
- Text colour: Black.

710 INSTALLING DIAGRAMS

- Location: At main switchgear and At section boards.
  - Installation: Wall mounted with cup & screw fixings.

720 INSTALLING PERIODIC INSPECTION NOTICES

- Location: At the incoming point of supply.
- Frequency of inspection: 3 year.

730 INSTALLING MAINTENANCE NOTICES

- Maintenance procedures: Install notices describing essential maintenance procedures and their frequency.
  - Location: At relevant equipment.

740 INSTALLING ELECTRIC SHOCK TREATMENT SIGNS

- Location: Rooms containing electrical switchgear.
  - Installation: Wall mounted with cup & screw fixings.

750 INSTALLING HAZARD SIGNS

- Location: At each item of switchgear.

Y60 Conduit, trunking and ducting

PRODUCTS

310 CONDUIT, TRUNKING AND DUCTING GENERALLY

- Standard: To BS 7671.
- Proposals: Submit drawings, technical information, calculations and manufacturer's literature.
- Conduit, trunking and ducting sizes not stated: Submit proposals and calculations.

320A RIGID CONDUIT PLASTIC

Final run outs from metalic trays for Extra Low Voltage wiring including, but not limited to, the following systems:
CCTV,
Intruder alarms,
Fire alarms,
Access Controls,
BMS wiring,
Public address,
Induction loops,
TV and radio distribution,
Nurse call,
Assistance alarms.
Structured cabling

- Standard: To BS EN 61386-21.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: PVC-U.
  Electrical properties: With electrical insulating properties.

320B RIGID CONDUIT: BLACK ENAMEL

For lighting and small power cabling generally

- Standard: To BS EN 61386-21.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Steel.
- Mechanical properties:
  - Resistance to bending: Rigid.
  Electrical properties: With electrical continuity properties.
  Resistance to corrosion to BS EN 61386-1: Class 2.

320C RIGID CONDUIT: GALVANISED

For lighting and small power cabling in plant rooms and areas exposed to the weather

- Standard: To BS EN 61386-21.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Steel.
- Mechanical properties:
  - Resistance to bending: Rigid.
  Electrical properties: With electrical continuity properties.
  Resistance to corrosion to BS EN 61386-1: Class 4.

380A CABLE TRUNKING AND CABLE DUCTING SYSTEMS FOR MAIN CABLE CONTAINMENT RUNS - GENERALLY SUSPENDED

- Standards: To BS EN 50085-1 and BS EN 50085-2-1 or to BS 4678-4.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Steel.
- Construction: To include means of preventing contact between liquids and insulated conductors and live parts.
- Type: 2.
  Resistance to flame propagation: Required.
- Electrical properties: With electrical continuity characteristics.
  Protection against corrosive and polluting substances: Medium protection outside and inside.
- Access method: With tools.
- Screening: Not required.
  Sizes:
  - 38 x 38 mm;
  - 50 x 38 mm;
  - 50 x 50 mm;
  - 75 x 50 mm;
  - 75 x 75 mm;
  - 100 x 50 mm;
  - 100 x 75 mm;
  - 100 x 100 mm;
  - 150 x 100 mm;
  - 150 x 150 mm; and
  - 200 x 100 mm.
- Compartments:
  - 1;
  - 2; and
  - 3.
- Accessories and fittings: Factory made of the same material type and finish as trunking or ducting.

380B CABLE TRUNKING AND CABLE DUCTING SYSTEMS METAL WALL MOUNTED

TRUNKING (INCLUDING BEDHEAD & DADO TRUNKING) - IN SHTM 06-01 CLINICAL RISK CATEGORY 3, 4 AND 5 AREAS ONLY.

Refer to Small Power specification for description of Category 3, 4, 5 areas.

- SHTM 06-01 paragraph 14.35 recommends the use of metal trunking & conduit within category 4 & 5 areas. Paragraph 16.50 recommends the use of metal finished sockets in category 3 areas therefore metal trunking & conduit is required in category 3, 4 & 5 areas.
- Standards: To BS EN 50085-1 and BS EN 50085-2-1 or to BS 4678-4.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Metallic.
- Construction: To include means of preventing contact between liquids and insulated conductors and live parts.
- Type: 2.
  Resistance to flame propagation: Required.

- Electrical properties: With electrical continuity characteristics.
  Access method: Without tools.
- Screening: Required.
- Sizes: approximately 210 x 60 mm.
- Compartments: 2.
- Accessories and fittings: Factory made of the same material type and finish as trunking or ducting.

380C CABLE TRUNKING AND CABLE DUCTING SYSTEMS PLASTIC WALL MOUNTED (EXCLUDING BEDHEAD TRUNKING) TRUNKING - IN SHTM 06-01 CLINICAL RISK CATEGORY 1 AND 2 AREAS ONLY.
Refer to Small Power specification for description of Category 1, 2 areas.

- SHTM 06-01 paragraph 14.35 recommends the use of metal trunking & conduit within category 4 & 5 areas. Paragraph 16.50 recommends the use of metal finished sockets in category 3 areas therefore it is permissible to use plastic trunking & conduit in category 1 & 2 areas.
- Standards: To BS EN 50085-1 and BS EN 50085-2-1 or to BS 4678-4.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: PVC-U.
- Construction: To include means of preventing contact between liquids and insulated conductors and live parts.
- Type: 2. Resistance to flame propagation: Required.
- Electrical properties: With electrical insulating characteristics. Access method: Without tools.
- Screening: Not required.
- Sizes: approximately 210 x 60 mm.
- Compartments: 2.
- Accessories and fittings: Factory made of the same material type and finish as trunking or ducting.

460 CONDUIT FITTINGS Generally

- Standards: To BS EN 61386-1 and to BS EN 61386-21, -22, or -23 as appropriate or to BS 4607-1.
- Manufacturer: Match conduit.
- Material: match conduit.
  - Finish: Match conduit.
- Conduit boxes: Fit covers of same material and finish as boxes. Include brass earthing terminals in PVC-U boxes.
- Plugs
  - For metallic boxes: Slotted brass.
  - For non metallic boxes: Hexagon screwed PVC-U.
- Locknuts:
  - For metallic boxes: Hexagonal steel.
  - For non metallic boxes: Hexagonal PVC-U.

475 INTUMESCENT LINEAR GAP SEALS

- Standard: To BS EN 1366-4.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.

EXECUTION

610 INSTALLING CONDUIT, TRUNKING AND DUCTING

- Standards: To BS 7671 and in accordance with IET Guidance Note 1.
- Cable trunking or ducting: Provide when multiple conduits running in parallel exceed: 3.
- Preparation: Cut square.
  - Burrs and sharp edges: Make smooth.
- Cross-sectional area: Maintain throughout the conduit, trunking and ducting length.
- Arrangement: Position vertically and horizontally in line with equipment served, and parallel with building lines.
- Conduit in walls: Avoid concealed horizontal runs.
- Distance from other services running parallel (minimum):
  - Generally: 150 mm.
  - Above radiators: 1000 mm.
  - Steam services: 300 mm.
- Fire barriers: Provide to maintain integrity of fire compartments.
- Rewireable installations: Enable rewiring from accessible boxes or accessories only.
- Support: Independently fix and support conduit, trunking and ducting from building structure.
- Cleaning: Clean insides of conduit, trunking and ducting before installing cables.
- Cabling: Install when conduit, trunking and ducting enclosure is complete.
- Submittals: Submit manufacturer's technical information and drawings showing the proposed routes of conduit, trunking and ducting and the location of service outlets.

620 PROTECTION OF METALLIC CONDUIT, TRUNKING AND DUCTING

- Joints and ends: Remove grease, oil, dirt and rust before applying protective paint. Paint immediately following installation.
- Protective paint: Compatible with conduit, trunking and ducting finish.
  - Type: Match factory finish.

630 INSTALLING CONDUIT GENERALLY

- Fixing: Fix securely. Fix boxes independently of conduit.
- Changes of direction: Conduit boxes or bends site formed by machine. Do not use elbows, tees or inspection bends.
- Joints: Manufacturer's jointing fittings.
  - Number of joints: Minimize.
  - Lengths of conduit: Maximize.
  - Open ends: Plug.
  - At movement joints in structure: Manufactured expansion coupling. Install adaptable boxes on both sides of joint at a maximum distance of 300 mm.
- Connections to boxes, trunking, equipment and accessories: Screwed couplings with rubber bushes at open ends.

- Conduit boxes: Install flush with finished surfaces. Provide extension rings if required.
  - Fixing screws: Countersunk, or round-headed screws.
  - Number of fixings (minimum): For conduit boxes use 2. Larger fittings use 4.
  - Lids: Fasten with brass slot pan head screws.
- Rear outlet boxes: Locate where surface conduits pass through walls to external equipment.
- Draw-in boxes:
  - Spacing (maximum): 10 m.
  - Number of bends between draw-in boxes (maximum): 2.
  - Floors: Do not install draw-in boxes in floors.
- Suspended ceiling installations: Fasten outlet boxes to structure above ceiling.

640 INSTALLING RIGID METALLIC CONDUIT

- Fixings: Spacer bar saddle.
- Joints: Screwed.
- Threaded conduits: Tightly screw to ensure electrical continuity, with no thread showing.
- Conduit connections to boxes and items of equipment, other than those with threaded entries: Earthing coupling with male brass bush and protective conductor.

650 INSTALLING RIGID NON METALLIC CONDUIT

- Fixings: Spacer bar saddle.
- Joints: Threaded.
- Conduit connections to boxes and items of equipment: Threaded bushed entries.

660 INSTALLING PLIABLE AND FLEXIBLE CONDUIT

- Fixings: Spacer bar saddle.
- Joints: Threaded.
- Connections to trunking: Female adaptors and externally screwed brass bushes.
- Connections to equipment: Threaded bush.

670 INSTALLING CONDUIT IN CONCRETE

- Fastening: Fix securely to reinforcement. Fix boxes to formwork to prevent displacement of boxes.
- Concrete cover to conduit: 30 mm.
- Conduit in structural slabs: Submit drawings showing proposed route and location.

680 INSTALLING CONDUIT CONNECTIONS TO EQUIPMENT

- Surface mounted equipment:
  - Concealed conduit: Conceal the final connection.
  - Exposed conduit: Contain the final connection from the conduit box within flexible metal conduit.
- Equipment subject to vibration: Flexible metal conduit terminating in swivel connectors.
  - Length of conduit: Adequate for removal of equipment for maintenance.
- Connections to external equipment: galvanised conduit.

690 INSTALLING TRUNKING GENERALLY

- Supports/ mounting arrangement: Suspension rods and steel channels.
- Joints: Manufacturer's jointing fittings. Maintain rigidity of trunking across joint.
  - Number of joints: Minimize.
  - Lengths of trunking: Maximize.
  - Open ends: Blank using manufacturer's removable end caps.
  - Metal edging: Protect with PVC edging strip.
  - Electrical continuity: Maintain at each joint with a copper link fitted on the outside of the trunking.
- Connections to conduit, boxes, equipment and accessories: Screwed couplings, adaptors, connectors and glands, with rubber bushes at open ends.
- Connections to trunking covers: Minimize. Submit proposals for lid removal.
- Electrical continuity of covers: Electrically continuous with the trunking or provide protective conductors.
- Access: Provide space around trunking to permit access for installing and maintaining cables. Set out access with covers on a continuous face to allow cabling to be laid in throughout its entire length.
- Trunking passing through building fabric openings: Provide fixed trunking covers. Extend covers 50 mm from both sides of the opening.
- Cable retaining straps: Required except when trunking cover is on top.

720 DRAINAGE OF CONDUIT, TRUNKING AND DUCTING

- Drainage outlets: Locate at lowest points in conduit, trunking and ducting installed externally, and where condensation may occur.

770 SUPPORTS AND FIXINGS

- Suspension systems: Proprietary, comprising channel sections with return lips and accessories.
  - Finish and colour: Match conduit, trunking or ducting as appropriate.
- Supports and fixings: Select to prevent deterioration by electrolytic action.
- Supports and fixings in locations where moisture may occur: Corrosion resistant.

COMPLETION

910 CLEANING

- Electrical equipment: Clean immediately before handover.

920 INSPECTION AND TESTING

- Standard: To BS 7671.
- Electrical properties: Measure electrical continuity and insulating properties of conduit, trunking and ducting. Submit results.

930 DOCUMENTATION

- Drawings: Submit, showing the location of conduit, trunking, ducting and service outlets.
  - Dimensions: Include sufficient to locate components accurately.
- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system

Y63 Cable supports

PRODUCTS

310 SELECTION OF CABLE SUPPORTS
- Standards: To BS 7671 and in accordance with IET Guidance Note 1.
- Proposals: Submit drawings, technical information, calculations and manufacturer's literature.
- Sizes not stated: Submit proposals and calculations.
- Spare capacity: 25%.

320 CABLE BASKETS for main wiring runs:
CCTV,
Intruder alarms,
Fire alarms,
Access Controls,
BMS wiring,
Public address,
Induction loops,
TV and radio distribution,
Nurse call,
Assistance alarms,
Structured cabling.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Steel wire.
  - Diameter: Submit proposals.
- Coating material: Hot dip galvanized.
- Sizes:
  - Width: Submit proposals.
- Side height: Submit proposals.
- Features:
  - Segregation: Cable dividers.
  - Protective cover: Not required.

330A CABLE LADDERS For 11,000V cables
- Standard: To BS EN 61537.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Steel.
- Resistance against flame propagation: Non flame propagating.
- Electrical properties:
  - Continuity characteristics: With electrical continuity.
- Conductivity characteristics: With electrical conductive system component.
- Coating material: Hot dip galvanized.
  Mechanical properties:
  - Cable ladder free base area: Board's choice.
  - Resistance to impact: Up to 50 J.
- Width:
  - 100 mm;
  - 200 mm;
  - 300 mm;
  - 400 mm;
  - 500 mm;

- 600 mm;
- 800 mm; and
- 1000 mm.

- Features:
  - Segregation: Not required.
  - Protective cover: Required.

340A CABLE TRAYS 400/230V Sub mains cabling

- Standard: To BS EN 61537.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Steel.
- Resistance against flame propagation: Non flame propagating.
- Electrical properties:
  - Continuity characteristics: With electrical continuity.
  - Conductivity characteristics: With electrical conductive system component.
- Coating material: Hot dip galvanized.
  Mechanical properties:
  - Cable tray free base area: Board's choice.
  - Resistance to impact: Up to 50 J.
- Width:
  - 100 mm;
  - 200 mm;
  - 300 mm;
  - 400 mm;
  - 500 mm;
  - 600 mm;
  - 800 mm; and
  - 1000 mm.
- Features:
  - Flanged: Return flanged.
  - Segregation: Not required.
  - Protective cover: Not required.

350 CABLE SUPPORT COMPONENTS

- Components generally: Corrosion resistant where moisture may occur.
- Joints and expansion couplers: Use cable support manufacturer's products.

360 PROTECTIVE COVERS

- Type: Flanged.
  - Profile: Flat.

370A CABLE SUPPORT BRACKETS: SUBMAINS CABLES

- Standard: To BS 6946.
- Type: Board's choice.
- Finish: Match cable supports.

380A CABLE FASTENINGS

- Use and types:
  - Submain cables<95 mm²: Polyethylene one piece overlapping single fixing clamps.
  - Submain cables >95 mm²: Aluminium two piece twin fixing clamps.
  - Trefoil grouped submain cables: Aluminium trefoil single or twin fixing clamps.

  Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Fire resistant power supply cables: cast iron cleats.

385 CABLE CLEATS

- Type:
  - Aluminium trefoil twin fixing clamps;
  - Aluminium two piece twin fixing clamps; and
  - LSZH two piece twin fixing clamps.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Fire resistant power supply cables: cast iron cleats.

390 CABLE TIES

- Type: Wrap around self locking releasable.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
  - Material: Nylon.

395A CABLE BANDS: FIRE ALARMS CABLING

- Type: Perforated metal bands.
  - Material: Copper.
  - Protective covering: LSZH.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.

EXECUTION

610 INSTALLING CABLE SUPPORTS

- Standards: To BS 7671 and in accordance with IET Guidance Note 1.
- Preparation:
  - Burrs and sharp edges: Make smooth.
  - Cutting: Minimize. Cut square along an unperforated line. Make good edges.
  - Treatment of cut surface: Extend 25 mm beyond the cut. Match finish of cable supports.
- Width: Maintain throughout the cable support length.
- Access: Provide space around cable supports to permit access for installing and maintaining cables.
- Joints and expansion couplers: Locate between the bracket support and the quarter point.
  - Number of joints: Minimize.
  - Lengths of cable supports: Maximize.
  - Ends: Blank with end plates
- Holes in cable supports for the passage of cables: Grommet.
- Fire barriers: Provide where required to maintain fire performance of fabric.

- Support: Independently fix and support from building structure.
  - Clearance from building fabric (minimum): 20 mm.
  - Proposals: Submit.
- Components: Avoid contact between dissimilar metals.
- Routing of cable supports: Submit drawings showing the proposed routes.

620 MULTIPLE CABLE RUNS

- Cable supports: Required when cables running in parallel exceed: 3.

630 INSTALLING CABLE TRAY AND CABLE LADDER

- Changes of size and direction: Manufacturer's accessories of the same material type, pattern, finish and thickness as cable supports.
  - Site-formed bends: Not permitted.
  - Cable bends: Radiused.

640 INSTALLING CABLE BASKET

- Joints:
  - Cut: Adjacent cross basket wires.
  - Earth conductors: Connect across joints.
- Accessories: Form on site and connect with basket manufacturer's coupling components.

650 INSTALLING PROTECTIVE COVERS

- Location: Cables requiring mechanical protection.

660 CABLE INSTALLATION

- Cabling: Install when cable supports are complete.
- Preparation: Clear cable path of debris.
- Cable pulling: Submit method statement.
- Fastening: Secure cables, do not indent sheaths.
  - Spacing (maximum): 600 mm.

670 INSTALLING CABLE SUPPORTS ON ROOFS

- Location: Elevate above roof.
- Mounting: Load spreading supports.

680 INSTALLING BRACKETS FOR CABLE SUPPORTS

- Suspensions: Threaded rod fixed to channel with shake proof washers and hex nuts.
- Cable supports: Hold down with clamps and spring channel nuts.

COMPLETION

910 INSPECTION AND TESTING

- Standard: To BS 7671.
- Electrical properties: Measure electrical continuity and insulating properties of cable supports. Submit results.

Y65 Electrical accessories

PRODUCTS

310 PRODUCTS GENERALLY
- Standard: To BS 5733.
  - Switches: To BS EN 60669-1.

320 ELECTRICAL ACCESSORIES Occupied spaces
- Electrical accessories manufacturer: Board's choice.
  - Product reference: Board's choice.
- Plate:
  - Material: Plastics.
  - Finish: White.
  - Insert colour: Manufacturer's standard.
- Mounting: Recessed.
- Earthing terminal: Required.
- Cable termination:
  - Method: Screw.
  - Arrangement: Board's choice.

320A ELECTRICAL ACCESSORIES Plant rooms
- Electrical accessories manufacturer: Board's choice.
  - Product reference: Board's choice.
- Plate:
  - Material: Aluminium.
  - Finish: Manufacturer's standard.
  - Insert colour: Manufacturer's standard.
- Mounting: Surface.
- Earthing terminal: Required.
- Cable termination:
  - Method: Screw.
  - Arrangement: Board's choice.

340 LIGHT SWITCHES Occupied spaces.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Application: Internal.
- Ingress protection to BS EN 60529: IP 2X.
- Rating: 20 A.
- Actuating method: Standard rocker bar.
- Mounting: Flush.
- Poles: Double pole.

340A LIGHT SWITCHES Plant rooms.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Application: Internal.
- Ingress protection to BS EN 60529: IP 2X.
- Rating: 20 A.
- Actuating method: Standard rocker bar.
- Mounting: Surface.
- Poles: Double pole.

350 DIMMER SWITCHES AND CONTROLS Where required

- Standards: To BS EN 60669-2-1 and BS EN 55015.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 2X.
- Mounting: Flush.
- Type: Board's choice.
- Rating: 1000 W.
- Suitable for the following loads: Fluorescent.
- Control: Momentary.

360 FUSED CONNECTION UNITS GENERALLY

- Standard: To BS 1363-4.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 2X.
- Mounting: Flush.
- Control: Switched.
- Indicator lamp: Required.
- Fuse carrier access: Screw.
- Poles: Double pole.
- Flex outlet: Base entry.

370 CABLE OUTLETS GENERALLY

- Standard: To BS 5733.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 2X.
- Mounting: Flush.
- Flex outlet: Base entry.

380A STANDARD SOCKET OUTLETS: SHTM06-01 CLINICAL RISK CATEGORY 3, 4 & 5
AREAS METAL FRONT PLATE

- Standard: To BS 1363-2.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 2X.
- Mounting: Flush.
- Type: Twin.
- Control: Switched.
  - Switch position: Submit proposals.
  - Indicator lamp: Not required.
- Interlock: 3 pin equal pressure.
- Accessories:.

MATERIALS - METAL FRONT PLATE

380B STANDARD SOCKET OUTLETS: SHTM06-01 CLINICAL RISK CATEGORY 1 & 2 AREAS PLASTIC FRONT PLATE

- Standard: To BS 1363-2.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 2X.
- Mounting: Flush.
- Type: Twin.
- Control: Switched.
  - Switch position: Submit proposals.
  - Indicator lamp: Not required.
- Interlock: 3 pin equal pressure.
- Accessories:.

MATERIALS - PLASTIC FRONT PLATE

380C STANDARD SOCKET OUTLETS: ISOLATED POWER SUPPLY IPS SOCKETS GENERALLY

- Standard: To BS 1363-2.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 2X.
- Mounting: Flush.
- Type: Twin.
- Control: Switched - DOUBLE POLE.
  - Switch position: Submit proposals.
  - Indicator lamp: Not required.
- Interlock: 3 pin equal pressure.
- Accessories: Dual earth terminals

MATERIALS - METAL FRONT PLATE
COLOUR - BLUE
MEIGaN COMPLIANT CLEAN EARTH SOCKET
ENGRAVED AS MEIGaN REQUIREMENTS

400 INDUSTRIAL SOCKET OUTLETS Single phase - internally

- Standards: To BS EN 60309-1 and BS EN 60309-2.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 44.
- Material: Polycarbonate.
- Voltage rating: 200-250 V a.c..
- Current rating: as drawn.
- Frequency rating: 50 60 Hz.
- Pin configuration: 2 pole and earth.
- Mounting: Surface angle mount.
- Controls: Integral switch with interlock.

400A INDUSTRIAL SOCKET OUTLETS Single phase - externally

- Standards: To BS EN 60309-1 and BS EN 60309-2.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 67.
- Material: Polycarbonate.
- Voltage rating: 200-250 V a.c..

- Current rating: as drawn.
- Frequency rating: 50 60 Hz.
- Pin configuration: 2 pole and earth.
- Mounting: Surface angle mount.
- Controls: Integral switch with interlock.

400B INDUSTRIAL SOCKET OUTLETS Three phase - internally

- Standards: To BS EN 60309-1 and BS EN 60309-2.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 44.
- Material: Polycarbonate.
- Voltage rating: 380-415 V a.c..
- Current rating: as drawn.
- Frequency rating: 50 60 Hz.
- Pin configuration: 3 pole, neutral and earth.
- Mounting: Surface angle mount.
- Controls: Integral switch with interlock.

400C INDUSTRIAL SOCKET OUTLETS Three phase - externally

- Standards: To BS EN 60309-1 and BS EN 60309-2.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 67.
- Material: Polycarbonate.
- Voltage rating: 380-415 V a.c..
- Current rating: as drawn.
- Frequency rating: 50 60 Hz.
- Pin configuration: 3 pole, neutral and earth.
- Mounting: Surface angle mount.
- Controls: Integral switch with interlock.

405 INDUSTRIAL PLUGS GENERALLY

- Standards: To BS EN 60309-1 and BS EN 60309-2.
- Manufacturer: As electrical accessories manufacturer.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: as socket.
- Material: Polycarbonate.
- Voltage rating: as socket.
- Current rating: as socket.
- Frequency rating: 50 60 Hz.
- Pin configuration: as socket.
- Number to be supplied: one per socket.

450 SHAVER SUPPLY UNITS GENERALLY

- Standard: To BS EN 61558-2-5.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 41.
- Mounting: Flush.

- Output voltage: 115 V and 230 V.
- Rating: 20 V·A.
- Isolating transformer: Integral.

460 DOUBLE POLE SWITCHES GENERALLY in occupied spaces

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 2X.
- Mounting: Flush.
- Rating: as drawings.
- Indicator lamp: Not required.

460 UNSWITCHED DOUBLE POLE SWITCHES GENERALLY in occupied spaces

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 2X.
- Mounting: Flush.
- Rating: as drawings.
- Indicator lamp: Not required.

470 COOKER CONTROL UNITS GENERALLY

- Standard: To BS 4177.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 2X.
- Mounting: Flush.
- Supply to cooker: as drawings.
- Switched socket outlet: Not required.
- Indicator lamp: Required.

480 COOKER CONNECTION UNITS

- Standard: To BS 5733.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 2X.
- Mounting: Flush.
- Individual terminal block capacity (minimum): 10 mm² stranded cable.

500 CEILING LIGHT SWITCHES GENERALLY

- Standard: To BS EN 61058-2-1.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Ingress protection to BS EN 60529: IP 4X.
- Mounting: Surface.
- Rating: 10 A.
- Configuration: As drawings.
- Cord colour: White.

EXECUTION

610 INSTALLING ELECTRICAL ACCESSORIES

- Standard: To BS 7671.

620 ARRANGEMENT

- Locations: As drawings.
  - Coordinate with other wall or ceiling mounted equipment. Submit proposals.
- Positioning: Accurate and square to vertical and horizontal axes.
- Alignment: Align adjacent accessories on the same vertical or horizontal axis.
- Fixing: Secure, plumb and level.
- Mounting heights (finished floor level to underside of accessory):
  - Light switches: 1200 mm.
  - Single voltage shaver outlets: 1200 mm.
  - Shaver supply units: 1200 mm.
  - Socket outlets: 450 mm.
  - Fan isolators: Adjacent fan.
  - Cooker control units: 200 mm above worktop.
  - Cooker connection units: 600 mm.
- Separation distance between adjacent accessories: (minimum): 30 mm.

630 GRID SWITCH PLATES

- Spare modules: Provide blank inserts.

640 INSTALLING LIGHT SWITCHES

- Multigang switches: Connect so that there is a logical relationship with luminaire positions.
  - Unused switch spaces: Fit with blanks.
  - Segregation: Internally segregate each phase with phase barriers. Include warning plates.

COMPLETION

910 FINAL FIX

- Accessory faceplates (Grid accessories only): Fit after completion of building painting.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.23 JB G1547**
Performance Specification Title	**MV Installations**	Date	**August 2014**
Prepared By	**JB**	Checked By	**PM**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	PM
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
MV INSTALLATIONS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central energy centre to the South of the hospital houses heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this specification shall include, but not be limited to the following:-

- Incoming Electrical Supplies and Main MV Switch Panels
- MV Site Distribution Systems
- MV Standby Generation
- MV Earthing Systems
- Electrical Network Management Systems

The foregoing summary is intended for the general guidance of the Board in the preparation of his Tender. Any omission from it shall not relieve him of his obligation to carry out the whole of the works herein described and/or indicated on the drawings

3.0 SPECIFIC EXCLUSIONS

Fire alarm systems, lightning protection systems and telecommunications systems requirements are generally covered in separate documentation.

4.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of SHTM 06-01, IEE Wiring Regulations BS 7671 (17th Ed.), current legislation, regulations and industry standards unless otherwise stated.

5.0 DESIGN CRITERIA

Electricity Supply Characteristics

The site will be provided with two new 11000Volt 50Hz, three phase electrical supplies from SPEN's MV network. These individual electrical supplies will be derived from the outgoing terminals of SPEN's automatic change over arrangement which shall be located in the adjacent switch room.

Drawings

As part of the development of the design Project Co. shall prepare general arrangement drawings of the works to be provided. These shall be based on the Architect's base drawings and coordinated with other services and building elements. A proposed drawing list shall be submitted with the Tender.

6.0 LIAISON

Project Co. shall include for liaison with:-

SPEN. Project Co. shall include for liaison with SPEN for the design of the services in/for the 11kV sub-station building The systems to be provided in the main 11kV substation include primary and secondary lighting, small power systems, fire alarm systems and comms systems for which further details are contained in other specifications

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety Regulations.

Project Co. shall include for liaison in conjunction with the Board with members of the Hospital's team with an interest in the planning and administration of the small power System.

Building Control. Project Co. shall liaise, with and adhere to, the requirements of the Building Control Officer.

Any other member of the Project and Board teams concerned with the planning and administration of small power installations.

7.0 SYSTEMS

7.1 Incoming Electrical Supplies

SPEN are providing two incoming electrical supplies each with a rating of 3MVA. These are to be arranged such that if either fails the other is capable of taking the complete building load.

The incoming MV electrical supplies will be terminated into the circuit breaker switch board which is designed to supply the electrical needs of the new development and includes an auto change over arrangement and two feeder breakers for the project which all need be monitored by the Electrical Network Management Systems (ENMS).

SPEN shall make volt free contacts available for status monitoring of the 4 devices which shall be run to a wall mounted interface demarcation box.

Project Co. shall liaise with SPEN examining their design drawings and proposals to verify the equipment being provided by SPEN is compatible with both the MV cables and the ENMS monitoring he is providing.

The RHSC-DCN supplies shall be terminated into the RHSC-DCN circuit breaker board which shall be designed to integrate with the generator circuit breaker board and provide supplies to the RHSC-DCN ring mains.

7.2 MV site distribution systems

Outline description

The MV systems will be required to safely distribute the outputs from the available incoming supplies, MV standby generators, to the distribution load centres indicated on the drawings. The systems shall be designed and installed to maximise the security of supply to each of the load centres.

The MV systems to be provided principally include MV switch panels, cables, ring main units, cast-resin transformers and generators all as indicated on the drawings WW-XX-XX-SC-530-001.

The outgoing circuits shall be interlaced between the four ring main units with the open point loaded in Sub-Station 2. The cabling for these circuits will be buried direct in soft landscapes and drawn into cable ducts and pits when under hard standings and either laid in cable trenches or cleated to cable ladder when installed within buildings.

The minimum normal depth for all buried MV cables will be 1000mm below finished ground level.

Details of the MV switchgear are contained on the drawings and in the NBS clauses accompanying this specification.

The MV ring main shall operate on an open circuit basis, effectively as two radial feeds, such that in the event of a single cable fault only one of the radial feeds is isolated by the MV circuit breaker. Each of the ring main units shall however be fitted with earth fault passage indicators to show the direction/location of the earth fault around the circuit.

Energy Centre and Site Distribution

Details of the site cable routes and the cable routes within the Energy Centre are indicated on the drawings accompanying this specification.

7.3 MV Standby Generation

General

The standby generation facilities to be provided principally include:-

- 3No 2000kW, 2500MVA, 50hz 11000V three phase, diesel engine powered generators.
- Monitoring and control equipment
- Control and switch gear
- Acoustic treatment of the generator rooms to ensure the specified noise levels are not exceeded.
- Engine exhaust systems
- Fuel storage and transfer systems

The systems shall be as noted on the drawings, as described in this specification and as described in all appropriate specifications prepared for the electrical engineering works.

Each of the individual standby generators shall be complete with a dedicated control panel as described hereinafter. These panels shall be located in the control room and shall be linked to an adjacent ENMS control panel.

Fuel Storage

Local storage and transfer systems shall be provided to give approximately 6 hours of full load run time for each generator.

The Individual generators shall each be provided with a local daily service fuel tank to hold a minimum of 3200 litres of fuel. The daily service tanks shall be provided with a minimum of a further 15% of overfill capacity into which the high level float switches shall be fitted.

The fuel transfer/pumping systems to this local tank from the bulk storage tanks are outlined in a separate specification. The daily services tank shall however be fitted with low and high level alarm switches and contacts for:-

- Tank ‘empty’ alarm output to the BEMS – set at 15% level.
- Tank ‘emptying’ float switch and contact to signal the re-filling pump to start and inlet valve to open. This shall also have an output to the BEMS – set at 25% level

- Tank ‘full’ float switch/contact and cut-out for shutting down the re-fill pump and closing the refill valve. This shall also have an output to signal to the BMS system – set at 100% level
- Tank ‘over full’ switch/contact to both close a second motorised valve and to give an over full alarm output the BMS – to be at 110% level.

The daily service tanks shall be fitted with a fuel dump control valve and pipe/line.

The daily service tanks to each generator engine hall shall be linked to a common fire wire system that in the event of a local fire shall cause:-

- The local fuel to be dumped back into the bulk storage on the ground floor.
- Close a free fall fire valve on each fuel pipe entering the engine hall
- Cause a fire alarm to be sounded

Fuel flow and return pipework will be provided from each generator to its daily service tank.

All fuel pipework, tanks and valves shall be compliant with the requirements noted in specification WW.A.P.1.2.17.

Where fuel pipework is to be installed at low level accross floors it shall be protected against mechanical damage and/or treated to ensure it does not form a tripping hazard. This shall be by installing it into a floor trench (subject to Structural Engineers approval), or installing it immediatly beneath the floor slab or providing a high visibility chamferred edged cover.

Required Noise Levels

The whole of the installation shall be acoustically treated to ensure the following sound pressure levels are not exceeded:-

- 3m from the Energy Centre - 62dB (A).
- 3m from the exhaust discharge – 62dB (A).
- Within the generator control rooms and MV switch rooms – 50 dB (A).

Combustion/Cooling Air and Sound Attenuation.

The acoustic treatment to be provided as part of the works shall include:-

- Acoustic air inlet and discharge weather louvres.
- Air inlet and discharge attenuators with automatically opening and closing dampers on the internal faces of the units.
- Acoustic lining of the generator hall walls and ceilings.
- Acoustic wall and doors, as required, between each pair of generators to reduce sound reverberation and thereby reduce the overall noise output.

The discharge air paths shall be sealed against the building fabric to prevent leakage back into the engine rooms and thereby assist with the prevention of overheating of individual generating sets or groups of generating sets.

Weather Louvres

Louvres shall be provided for the air inlet and discharge from each set (3 No).

The louvres shall be selected to form part of the overall acoustic treatment of the generator installations and shall prevent water ingress into the building under all operating conditions.

The inlet louvres shall be sized and fixed/sealed to the building fabric in such a way as to enable them to be removed and to enable individual inlet attenuators to be removed and replaced through their louvre openings.

The discharge louvres shall be sized and fixed/sealed to the building fabric in such a way as to enable them to be removed and to enable removal/ replacement of the discharge attenuators and the generator sets through their openings.

Each of the inlet and discharge louvres shall have a long lasting finish to a colour to be agreed with the Architects.

Each louvre shall be complete with a bird mesh grill.

Inlet and Discharge Attenuators.

Separate air inlet and discharge attenuators pairs shall be provided for each of the 3 No generators set being provided as part of the current works.

The attenuators shall be selected to form part of the overall acoustic treatment of the generator installations.

Attenuators shall be of the dissipative type and constructed of specially selected high quality materials. Outer casings shall be made of galvanised sheet steel.

Each unit shall constructed to prevent air leakage

Internal splitter units shall have aerodynamic leading and trailing edges to reduce pressure drop across them.

The acoustic infill shall be of inorganic high density bonded long stranded rock wool sufficient to obtain the specified acoustic performance and packed under compression to eliminate voids due to vibration and settling. Infill material shall insect, vermin and moisture proof.

The louvres shall be structurally designed to withstand the pressure drops across them under operating conditions.

Automatic multi-bladed dampers shall be provided on the inlet attenuators. The dampers shall be arranged to open on the start signal for the appropriate standby generator and to close once that engine has stopped operating.

Engine Exhausts

Each engine shall be complete with its own exhaust systems designed to safely discharge the exhaust gasses to atmosphere and to silence the noise output to acceptable levels.

Each engine being provided with both primary and secondary silencers that shall be fitted in series.

The primary silencers shall be of a multiple chamber reactive type designed for low frequency attenuation. The secondary exhaust silencers shall be straight through absorptive type for mid to high frequency attenuation.

Silencers shall be of welded steel construction. The acoustical infill shall be formed from inorganic high density bonded material capable of operating at the maximum service temperatures of 650 degrees celsius.

Exhaust pipe shall be constructed from high quality steel with welded joints.

The noise level 3 m from the exhaust discharge with 3 sets running, shall be no more than 62 dB (A).

The whole of the internal exhaust systems shall be complete with thermal insulation and stucco aluminium cladding to reduce the temperature of the accessible exhaust components to safe levels.

Vertical runs of discharging exhaust shall have drain pipes and drain valves.

7.4 Earthing Systems

The whole of the electrical systems shall be earthed and bonded to accord with the requirements of BS 7430, BS 7671 and Scottish Power Energy Networks (SPEN). The requirements for this are interpreted onto the drawings accompanying this specification.

Under mains supply conditions (Mains only and generators paralleling with the mains) the systems shall rely on SPEN's earth.

Under generator only conditions when all generators are operating in parallel the systems shall be earthed to one generator's neutral via the appropriate neutral earthing panel and its MV resistor.

The neutral earthing panels shall be equipped with a spare/paralleled circuit earth resister in a separate compartment such that one can be removed while the other is in use.

The neutral earthing shall be controlled by the Electrical Network Management System and the generator control panels

Two sets of earthing rods shall be provided to form a connection from the MV earth bars to the general mass of earth. These shall each comprise a minimum of 4 No parallel earth electrodes driven to depth of 4.8m and contained in concrete inspection chambers. The minimum resistance to earth of each set of earth electrodes is one Ohm. Where this is not achieved then either additional earth rods shall be installed or the installed units shall be driven deeper.

7.5 Electrical Network Management Systems

Generally

The new MV electrical systems will principally comprise two incoming supplies feeding into a distribution network whose principle equipment includes approximately 18 No MV circuit breakers, 4No transformers, 3No MV Generators, as well as outputs for the connection of generator testing load bank modules and the CHP unit.

The Main LV systems will principally comprise approximately 4No main LV switch panels, 30No sub-main panels supplying the Life Safety, critical, essential, less-essential and non-essential electrical systems throughout the new development. The Sub-main LV distribution systems will comprise sub-main panels, bus-bars, switches/circuit breakers etc as shown on the drawings.

An Electrical Network Management System (ENMS) will be required to monitor and automatically control the electrical systems/network during normal and abnormal conditions.

The ENMS will be required to:-

- Work in conjunction with the protection devices provided throughout the MV and LV distribution systems and where necessary carry out alternative switching of the systems as a result of MV or LV devices switching or tripping.
- Provide ‘event’ alarms at each control panel and on each display panel.
- Have password controlled ‘event’ acknowledgement at each control panel and in the FM office.
- Record MV and LV system events and, when required, provide print-outs showing all events.
- Enable authorised persons to control and carry out selective switching of the systems (manual override of any controlled/monitored device). This facility is to be password protected at each control/interface point and shall be available only in the generator control rooms and in the control rooms associated with the main incoming MV switch panel.
- Have separate passwords (higher levels of authorisation) for control of the MV systems.
- Have separate passwords for each user of the system and be able to record which user carried out which operation, alarm acknowledgement etc.
- Provide indication of the condition of the electrical network (hierarchical schematics) including the status of each item connected/monitored. This shall be achieved by the displaying of systems schematics on each of the display panels and identifying which of the devices are Closed, open, tripped withdrawn etc.
- Under partial or total mains failure conditions match the available supplies to the load and where necessary match the connected load to the available supplies.
- Control the switching of loads to meet the load step limits of the mains and the generators under all conditions.

- Provide output enable signals to the BMS to enable the BMS to start and stop (By the absence of the signals) the mechanical plant including chillers, fans, pumps, boilers, humidifiers etc. In this connection it should be noted that the BMS will need to be specially designed to accept the connection or removal of these ENMS signals as 'priorities' which need to be acted upon at a speed to suit the switching requirements of the Electrical systems.
- Apply the loads to the generators in an expedient manner to an agreed priority schedule.
- Control the necessary synchronisation with the mains and switching of the systems for both generator testing and when the mains are re-established after mains failure.
- Provide agreed control of the neutral earthing resistors for the various mains/generator paralleling situations.
- Capture and relay switchgear status, energy consumption, harmonic content, operation counter and fault indication to each of the interface control units and display these on the indicated schematics
- Be modular in its nature and be able to be extended
- Have 25% spare capacity.

The ENMS shall use dedicated cables that are not used for any other purpose.

Separate 'A' and 'B' ENMS system control units will be required and will be linked to provide the required hot standby and increased resilience. The linking between the two systems shall be as indicated in the concept schematic.

ENMS user display and control units will be required at the following locations:-

- The Energy Centre control room— control panel and systems display.
- Main MV Switchroom — control panel and systems display.
- Main LV Panel; A1 - systems display
- Main LV Panel; A2 - systems display
- Main LV Panel; B1 - systems display
- Main LV Panel; B2 - systems display
- the Estates Office – display unit and control unit with only facilities to accept alarms (i.e. it shall not be possible to control switching from this location)
- Security Control room – display unit and control unit with only facilities to accept alarms (i.e. it shall not be possible to control switching from this location)

Each systems display unit shall provide hierarchical schematics of the systems showing the status of the devices controlled and/or monitored. This including switchgear status, energy consumption, harmonic content, operation counter and fault indication

Power supplies to local ENMS panels shall be provided from local battery backed power supply units that have sufficient autonomy to maintain the local systems for a minimum period of 72 hours under mains failure conditions. Each of these power supply units shall be monitored such that alarms are raised in the event of a failure.

Systems Operation

General

The ENMS will be arranged/programmed to control the electrical systems to make the best use of the available sources of supply (be that mains and/or generators).

- Matching of the Generators to required load
  - When the load is less than the capacity of the sets available (including synchronised/paralleled units and available non-running units) then a minimum of 500kVA of spinning reserve shall normally be paralleled.

- Matching of the load to the available generators.
  - Low priority numbers (less essential) shall be disabled until sufficient generators are available.
  - Allocation of 'load priorities' to various load centres, energy users, load types etc. all to enable the highest priority loads to be connected first or disconnected last while maintaining the systems within design limits.

Although the exact load prioritisation schedule will need to be agreed with the Hospital Board it is expected to include various priority ratings such as those noted in the table below:-

Priority Rating	Outline description of Load
1	Statutory requirements – Evacuation lifts, smoke extract/pressurisation fans, sprinkler pumps, wet riser pumps etc. Generator auxiliary supplies
2.1	Riser 1 Category 4 and 5 area life safety lighting and small power.
2.2	Riser 2 Category 4 and 5 area life safety lighting and small power.
2.3	Riser 3 Category 4 and 5 area life safety lighting and small power.
2.4	Riser 4 Category 4 and 5 area life safety lighting and small power.
3.1	Riser 1 Category 3 area Heating and Vent systems
3.2	Riser 2 Category 3 area Heating and Vent systems
3.3	Riser 3 Category 3 area Heating and Vent systems
3.4	Riser 4 Category 3 area Heating and Vent systems
4	Essential heating and systems
5	Vertical transportation
6	Imaging equipment supplies
7.1	Less Essential Heating and Ventilation Systems
7.2	Less Essential Heating and Ventilation Systems
8	Imaging equipment supplies
9.1	Chillers and cooling – stage 1
9.2	Chillers and cooling – stage 2
9.3	Chillers and cooling - stage 3

It should be noted that some of these load priorities may, subject to actual loads, be either switched together or switched at different times or even be sub-divided further as the design is finalised.

Mains failure – When RHSC MV systems healthy

Under normal mains failure conditions (when the RHSC-DCN MV infrastructure is healthy) the standby generator systems will be required to start and synchronise sufficient generator sets to permit the following minimum RHSC-DCN loads to be re-connected:-

Elapsed Time from generator start signal	**Outline description of loads to be connected**	**Load STEP to be connected (kVA)**
15 seconds	RHSC-DCN and energy centre - Lighting, small power and statutory life safety	1000
25 seconds	RHSC-DCN and energy centre - General loads	1000
35+ Seconds	RHSC-DCN I and energy centre - Non essential loads	1000

Under extreme conditions when generators sets may not be available to start (due to maintenance of individual units or switchgear not being available etc) the 15 and 25 second loads to be applied shall also be as the above table with loads adjusted proportionally for the number of units available to start.

Under Mains failure conditions the initial load sequencing shall be as follows:-

- Start signal to transfer to alternative SPEN supply (Wait 1 second)
- Start Signal to Generator (Wait 2 second)
- Generator Synchronising Period (+12 seconds)
- Transfer to alternative SPEN supply (If available)
- Commence sequential load connection process
- If alternative SPEN supply not available
  - RHSC Main Breakers open
- Review available synchronised generators and commence sequential load connection process

After the initial load sequencing, the ENMS shall continue to match the connected load of the site to the available generators by:-

- Enabling greater loads by enabling further load priority signals and starting of available generators up to the capacity of the generators available
- Starting/synchronising/paralleling of further generators when the site load increases.

- Disabling loads priorities when the site load exceeds the available generator capacity

Mains failure – Elements of MV systems tripped or isolated.

If both the Incoming supplies fail while elements of the MV Systems are out of circuit then the ENMS shall automatically work to restore electrical supplies to the loads without supplies in accordance with the Truth Table (to be progressed at Preferred Bidder stage).

Where the above requires the generators to be started to supply the failed loads then the generator starting and load sequencing shall generally be similar to that noted for normal mains failures. It should however be noted that, unless specifically required by the Truth Table, healthy supplies to RHSC-DCN loads should not be isolated in the process.

Operating Scenarios

The systems will need to be programmed to ensure the best use is made of the available sources. This is expected to include:-

Condition	**Response**
Normal operation-	Electrical systems operates from preferred incoming supply
Single supply failure-	All loads transfer to the single healthy supply.
Twin supply failure- (with normal Generator start conditions)	After the pre-set monitoring period (adjustable 0 - 5 seconds) Generators start and synchronise as one common group. After 12 seconds from the generator start signal the transformer are energised in two stages. After 15 seconds from the generator start signal the maximum permissible load step is applied to the generators (1.5MVA) After 25 seconds from generator start signal a further maximum permissible load step is applied to the generators (1MVA) The remaining plant load is then introduced
Twin supply failure- (with abnormal Generator start conditions)	After the pre-set monitoring period (adjustable 0 - 5 seconds) Generators start and synchronise as one common group. After 15 second from the generator start signal maximum permissible loads are applied - Loads commensurate with the number of generators synchronised. After 25 seconds from the generator start signals maximum permissible additional loads are applied – Loads

Condition	Response
	commensurate with the number of generators synchronised. At 10 second intervals additional maximum permissible loads are applied until all generators are fully loaded.
Normal running on generators	The number of generators synchronised and supplying load are optimised to ensure that the number of units running matches the load with 2000kW spare. (i.e. N+1 generators on line)

MATERIALS AND WORKMANSHIP CLAUSES

V10 High voltage connection

To be read with Preliminaries/ General conditions

GENERAL

110 INCOMING ELECTRICITY SUPPLY
- Nature of current: Alternating.
- Phase: Three.
- Voltage: 11000 V.
- Source: Electricity Distributor.

120 ELECTRICITY DISTRIBUTOR
- Details: SPEN.

SYSTEM PERFORMANCE

210 DESIGN
- Design: Complete the design of the high voltage connection in accordance with the
- Electricity Distributor's guidelines.
- Proposals: Submit drawings showing equipment positions and routes, technical information and calculations.
- Evidence of agreement with Electricity Distributor: Submit.

220 SUPPLY CHARACTERISTICS
- Anticipated maximum demand: 3MVA.
- Maximum prospective short-circuit current: 7.9kA.
- Load voltage unbalance (maximum): In accordance with Engineering Recommendation P29.
- Supply arrangement: 2 No alternate supplies terminated Multi-breaker MV panel with two outgoing feeders that is supplied as part of SPEN's works.

EXECUTION

630A MANAGEMENT
- Establishing the supply: Manage and liaise with the Electricity Distributor and Electricity Supplier to establish the incoming electricity supply.
- Examine the installation and proposal drawings submitted by SPEN for the dual use switch panel and verify that the proposed outgoing MV cables can be installed and terminated

COMPLETION

920 DOCUMENTATION
- Operation and maintenance instructions: Submit.
- Record drawings: Submit.

V12 Generator systems

To be read with Preliminaries/ General conditions

GENERAL

115 RECIPROCATING INTERNAL COMBUSTION ENGINE DRIVEN ALTERNATING CURRENT GENERATOR SYSTEM Generators G1 to G3.

- System manufacturer: Board's choice.
- Internal combustion engine: Required.
  - Type: Compression engine.
- Internal combustion engine electrical equipment: Required.
- Governor: Required.
- Alternator: Required.
- Automatic voltage regulators: Required.
- Control panel: Required.
- Fuel: Diesel supply systems, as section S40.
  - Storage tanks: Day tank and Storage tank, as section S40.
- Exhaust and silencer: Custom.
- Vibration isolation mountings: As section Y31.
- Gas detection and alarm systems:
- Generator housing: Plant room and Submit design and cost proposals.
- Earthing: as drawings.
- Signs and notices: As section N15.
- Ventilation: Metal louvres, as section L10 and Submit design and cost proposals.
- Accessories:
  - Drip tray;
  - Emergency stop buttons;
  - Load bank; and
  - Safety guards and stone guards.

120 SYSTEM CONFIGURATION

- Configuration: To BS ISO 8528-1.
- Installation: Fixed.
  Mounting: With a base frame, integrally mounted control gear, switchgear and auxiliaries.
- Mounting type: Fully resilient.
  - Accessories: Lifting points.
- Engine and alternator connection:
  - Coupling: Manufacturer's standard.
  - Assembly: Manufacturer's standard.

140 INTERNAL COMBUSTION ENGINE ANCILLARIES

- Electrical equipment: Required.
  - Operating voltage: 24 V d.c.
  - Earth polarity: Negative.

SYSTEM PERFORMANCE

210 DESIGN

- Design: Complete the design of the generator system.
- Prime mover and alternator size: Take into account connected loads including ancillaries, harmonics and transient operation.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature. Include:
  - General arrangement drawings.
  - Control diagrams.
  - Prime mover and alternator data.
  - Power output curves.
  - Generator system efficiency at 50%, 75% and 100% full load.
  - Start up temperature (minimum).
  - Fuel and lubricating oil characteristics and consumption, as outlined in BS ISO 3046-1.
  - Minimum run time without fuel and lubricating oil tank replenishment.
  - Calculations for performance of acoustic enclosures and silencers.
  - Maintenance access dimensions.
  - Details of plinths and anti-vibration mountings.

215 LOAD CHARACTERISTICS

- Total load (active power): 2.0MW - Each unit.
- Total load (reactive power): 2.5MVA - Each unit.
- Load type/ size:
  - Air conditioning;
  - Battery charger;
  - Discharge lighting;
  - Fluorescent lighting;
  - Small power;
  - Lifts;
  - Medical imaging equipment;
  - Motors; and
  - UPS.

225 PERFORMANCE OF GENERATOR SYSTEMS

- Standard: To BS ISO 8528-1.
- Application: Continuous power.
- Electrical characteristics:
  - Number of phases: Three.
  - Voltage: 11000V.
  - Frequency: 50 Hz.
- Site criteria: Land use.
- Operation: Parallel operation with other generator systems and with the incoming electrical supply.
- Start-up mode: Automatic.
- Full load acceptance: for multiple synchronised generators
  55% Full load in 15 seconds
  90% full load in 22 Seconds
  100% full load 29 seconds.
  - Start-up time to full load acceptance (maximum): 29 seconds.
- Performance class: G3.

240 GENERATING SYSTEMS FOR SAFETY SERVICES

- Standard: To BS 7698-12.

- Performance class: 3.

250 SERVICE CONDITIONS

- Environment: Inside.
- Site temperature:
  - Maximum: 30°C.
  - Minimum: - 20°C.
- Altitude (above sea level): 100.
- Humidity (RH): Submit proposals.
- Atmospheric conditions: Within 10 km of coast.

260 SYSTEM MODE OF OPERATION

- Details: Refer to description of operation given in the outline scope of works document for greater details - However the general principles will be upon mains failure: The system senses mains failure, starts the generators while isolating the mains supply.

  The generators run up to rated speed, synchronise and applies the load in a controlled manner. The system monitors for system faults and alarms, and initiates emergency shutdowns/actions where required.

  The systems monitors the load and ensures the number of units running is commensurate with it.

  The systems monitor the applied load and ensures it is commensurate with the number of units available.

  On restoration of mains supply manual intervention will be required to synchronise the systems with the mains and hand the load back to the mains.

  The systems shall be capable of being tested using the site load without a break in the supply to the load.

265 GENERATOR SYSTEMS OPERATING IN PARALLEL

- Synchronization: Automatic.

270 FUEL AND OIL CONSUMPTION

- Fuel consumption (maximum): 520 Litres per hour per set at rated load.
- Oil consumption (maximum): Submit proposals.

275 DIESEL EXHAUST EMISSIONS

- Emission standard: E.U. Directive 2004/26/EC compliant.

280 CONNECTING GENERATORS TO THE PUBLIC SUPPLY NETWORK

- Standard: To Energy Networks Association G59/1.

290 NEUTRAL EARTHING

- Type: Switched neutral connection to earth.

PRODUCTS

310 GENERATOR SET

- Standards: To BS ISO 8528-1.
  - Internal combustion engine to BS ISO 8528-2 and BS 5514-6.
  - Governor: To BS 5514-4.
  - Alternator: To BS 5000-3, and BS ISO 8528-3 or BS EN 60034-22.
  - Automatic voltage regulator: To BS 4999-140.
  - Control panel: To BS ISO 8528-4.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

340 INTERNAL COMBUSTION ENGINES GENERALLY.

- Standards: To BS ISO 8528-2.
- Type: Compression engine.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Number of cylinders: Submit proposals.
  - Total displacement: Board's choice.
- Rated speed: 1500 rpm.
- Overspeed protection: To BS 5514-6.
- Air/ fuel intake: Turbo-charged.
- Air filters: Replaceable dry element type.
- Fuel filters:
  - Type: Replaceable paper type.
  - Filtration: To remove contaminants larger than 10 µm.
- Oil filters: Replaceable full flow type.
- Crankcase oil heater: Thermostatically controlled.
- Oil reservoir tank: To maintain the required oil level in the sump.
  - Reservoir capacity: Submit proposals.
  - Oil level monitor: Required.
  - Drain valve: Locate to provide gravity oil removal and easy maintenance.
  - Used oil container: Provide.
- Cooling system: Closed-circuit pressurized water based.
  - Coolant heater: Required.
  - Radiator: Generator Base Frame Mounted.

  Protective guard: Required.
  - Drain valve: Locate to provide easy maintenance.
  - Fan: Electric motor driven or Engine driven.
- Engine starting method: Electric starter motor .
  - Starter lockout: After 3 unsuccessful start attempts.
- Accessories: submit proposals.

345 INTERNAL COMBUSTION ENGINE ELECTRICAL EQUIPMENT

- Engine start battery: High performance plant to BS 6290-2 or Free electrolyte nickel cadmium batteries to BS 6260.
  - Capacity: Sufficient to Crank the engines 5 times at operating temperatures.
  - Charger: Batteries charged from mains when available, and charge alternator on when engine when running.
  - Lockable isolator: Required.
  - Location: Remote stand.
- Battery and charger for control panel: Required.

Capacity: Sufficient to enable control panel to function for 48 hours following mains failure.

350 GOVERNOR

- Standard: To BS 5514-4.
- Type: Electronic.
- Manufacturer: System manufacturer.
  - Product reference: Submit proposals.
- Mode of operation: To enable engine to operate continuously at rated speed from no-load to the rated full electrical load.
- Adjustments:
  - Acceleration rate;
  - Load gain;
  - Maximum speed;
  - Speed droop; and
  - Stability.

370A ALTERNATORS GENERALLY .

- Standard: To BS 5000-3, and BS ISO 8528-3 or BS EN 60034-22.
- Type: Synchronous.
- Manufacturer: Submit proposals.
- Product reference: Submit proposals.
- Excitation: Submit proposals.
- Overspeed withstand: 120% rated speed.
- Underspeed withstand: 95% rated speed.
- Short-circuit withstand capability (minimum): 2.5 times full-load short-circuit current for 10 s.
- Thermal classification to BS EN 60085: H.
- Ingress protection to BS EN 60034-5: IP32.
- Anti-condensation heater: Required.
- Protection:
  MV Circuit breaker with over current and earth fault inverse definite minimum time lag relay.
  Stator earth fault and rotor earth fault.
  General fault protection
- Output cable terminal boxes: Removable lid and side covers.
  - Outgoing cable entry: Top - Submit proposals.

380 AUTOMATIC VOLTAGE REGULATORS

- Standard: To BS 4999-140.
- Manufacturer: System manufacturer.
  - Product reference: Board's choice.
- Grade: 2.

450 CONTROL PANEL Individual controllers for Units G1 to G12.

- Standard: To BS ISO 8528-4.
- Manufacturer: System manufacturer.
  - Product reference: Submit proposals.
- Configuration: Group controls, alarms and indicators in common control panel.
- Controls:
  - Alarm reset;
  - Automatic/ manual switch;
  - Emergency stop;
  - Frequency adjust;
  - Key operated start/ stop switch;
  - Lamp test;
  - Load bank test;
  - Mains failure simulation; and
  - Maintenance bypass.
- Indicators:
  - Electrical:
  - Ammeter with phase selector switch;
  - Battery voltage;
  - Frequency meter;
  - Generator synchronized;
  - kW·h meter;
  - Power factor meter with phase selector switch; and
  - Voltmeter with phase selector switch.
  - Prime mover:
  - Coolant temperature gauge;
  - Fuel gauge;
  - Oil pressure gauge; and
  - Tachometer.
  - Status:
  - Coolant heater on;
  - Emergency stop activated;
  - Generator in use;
  - Generator ready;
  - Generator off-load indication ;
  - Generator on-load indication ;
  - Hours run meter;
  - Mains available indicator; and
  - Mains failure indicator.
- Alarms:
  - Visual:
  - Battery charge failure;
  - Battery low voltage;
  - Cooling fan failure;
  - Engine overspeed;
  - Engine start failure;
  - Engine underspeed;
  - High oil temperature;
  - Low fuel; and
  - Low oil pressure
  - Audible: Common alarm with mute button.
  - Remote generator system alarm: to ENMS and BMS.

450A CONTROL PANEL System controller - One per engine hall and one per Main MV intake room.

- used for Electrical network control and monitoring.
  Standard: To BS ISO 8528-4.
- Manufacturer: System manufacturer.
  - Product reference: Submit proposals.
- Configuration: Group controls, alarms and indicators in common control panel.
- Controls: Electrical Network control.
- Indicators:
  - Electrical: status of all devices connected (Open, Closed, withdrawn, tripped earthed etc) Primary power failure to any control panel. .
  - Prime movers: status of all generators .
  - Status: of incoming supplies.

  Alarms:
  - Visual: common alarm on the panel and common alarm xenon beacon externally on the wall of the Energy Centre.
  - Audible: Common alarm with mute button.
  - Remote generator system alarm: bms.

470 DAY TANKS

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Capacity: 3200 Litre for each set.
- Location: Adjacent to generators.
- Fuel transfer: Gravity fed.
- Low level indicator and alarm: Required.
- Fittings:
  - Drain valve;
  - Fill pipe and cap;
  - Isolating valve;
  - Tank level indicator; and
  - Vent pipe.

480 DRIP TRAYS

- Type: Removable.
- Overflow outlet pipe: Run to a location where a container can be fitted below the pipe outlet.
- Capacity: 1.5 times the oil capacity of the prime mover sump.

485 EMERGENCY STOP BUTTONS

- Type: Red 40 mm mushroom head, hand operated.
  - Key to reset: Required.
- Manufacturer: Board's choice.
  - Production reference: Board's choice.
- Operation: To shut down the generator system immediately on activation.
- Mounting: Pedestal mounted.

490A LOAD BANKS for installation testing

- Type: 11KV inductive load (LV load banks and step down transformers would be acceptable) Testing of the mechanical/thermal performance of the installation shall be carried by

Connecting the load banks to the spare switches on the Energy Centre MV switch boards.
Such tests shall be completed and then re-demonstrated during Hot summer weather conditions.

- Manufacturer: Board's choice.
- Product reference: Board's choice.
- Rating: 110% rated load.
- Enclosure:
  - Ingress protection to BS EN 60529: Boards Choice.
  - Anti-condensation heater: Boards choice.
- Arrangement: Switch in equal load steps controlled from the generator system control panel.
  - Number of load steps: to mimic ideal load application.
- Forced air cooling with run on timer: Required.
- Selective load control and load indicator: Required.
  - Load step size: to mimic ideal load application.

495 GENERATOR SET FACTORY INSPECTIONS AND TESTS

- Notice before inspections: 14 d.
- Test equipment calibration certificates: Submit.
- Witnessing: Arrange for factory testing to be witnessed by the contract administrator and 5 colleagues.
- Testing: To BS ISO 8528-6.
  - Type: Acceptance tests and Functional tests.

498 GENERATOR SET ACCEPTANCE TESTS

- Location: At manufacturer's works with electrical load and On site.
- Checks:
  - Unit 1
  - Unit 2
  - Unit 3
  - Parallel operation
- Measurements:
  - Unit 1
  - Unit 2
  - Unit 3
  - Parallel operation
- Acceptance test report: To BS ISO 8528-6.
- Results: Submit.

499 GENERATOR SET STANDARD FUNCTIONAL TESTS

- Standard: To BS ISO 8528-6.
- Location: At manufacturer's works under test-bed conditions.
- Results: Submit.

FABRICATION

550 CUSTOM EXHAUSTS

- Exhaust: In accordance with BS 5854.
- Type: Natural draught.
- Manufacturer: System manufacturer.
- Material: Stainless steel.
- Fittings:
  - Adaptors;
  - Bends;
  - Firestop plates;
  - Flexible coupling;
  - Flue collector boxes;
  - Ridge terminal and adaptors;
  - Storm collars and flashings; and
  - Wall brackets.
- Exhaust silencers
  - Type: Baffle.

560 FABRICATION PROPOSALS

- Design: Complete the design of the generator system.
- Prime mover and alternator size: Take into account connected loads including ancillaries, harmonics and transient operation.
- Proposals: Submit drawings, technical information, calculations and manufacturer's literature. Include:
  - General arrangement drawings.
  - Control diagrams.
  - Prime mover and alternator data.
  - Power output curves.
  - Generator system efficiency at 50%, 75% and 100% full load.
  - Start up temperature (minimum).
  - Fuel and lubricating oil characteristics and consumption, as outlined in BS ISO 3046-1.
  - Minimum run time without fuel and lubricating oil tank replenishment.
  - Calculations for performance of acoustic enclosures and silencers.
  - Maintenance access dimensions.
  - Details of plinths and anti-vibration mountings.

EXECUTION

620 INTERRUPTIONS TO EXISTING SUPPLIES

- Notice before interruption: 28.
- Connection to existing switchgear: Submit proposals.

630 INSTALLING GENERATOR SYSTEMS

- System: Install to provide access for maintenance without having to remove connections and accessories.
- Fuel pipelines: Flexible final connection to engine.
- Safety guards and stone guards: Install.

640 INSTALLING EXHAUSTS

- Location: generally As drawings.
- Arrangement:

- Position to minimize noise levels and prevent exhaust gases entering the building through doors, windows or ventilation systems.
- Slope exhaust away from engine. Terminate exhaust with rain cap.
- Seal fabric penetrations to provide same level of protection from transmission of sound and fire as original fabric.
- Apply minimum of 50 mm lagging to exhaust in plant rooms.

650 INSTALLING CONTROL PANELS
- Location: Remote free standing.

655 INSTALLING EMERGENCY STOP BUTTONS
- Location: adjacent to each generator and on exit to each generator room.

670 INSTALLING DRIP TRAYS
- Location: Under parts of the generator system where fuel or lubricant leakage may occur.

COMPLETION

910 TESTING AND COMMISSIONING GENERALLY
- Standard: To BS ISO 8528-6.
- Operation of control panel: Verify.
- Cold start-up test: Record start-up time with generator idle for 24 h before.
- Results: Submit.
- Notice before commencing tests (minimum): 2 weeks.

940 TESTING GENERATORS OPERATING IN PARALLEL
- Synchronization controls: Verify.
- Load sharing: Verify.
- Operation of controls: Verify.
- Start-up and shutdown: Verify.
- Results: Submit.

950 PADLOCKS AND KEYS
- Locking mechanism: Five lever.
- Material: Brass.
- Quantity: Submit proposals.
- Padlock keys: Two for each padlock.
- Padlock identification: Stamp padlock describing its function.

960 DOCUMENTATION
- Operation and maintenance instructions: Submit.
- Record drawings: Submit.

970 SPARES AND CONSUMABLES
- Indicator lamps: Supply 2 of each type used.
- Filter elements: Supply one set.

980 LABELLING
- Rating plate: To BS ISO 8528-5.

V20 High voltage distribution systems

To be read with Preliminaries/ General conditions

GENERAL

110 HIGH VOLTAGE DISTRIBUTION SYSTEM whole.

- High voltage connection: New incoming supply, as section V10.
- Switchgear:
  - Existing;
  - Ring main units, as section V21;
  - Switchboards, as section V21; and
  - Switchgear assemblies, as section V21.
- Transformers: Fluid immersed, as section V22 and Dry type as section V23.
- Cabling: Low smoke thermosetting insulated, as section V24.
  - Accessories: High voltage cable terminations, as section V24 and Underground concrete cable protection covers, and protection tapes for underground cables, as section V24 and underground earthenware cable ducts.
- Containment:
  - Buried conduit, as section Y63;
  - Cable ladders, as section Y60; and
  - Cable trays, as section Y60.
  - Accessories: Cable cleats, as section Y60 and Protective covers, as section Y60.
- Building works:
  - Trenches, pipeways and pits, as section P30;
  - Holes, chases, covers and supports, as section P31; and
  - Plinth and bund systems, as section P33.

SYSTEM PERFORMANCE

210 DESIGN

- Design: Complete the design of the high voltage distribution system.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

220 GRADING STUDY

- Scope: Complete (including existing, if any) high voltage distribution system.
- Fault calculations: Include fault impedance, and short circuit, asymmetric and symmetrical fault current analysis.
- Protective devices: Coordinate the selection and adjustment of protective device settings to achieve discrimination throughout the fault level range. Grade so that a fault on any outgoing branch circuit is cleared by the switching device installed in the faulted branch circuit without affecting the other outgoing branch circuits. Demonstrate discrimination using time-current coordination curves with single line diagrams, in the study report.
- Manufacturers' details and recommended settings: Include in study report.
- Study report: Submit.

EXECUTION

620 INSTALLING HIGH VOLTAGE DISTRIBUTION SYSTEMS

- Layout: Position cabling and equipment to provide safe and easy access for operation and maintenance.

COMPLETION

910 TESTING AND INSPECTION

- Testing and inspection results: Submit.

940 DOCUMENTATION

- Operation and maintenance instructions: Submit.
- Record drawings: Submit.

V21 High voltage switchgear

To be read with Preliminaries/ General conditions

PRODUCTS

310 HIGH VOLTAGE SWITCHGEAR GENERALLY

- Standards: To BS EN 62711-200, BS EN 60694 and IEC 60466.

320 HIGH VOLTAGE SWITCHBOARDS GENERALLY

- Type: Cubicle .
- Manufacturer: FKI Switchgear, Schneider or equal.
  - Product reference: Board's choice.
- Access: Rear.
- Switchgear arrangement: Submit proposals.
- Voltage rating: 12 kV.
- Prospective rated short circuit current (1 s): 25kA
- Terminals: Suitable for the dry connection of copper and aluminium conductors.
- Enclosure: Manufacturer's standard.
  - Accessories: Anti-condensation heater and thermostat and Padlocks and keys.
- Service conditions: Normal indoor.
- Functional units: As drawings.
- High voltage busbars: Required.
- Transportation or installation restrictions: As drawings.
- Accessories:
  - Manufacturer's standard;
  - Ammeters;
  - Voltmeters ;
  - Frequency meters;
  - Phase meters;
  - Power factor meters;
  - Wattmeters; and
  - Current transformers.

330 RING MAIN UNITS GENERALLY

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals .
- Ring switches: High voltage switch-disconnectors.
- Outgoing feeder device: High voltage circuit breaker
  - Protection relay: Required
- Transportation or installation restrictions: None.

340 HIGH VOLTAGE EARTHING SWITCHES

- Standard: To BS EN 62271-102.
- Manufacturer: Board's choice.
  - Product reference: Submit proposals.
- Circuit interrupting medium: Vacuum.
- Number of poles: 3.
- Rated voltage: 12 kV.
- Rated insulation levels:

- Short time power frequency: 12 kV.
- Lightning impulse: 23 kV.
- Rated frequency: 50 Hz.

- Rated current: 630 A.
- Rated short time withstand current: 50 kA for 1 s .
- Short circuit making current: Manufacturer's standard.
- Switch class: E2.
- Operating mechanism: Independent power

350A HIGH VOLTAGE CIRCUIT BREAKERS GENERALLY

- Standard: To BS EN 62271-100.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals .
- Circuit interrupting medium: Vacuum.
- Number of poles: 3.
- Surge arrestors: Required.
- Rated voltage: 12 kV.
- Rated insulation level:
  - Short time power frequency: 32 kV.
  - Lightning impulse: 23 kV.
- Rated frequency: 50 Hz.
- Rated current: 630 A.
- Rated short time withstand current: 25 kA for 1 s.
- Short circuit making current: Manufacturer's standard.
- Rated operating sequence: CO-5-CO.
- Rated break time: Manufacturer's standard.
- Circuit breaker class: E2
- Operating mechanism: Stored energy.
- Type of operation: Remote.
- Method of installation: Withdrawable
- Integral earthing switch: Board's choice.
- Minimum degree of ingress protection to BS EN 60529: IP31
- Mechanical interlocking: Captive key exchange type with square faced key and alphabetical or numerical coded operating face.
- Intertripping: Required wher.
- Protection:
  - as drawings
- Remote control and monitoring unit: Required.
  - Functions: Remote control and circuit-breaker position indicators.

370 HIGH VOLTAGE SWITCHES GENERALLY

- Standard: To BS EN 60265-1.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals .
- Circuit interrupting medium: Vacuum.
- Number of poles: 3.
- Rated voltage: 12 kV.
- Rated insulation levels:
  - Short time power frequency: 23 kV.
  - Lightning impulse: 23 kV.
  - Rated frequency: 50 Hz

- Rated current: 630 A.
- Rated short time withstand current (1 s): 25 kA.
- Short circuit making current: Manufacturer's standard.
- Switch class: M2.
- Operating mechanism: Independent manual.
- Integral earthing switch: Submit proposals.

380 HIGH VOLTAGE SWITCH-DISCONNECTORS GENERALLY

- Standard: To BS EN 60265-1.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals .
- Circuit interrupting medium: Vacuum.
- Number of poles: 3.
- Rated voltage: 12 kV.
- Rated insulation levels:
  - Short time power frequency: 23 kV.
  - Lightning impulse: 23 kV.
- Rated current: 630 A.
- Rated short time withstand current (1 s): 25 kA.
- Short circuit making current: Manufacturer's standard.
- Switch class: E3.
- Operating mechanism: Stored energy.
- Integral earthing switch: Submit proposals.

410 HIGH VOLTAGE BUSBARS GENERALLY

- Standard: To BS 159.
  - Approval: ASTA certified.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals .
- Material: Copper.
- Insulation medium: Manufacturer's standard.
- Number of poles: 3.
- Extendable: Required
- Rated voltage: 12 kV.
- Rated insulation levels:
  - Short time power frequency: 32 kV.
  - Lightning impulse: 23 kV.
- Rated frequency: 50 Hz.
- Rated current: 630 A.

420 AMMETERS AND VOLTMETERS

- Standard: To BS 89-2.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

421 FREQUENCY METERS

- Standard: To BS 89-4.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

422 PHASE METERS AND POWER FACTOR METERS

- Standard: To BS 89-5.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

423 WATTMETERS

- Standard: To BS 89-3.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

430 CURRENT TRANSFORMERS

- Standard: To BS EN 60044-1.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals .
- Type: Submit proposals
- Accuracy classification:
  - For use with protective equipment: 5P or 10P to suit relays and discrimination.
  - For use with measuring equipment: Boards proposals to suit meters used.
- Primary rating: Submit proposals
- Secondary rating: 1 A
- Rated short time current: Match the circuit in which the current transformer is installed.
- Test links: Provide for connection of calibration instruments and meters.

440 DIGITAL MULTIFUNCTION METERING EQUIPMENT

- Manufacturer: Submit proposals
  - Product reference: Submit proposals
- Display type: Submit proposals .
- Minimum degree of ingress protection to BS EN 60529: Match high voltage switchgear.
- Metering functions:
  - Active energy (kW·h);
  - Active power (kW);
  - Apparent power (kV·A);
  - Frequency (Hz);
  - Maximum active power demand (kW);
  - Phase currents (A);
  - Power factor;
  - Pulsed output (kW h); and
  - Reactive power (kV·A(r))
- Mounting: Recessed into switchgear

460 INDICATOR LAMPS

- Manufacturer: Submit proposals
  - Product reference: Submit proposals
- Lamp type: Cluster LED with bezel. Standardize.
- Lens colour: To BS EN 60073.
- Lamp mounting: Recessed.
- Common lamp test facility: Required.
- Access for lamp replacement: Externally from front.

480A HIGH VOLTAGE SWITCHGEAR TRIPPING AND CLOSING UNITS

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals .
- Battery capacity: Adequate to supply the standing load for 24 h on loss of a.c. supply. After 24 h, capable of tripping and closing the circuit breakers 10 consecutive times.
- Enclosure: To BS EN 62208.
  - Material: Steel.
  - Minimum degree of ingress protection to BS EN 60529: IP31
  - Lockable hinged door: Required.
  - Mounting: Floor
  - Finish to enclosure and supporting framework: Corrosion resistant paint
  - Colour: Match high voltage switchgear
- Incoming supply protection: Miniature circuit breaker to BS EN 60898.
- Charger type: Constant voltage current limiting.
- Battery type: Sealed nickel cadmium to BS EN 60622
- Output:
  - Type: Direct current (d.c.).
  - Voltage: 48 V
- Digital voltmeter: Required.
- Indicator lamps:
  - Mains supply healthy.
  - Mains supply failed.
  - Charger failed.
  - Float charge.
  - Boost charge.
  - Low voltage.
  - High voltage.
  - Positive and negative earth fault alarms.
  - Low electrolyte (vented cells only).
- Common fault relay contact: Required.
  - Type: Volt free.
- Vented battery labelling: Describe the treatment required following contact with the electrolyte and warn of the explosion risk caused by naked flames.
- Remote monitoring facility: ENMS and BMS

490 VOLTAGE TRANSFORMERS

- Standard: To BS EN 60044-2 and/or BS EN 60044-5 to sit application.
- Manufacturer: Switchboard manufacturer.
  - Product reference: Board's choice.
- Type: Cast resin encapsulated.
- Accuracy classification: To suit protection, metering and control systems.
- Primary voltage: 12 kV
- Secondary voltage: 110 V.

495 PADLOCKS AND KEYS

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Locking mechanism: Five lever.
- Material: Brass.

496 PADLOCK AND KEY CABINETS

- Type: Wall mounted metal.

- Finish: Match switchgear.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.

FABRICATION

510 SWITCHGEAR GENERALLY

- Switchgear: Factory built.
- Free standing switchgear: Provide lifting bolts within reinforced top frame.
- Insect proofing: Cover assembly openings with non-combustible and non-corroding insect proof mesh.

515 PROPOSALS

- Content: Include the following:
  - Overall dimensions.
  - Degree of ingress protection.
  - Mounting and fixing details.
  - Builders work requirements including details of cast in rails.
  - Fault level and rated short circuit characteristics.
  - Functional unit details.
  - Details of paint systems and colour finishes.
  - Door swings.
  - Access panel details.
  - Schedule of labels.
  - Dimensioned general arrangement drawings, plans elevations and sections.
  - Shipping sections.
  - Cable gland plate details.
  - Routing of cables within assembly.
  - Arrangement of busbars, connections and supports.
  - Internal controls, instrument and meter diagrams.
- Proposals: Submit before fabrication.

590 FACTORY INSPECTIONS AND TESTS

- Notice before inspecting and testing: 28d
- Inspections:
  - Fabrication: Inspection not required
  - Assembly completed, busbars exposed and functional units assembled: Inspection not required.
- Testing: In accordance with BS EN 62271-100 and BS EN 60694.
  - Factory testing of completed assembly: Required
  - Routine tests: Required.
  - Special tests: Interlocks and interfaces.
- Test equipment calibration certificates: Submit.
- Witnessing: Arrange for factory testing to be witnessed by the contract administrator and 3 colleagues.
- Test and inspection reports: Submit.

EXECUTION

610 ALTERATIONS TO EXISTING SWITCHGEAR

- Standards: In accordance with manufacturers' or fabricator's instructions and type test certificates.
- Alterations: Submit records of alterations made to assemblies.

620 INSTALLATION GENERALLY

- Transportation, off-load and installation: Submit method statement.
- Fixing equipment: Fix in accordance with manufacturer's instructions.
  - Fasteners: Zinc electroplated.
- Assembly: Line and level panels in accordance with manufacturer's or fabricator's instructions.
  - Interconnect busbars.
  - Connect earthing conductor to system main earth terminal.
  - Replace fittings removed for transport.
  - Clearance (minimum): 1000 mm front and rear.

640 CONNECTIONS

- Incoming high voltage cables: Connect to switchgear.

650 INSTALLING METERING EQUIPMENT

- Digital metering equipment: Connect to building management system.

COMPLETION

910 CLEANING AND GENERAL INSPECTION

- Dust and debris: Remove.
- Completed installation: Inspect in accordance with BS EN 60694 and switchgear manufacturer's or fabricator's instructions.
- Labelling: Verify.
- Fuse ratings: Check and confirm.
- Enclosure earthing: Verify.
- Cables terminations: Inspect.
- Reports: Submit.

915 LABELLING

- Name plates in accordance with BS EN 60694: Provide.
- Equipment identification labels: . . . . .
- Anti-condensation heaters: Provide caution notices advising against accidental switching off.
- Standby power: Provide danger warning notices stating that assemblies may be energized from more than one source.
- Indicator lamps: Label each lamp describing its function.
- Fuses, terminal blocks and other assembly components: Label describing their purpose.
- Spare fuses: Label, describe their rating.
- Cabinets for padlocks and spare keys: Label.

920 TESTING AND COMMISSIONING

- Notice before testing and commissioning: 28d
- Testing generally: In accordance with BS EN 60694 and BS EN 62271-200
- Method statement: Submit.
- Earthing: Check and verify.
- Protective device settings: Configure to match the grading study.
- Voltage test: In accordance with BS EN 62271-100.
- Insulation resistance tests: Carry out for:
  - Ancillary trip and alarm wiring with any fuses and remote connections removed (500 V d.c.).
  - Anti-condensation heaters (500 V d.c.).
- Operation of alarm and trip devices: Check and verify.
- Indicators: Verify correct operation.
- Intertripping: Verify correct operation.
- Anti-condensation heaters: Check and confirm correct operation.
- Enclosure access interlocks: Check and confirm correct operation.
- Gas tightness of gas filled compartments: Verify.
- Condition of gas in gas filled compartments: Determine in accordance with BS EN 60480.
- Inspection and test results: Submit.

930 SPARE TOOLS

- Tools: Supply the tools necessary for maintaining the equipment, including racking handles and a torque spanner.
- Tool cabinet: Include name plate, labelled shelves and non-lockable door.
  - Dimensions: Size for storing racking handles, special tools, spare lamps, spare fuse links and other equipment necessary for satisfactory assembly and operation.
  - Location: Separate wall mounted, with finish to match switchgear

940 PADLOCKS AND KEYS

- Quantity: 6.
- Padlock keys: Two for each padlock.
- Padlock identification: Stamp padlock describing its function.

950 CALIBRATION CERTIFICATES

- Certificates of calibration for meters and instruments: Submit.

960 SPARES AND CONSUMABLES

- Manufacturer's recommended spares: Supply two sets.
- Spare fuses: Two of each type and rating used.
- Operating handles for circuit breakers and switches: One per device.

V22 Fluid immersed transformers

To be read with Preliminaries/ General conditions

PRODUCTS

310 TRANSFORMER Energy centre - step down generally

- Standards: To BS EN 60076-1, BS EN 50464-1 and BS 6436.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Transformer operation: Perform as specified for at least two years under the service conditions.
- Compliance with specified performance: Submit evidence.
- Transformer type: Low loss.
  - Losses: Submit details.
- Service conditions:
  - Application: Network distribution.
  - Generator connection: Not applicable.
  - Suitable for operation in parallel with other transformers: Required.
  - Altitude: Less than 1000 m above sea level
  - Ambient temperature:
    Minimum: -25°C .
    Maximum: 40°C .
- Voltage waveform:
  - Supply:
    Total harmonic distortion: Less than 5%.
    Even harmonic distortion: Less than 1%.
  - Load: Symmetrical three phase supply .
  - Frequency: 50 Hz .
  - Phases: Three .
- Duty: Approximately balanced and sinusoidal continuous three phase loading .
- Environmental conditions: Normal, with ordinary pollution rates and Outdoor .
- Transportation or installation restrictions: Craned onto and off roof. .

312 MANUFACTURER'S INFORMATION

- General arrangement drawings: Submit fully dimensioned and detailed general arrangement drawings including:
  - Weight of core and winding assembly.
  - Weight of tank and fittings.
  - Total weight including oil.
  - Quantity of oil.
  - Base details.
  - Cable box details.
  - Rating and connection plate details.
  - Arrangement and connection drawings for ancillary equipment.
- Transformer ancillary equipment: Submit manufacturer's literature.
- Type test certificates: Submit. Include:
  - Temperature rise.
  - Lightning impulse.
  - Partial discharge.
  - Sound level.

315 TRANSFORMER COOLING

- Type:
  - Internal dielectric cooling medium: Insulating liquid with a fire point > 300°C (K). Circulation method: Natural thermosyphon cooling in windings (N) .
  - External cooling medium: Air (A) . Circulation method: Natural convection (N) .
- Forced cooling controls: Not applicable.

320 FLUID PRESERVATION EQUIPMENT

- Conservator: Dehydrating (silica-gel) breather.

325 RATED POWER

- Rated apparent power: 2000 kV·A.
- Enhanced rating with additional cooling: Not applicable.

330 EARTHING

- High voltage system earthing: as drawings.
- Low voltage system earthing: TNC-S.

335 VOLTAGE RATIO AT PRINCIPLE TAPPING

- Primary winding to secondary winding: 11000:400. (No load)

350 CONNECTION AND PHASE DISPLACEMENT

- Vector group to BS EN 60076-1: Dyn11.

355 PRIMARY VOLTAGE TAPPINGS

- Sizes: Variations upto _8% and down to -10% in 8 steps.
- Tap change facility: On-load.
  - Type: Manual.

358 MANUAL TAP CHANGE FACILITY

- Position indicator: Required.
- Controls: External mounted.
- Controls: Lockable. Supply padlock and two keys.

365 TANK CONSTRUCTION

- Material and construction: Welded mild steel fabricated to prevent distortion when the complete transformer is lifted, jacked or transported.
  - Finish: Manufacturer's standard.
- Accessories:
  - Earthing boss tapped M12;
  - Filter valves;
  - Flanged fluid drain valve with closed position padlocking facility. Fitted with a gasketted cover plate;
  - Fluid drain valve with facility for padlocking in the closed position with padlock and two keys. Fitted with a female tapped outlet and a plug;
  - Fluid filler with filter and plug/ cap;
  - Jacking lugs;
  - Lifting lugs;
  - Marshalling box;

- Pulling eyes; and
- Sight glass type fluid level indicator.

367 INDICATORS AND ALARMS

- Buchholz relay: With adjustable alarm and trip contacts.
- Dial type oil level indicator: With adjustable alarm and trip contacts.
- Dial type oil temperature indicator: With adjustable alarm and trip contacts.
- Dial type winding temperature indicator: RequiredWith adjustable alarm and trip contacts.
- Pressure relief device: With adjustable alarm and trip contacts.
- Local audible alarm systems: Not required.

370 NOISE EMISSION CONTROL

- Sound pressure level (maximum): 50 dBA at 1 m.
- Anti-vibration mountings: Required.

375 HIGH VOLTAGE AND LOW VOLTAGE CABLE TERMINATIONS

- Position: On opposite sides.
- Cable terminations: High voltage required and Low voltage required.
  - Cables: High voltage as section V24 and Low voltage as section V32.

380 HIGH VOLTAGE CONNECTION ARRANGEMENT

- Cable entry: Bottom.
- Type of enclosure: Flange and terminations suitable for direct connection to ring main unit.

390 LOW VOLTAGE CONNECTION ARRANGEMENT

- Cable entry: Bottom.
- Type of enclosure: Flange and connections suitable for direct connection to low voltage switchboard.

400 FACTORY INSPECTIONS

- Notice before inspections: 14 days.
- Testing: In accordance with BS EN 60076-1.
  - Routine tests: Undertake
  - Type tests: Not required.
  - Special tests: NONE.
- Test equipment calibration certificates: Submit.
- Witnessing: Arrange for factory testing to be witnessed by the contract administrator and 3 colleagues.
- Test report: Submit

EXECUTION

610 INSTALLATION GENERALLY

- Transportation, off-load and installation: Submit method statement.
- Assembly: Replace fittings removed for transport.

620 INSTALLING CONTROLS, INDICATORS AND ALARMS

- Controls, indicators and alarms: Connect to marshalling box.
- Marshalling box location: Tank mounted.

COMPLETION

910 CLEANING AND GENERAL INSPECTION

- Dust and fluid: Remove.
- Tank and fittings: Inspect.
- Fluid leaks: Check.
- Breather: Verify fitment and confirm silica-gel crystals are blue.
- Operation of tap changer over the operating range: Verify.
- Transformer earthing: Verify.
- Cable terminations: Inspect.
- Fluid levels: Check and confirm correct.
- Reports: Submit.

915 LABELLING

- Rating plate in accordance with BS EN 60076-1: Provide.
- Identification label: Reference Number.

920 TESTING AND COMMISSIONING

- Method statement: Submit.
- Insulation resistance tests: Carry out for:
  - High voltage winding to earth (1000 V d.c.).
  - Low voltage winding to earth (500 V d.c.).
  - High voltage winding to low voltage winding (1000 V d.c.).
  - Ancillary trip and alarm wiring with fuses and remote connections removed (500 V d.c).
  - Cooling fan motors (500 V d.c.).
- Operation of level, alarm, and trip devices: Check and verify. Test Buchholz relays using nitrogen injection.
- Dielectric strength: Sample the fluid and test in accordance with BS 5263. Confirm the breakdown strength is acceptable.
- Cooling fan motors thermal overloads: Check and confirm correct operation.
- Forced cooling temperature controls: Check and confirm correct operation.
- Tap changer: Set on the principle setting and padlock in position.

925 OIL TESTS

- Tests: In accordance with BS 5263.
  - Sample interval: 3 months and 12 months after Practical Completion.

930 PADLOCKS AND KEYS

- Locking mechanism: Five lever.
- Material: Brass.
- Quantity: 4.
- Padlock keys: Two for each padlock.
- Padlock identification: Stamp padlock describing its function.

940 DOCUMENTATION

- Operation and maintenance instructions: Submit.
- Record drawings: Submit.

V23 Dry-type transformers

To be read with Preliminaries/General conditions

PRODUCTS

310 TRANSFORMER Energy Centre, step up

- Standards: To BS EN 60076-11 and To BS 7844-1.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Transformer operation: Perform as specified for at least two years under the service conditions.
- Compliance with specified performance: Submit evidence.
- Transformer type: Low loss.
  - Losses: Submit details.
- Transformer configuration: Encapsulated
- Service conditions:
  - Application: Generator.
  - Generator connection: Through switchgear.
  - Suitable for operation in parallel with other transformers: Not required.
  - Altitude: Less than 1000 m above sea level
  - Ambient temperature:
  - Minimum: -25°C.
  - Maximum: 40°C.
- Voltage waveform:
  - Supply:
  - Total harmonic distortion: Less than 5%.
  - Even harmonic distortion: Less than 1%.
  - Load: Symmetrical three phase supply.
  - Frequency: 50 Hz.
  - Phases: Three.
- Duty: Approximately balanced and sinusoidal continuous three phase loading.
- Environmental conditions: Class E1.
- Fire resistance: Class F0.
- Transportation or installation restrictions: Submit proposals.

310A TRANSFORMER - step down

- Standards: To BS EN 60076-11 and To BS 7844-1.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Transformer operation: Perform as specified for at least two years under the service conditions.
- Compliance with specified performance: Submit evidence.
- Transformer type: Low loss.
  - Losses: Submit details.
- Transformer configuration: Encapsulated
- Service conditions:
  - Application: Network distribution.
  - Generator connection: Not applicable.
  - Suitable for operation in parallel with other transformers: Not required.

- Altitude: Less than 1000 m above sea level
- Ambient temperature:
- Minimum: -25°C.
- Maximum: 40°C.

- Voltage waveform:
  - Supply:
  - Total harmonic distortion: Less than 5%.
  - Even harmonic distortion: Less than 1%.
  - Load: Symmetrical three phase supply.
  - Frequency: 50 Hz.
  - Phases: Three.
- Duty: Approximately balanced and sinusoidal continuous three phase loading.
- Environmental conditions: Class E1.
- Fire resistance: Class F1.
- Transportation or installation restrictions: Submit proposals.

315 MANUFACTURER'S INFORMATION

- General arrangement drawings: Submit fully dimensioned and detailed general arrangement drawings including:
  - Weight of core and winding assembly.
  - Weight of enclosure.
  - Total weight.
  - Base details.
  - Cable box details.
  - Rating and connection plate details.
  - Arrangement and connection drawings for ancillary equipment.
- Transformer ancillary equipment: Submit manufacturer's literature.
- Type test certificates: Submit. Include:
  - Temperature rise.
  - Lightning impulse.
  - Partial discharge.
  - Sound level.

320 TRANSFORMER COOLING

- Cooling medium: Air (A)
  - Circulation method: Natural (N)

325 RATED POWER

- Rated apparent power: as drawings.
- Enhanced rating with additional cooling: not required.

2900 -EXT, EC Specification

330A EARTHING step-up

- High voltage system earthing: star point - Via NER panel.
- Low voltage system earthing: LV Delta winding - casing to LV systems earth Bar.

330B EARTHING Step Down

- High voltage system earthing: MV Delta winding - Casing to MV earth Bar.
- Low voltage system earthing: Star Point

335A VOLTAGE RATIO AT PRINCIPLE TAPPING Step-up
- Primary winding/ secondary winding: 400/11000.

335B VOLTAGE RATIO AT PRINCIPLE TAPPING step-down
- Primary winding/ secondary winding: 11000:400.

350A CONNECTION AND PHASE DISPLACEMENT step-up
- Vector group to BS EN 60076-1: Ynd11.

350B CONNECTION AND PHASE DISPLACEMENT step-down
- Vector group to BS EN 60076-1: Dyn11.

355 PRIMARY VOLTAGE TAPPINGS
- Sizes: ±2.5%

363 TRANSFORMER ACCESSORIES
- Accessories:
  - Bi-directional rollers;
  - Earthing boss tapped M12;
  - Lifting lugs;
  - Lockable auxiliary marshalling box fully cabled from each transformer auxiliary device to fixed & labelled terminals; and
  - Pulling eyes.

365A ENCLOSURE step-up
- Ingress protection to BS 60529: IP44
- Material and construction: Welded mild steel fabricated to prevent distortion when the transformer and enclosure is lifted or transported.
  - Finish: Manufacturer's standard
- Accessible interior and feeder circuit breaker: Not required.
  - Door interlocks: Prevent enclosure doors being opened while circuit breakers are closed.
    Interlocking: Captive key exchange type with square faced key and alphabetical or numerical coded operating face.
- Cable gland plates: High voltage
  - Type: Manufacturer's standard
- Anti-condensation heaters with thermostatic control: Required .
  - Type: Manufacturer's standard
- Forced ventilation fans: Not required
  - Type: Manufacturer's standard .
  - Controls: Manufacturer's standard .

365B ENCLOSURE step down
- Ingress protection to BS 60529: IP44
- Material and construction: Welded mild steel fabricated to prevent distortion when the transformer and enclosure is lifted or transported.
  - Finish: Manufacturer's standard
- Accessible interior and feeder circuit breaker: Not required.
  - Door interlocks: Prevent enclosure doors being opened while circuit breakers are closed.
    Interlocking: Captive key exchange type with square faced key and alphabetical or numerical coded operating face.
- Cable gland plates: High voltage and Low voltage

- Type: Manufacturer's standard
- Anti-condensation heaters with thermostatic control: Required .
  - Type: Manufacturer's standard
- Forced ventilation fans: Not required
  - Type: Manufacturer's standard .
  - Controls: Manufacturer's standard .

367 INDICATORS AND ALARMS

- Thermal protection: Required.
  - Type: Manufacturer's standard.
- Dial type winding temperature indicator: Required.
- Digital type winding temperature indicator: Required.
- Local audible alarm systems: Minimum 65 dBA sounder with xenon flashing beacon

370 NOISE EMISSION CONTROL

- Sound pressure level (maximum): 50 dB(A) at 1m
- Anti-vibration mountings: Required

375 HIGH VOLTAGE AND LOW VOLTAGE CABLE TERMINATIONS

- Position: to suit installations
- Cable terminations: High voltage required and Low voltage required.
  - Cables: High voltage as section V24 and Low voltage as section V32.

380 HIGH VOLTAGE CONNECTION ARRANGEMENT

- Cable entry: to suit installation.
- Type of enclosure: to suit installation

390 LOW VOLTAGE CONNECTION ARRANGEMENT

- Cable entry: to suit installation.
- Type of enclosure: to suit installation.

400 FACTORY INSPECTIONS

- Notice before inspections: 14 days .
- Testing: In accordance with BS EN 60076-11.
  - Routine Tests: Undertake.
  - Type Tests: Required
  - Special Tests: none
- Test equipment calibration certificates: Submit.
- Witnessing: Arrange for factory testing to be witnessed by the contract administrator and 3 colleagues.
- Test report: Submit.

EXECUTION

610 INSTALLATION GENERALLY

- Transportation, off-load and installation: Submit method statement.
- Assembly: Replace fittings removed for transport.

620 INSTALLING CONTROLS, INDICATORS AND ALARMS

- Controls indicators and alarms: Connect to marshalling box.
- Marshalling box location: Mounted on enclosure

COMPLETION

910 CLEANING AND GENERAL INSPECTION

- Dust and debris: Remove.
- Enclosure: Inspect.
- Windings: Inspect.
- Temperature sensor probes: Inspect.
- Forced cooling system: Inspect.
- Anti-condensation heating system: Inspect.
- Labelling: Verify.
- Transformer and enclosure earthing: Verify.
- Cables terminations: Inspect.
- Reports: Submit.

915 LABELLING

- Rating plate: In accordance with BS EN 60076-11.
- Identification label:: reference No

920 TESTING AND COMMISSIONING

- Method statement: Submit.
- Insulation resistance tests: Carry out for:
  - High voltage winding to earth (1000 V d.c.).
  - Low voltage winding to earth (500 V d.c.).
  - High voltage winding to low voltage winding (1000 V d.c.).
  - Ancillary trip and alarm wiring with any fuses and remote connections removed (500 V d.c.).
  - Cooling fan motors (500 V d.c.).
  - Anti-condensation heaters (500 V d.c.).
- Operation of alarm and trip devices: Check and verify.
- Cooling fan motors thermal overloads: Check and confirm correct operation.
- Forced cooling temperature controls: Check and confirm correct operation.
- Anti-condensation heaters: Check and confirm correct operation.
- Tap change links: Set on the principle setting.
- Enclosure access interlocks: Check and confirm correct operation.

930 PADLOCKS AND KEYS

- Locking mechanism: Five lever.
- Material: Brass.
- Quantity: Submit proposals.
- Padlock keys: Two for each padlock.
- Padlock identification: Stamp padlock describing its function.

940 DOCUMENTATION

- Operation and maintenance instructions: Submit.
- Record drawings: Submit.

945 SPARES AND CONSUMABLES

- Filters for cooling system: Two sets

V24 High voltage cabling

To be read with Preliminaries/ General conditions

PRODUCTS

310A HIGH VOLTAGE CABLES GENERALLY

- Materials:
  - Underground cable networks for housing developments: In accordance with ENA ER G81-2.
  - 11 kV, underground industrial and commercial connections: In accordance with ENA ER G81-5.
- Bonds electrical power cable terminations: To BS 7197.
- Proposed high voltage cables: Submit drawings, technical information, calculations and manufacturer's literature.
- Spare capacity (percentage of current carrying capacity): 25%.

330 THERMOSETTING INSULATION CABLES

- Standard: To BS 6622.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Voltage designation: 11 kV.
- System category: A.
- Number of cores: 3.
- Conductor: Stranded copper.
- Insulation: Cross linked polyethylene (XLPE).
- Screen: Not required.
- Armour material: Galvanized steel.
- Oversheath: Polyvinyl chloride (PVC).
  - Thickness: Submit proposals.
  - Colour: Red.
- Semi-conducting layer on oversheath: Not required .

340 LOW SMOKE THERMOSETTING INSULATION CABLES

- Standard: To BS 7835.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Voltage designation: 11 kV.
- System category: A.
- Number of cores: 3.
- Conductor:
  - Material: Copper.
  - Type: Stranded.
- Insulation: Cross linked polyethylene (XLPE).
- Protection: Armoured.

360 HIGH VOLTAGE CABLE TERMINATIONS

- Impregnated paper insulation cables: To BS 7888-4.2.
  - Type: Submit proposals.
- Extruded insulation cables: To BS 7888-4.1.
  - Indoor: Submit proposals.
  - Outdoor: Submit proposals.

370 UNDERGROUND PLASTICS CABLE PROTECTION COVERS

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Polyethylene.
- Size:
  - Length: Submit proposals.
  - Width: 150 mm.
  - Thickness: 18 mm.
- Jointing method: Peg.
- Identification: Laminate underground cable marker tape to top face.

390A EARTHENWARE DUCTS FOR UNDERGROUND CABLES .

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Accessories: Proprietary duct plugs.

400 PROTECTION TAPES FOR BURIED ELECTRICITY SUPPLY CABLE

- Standard: To ENA TS 12-23.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

410 MANHOLES

- Access chambers: Submit proposals.
- Inspection chambers: Submit proposals.

EXECUTION

610 INSTALLING HIGH VOLTAGE CABLES

- Underground cable networks for housing developments: In accordance with ENA ER G81-3.
- 11 kV underground industrial and commercial connections: In accordance with ENA ER G81-6.
- Execution: Controlled by authorized persons and undertaken by competent persons.
  - Evidence of authorization: Submit.
  - Evidence of competence: Submit.
  - Permit to work procedure and method statements: Submit.
- Preparation: Store cables above 5°C for 24 h before installation.
- Installation temperature (minimum): 5°C.
- Cables: Install in one length.
- Cable pulling: Do not overstress. Prevent kinks and twisting of the cable.
  - Installation method: Submit proposals.

620 EXCAVATIONS

- Excavations next to existing underground services: In accordance with HS(G) 47.
  - Method statement: Submit.
- Existing underground services: Expose and identify.

635 INSTALLING THERMOSETTING INSULATION CABLES

- Installation: In accordance with BS 6622 Appendix C.
- Stress relief: Slide semi-conducting sleeve over exposed insulation.

640 INSTALLING LOW SMOKE THERMOSETTING INSULATION CABLES

- Installation: In accordance with BS 7835 Appendix C.
- Stress relief: Slide semi-conducting sleeve over exposed insulation.

650A CABLES IN TRENCHES

- Base: Newly prepared bedding.
  - Material: Sand.
- Multiple cables in same trench: Set 250 mm apart.
  - Cable formation within trench: Flat.
- Manholes: Provide manholes, draw pits and jointing chambers.
- Cables below roads and hard standings: Duct and derate if longer than 10 m. Extend ducts 1 m beyond hard standing.
- Cable identification and protection: Underground Marker tape and flush cable plaques.

660A INSTALLING CABLE DUCTS.

- Location and colour coding: In accordance with NJUG Volume 1 'Guidelines on the positioning and colour coding of underground utilities' apparatus'.
- Duct formation within trench: flat at 300mm centres.
- Gradient (maximum): 1:20.
- Duct bends: Suitable for cable bending radii.
- Manholes: Provide manholes, draw pits and jointing chambers.
- Duct alignment: Check before installing cables.
- Duct cleaning: Clean duct run before installing cables.
- Draw ropes: Install draw ropes in ducts.
  - Type: Corrosion resistant, minimum breaking strength 550 N.
- Duct ends: Plug and seal with proprietary duct plugs.

670 CABLES IN DUCTS

- Cable installation from cable drums: Submit method statement.

680 PROTECTION TAPE FOR BURIED ELECTRICITY SUPPLY CABLE

- Installation: In accordance with ENA TS 12-23.

690A INSTALLING HIGH VOLTAGE CABLE JOINTS

cable joints shall be avoided wherever possible

- Straight cable length before and after joint (minimum): 1 m.
- Spacing between joints (minimum): 2 m.
- Joint identification: Label as follows:
  - Date installed.
  - Board's name.
  - Circuit reference.
  - Cable type and size.

COMPLETION

910 CABLE TESTING AND INSPECTION

- Cleating and bending radii of cables: Verify and confirm that they are in accordance with manufacturer's recommendations.
- Cable terminations: Verify and confirm that they are in accordance with manufacturer's recommendations.
- Continuity and polarity: Verify.
- Insulation test: Submit results.
- Sheath test: Submit results.
- Pressure test:
  - Paper insulated cables: To BS 6480.
  - Thermosetting insulation cables: To BS 6622.
  - Results: Submit.

920 DOCUMENTATION

- Record drawings: Submit, showing cable types, sizes, routes and depths, duct sizes and lengths, joint locations, joint and service phasing.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.24 JB G1547**
Performance Specification Title	**Uninterruptable Power Supplies**	Date	**August 2014**
Prepared By	**JB**	Checked By	**PM**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	PM
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
UNINTERRUPTIBLE POWER SUPPLIES SPECIFICATION

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include, but not be limited to the following:-

- Uninterruptible Power Supply Systems supporting the main core server room.
- Uninterruptible Power Supply Systems supporting clinical areas with isolated power supply (IPS) systems.
- Switchboards on the output side of the UPS, complete with interlocking arrangements.

3.0 INTERFACES AND DEMARCATIONS

The UPS systems shall be integrated with a host Internet Protocol network which will support communication, interaction, data transfer and data retrieval from and between the various engineering systems in the building. The UPS systems shall be connected to the host network via gateways. The Building Management System (BMS) will be provided with a Graphical User Interface which will permit the interrogation of the UPS systems down to component level. It is not intended that the BMS will control the system but rather will monitor component status and provide fault alarm indication at the Graphical User Interface.

4.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of current legislation, regulations and standards stated in the Materials & Workmanship clauses.

5.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

6.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

The Hospital. Project Co. shall include for liaison in conjunction with the Board with members of the Hospital's team with an interest in the planning and administration of the UPS systems.

Building Control. Project Co. shall liaise, with and adhere to, the requirements of the Building Control Officer.

Any other member of the Project and Board teams concerned with the planning and administration of UPS systems.

7.0 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

7.1 General

UPS shall be provided to serve the loads as follows:-

- Main core server room
- Isolated Power Supplies (IPS) serving theatres
- IPS serving areas other than theatres

The battery autonomy for each of the above areas is described in section V44, clauses 350A, 350B and 350C below.

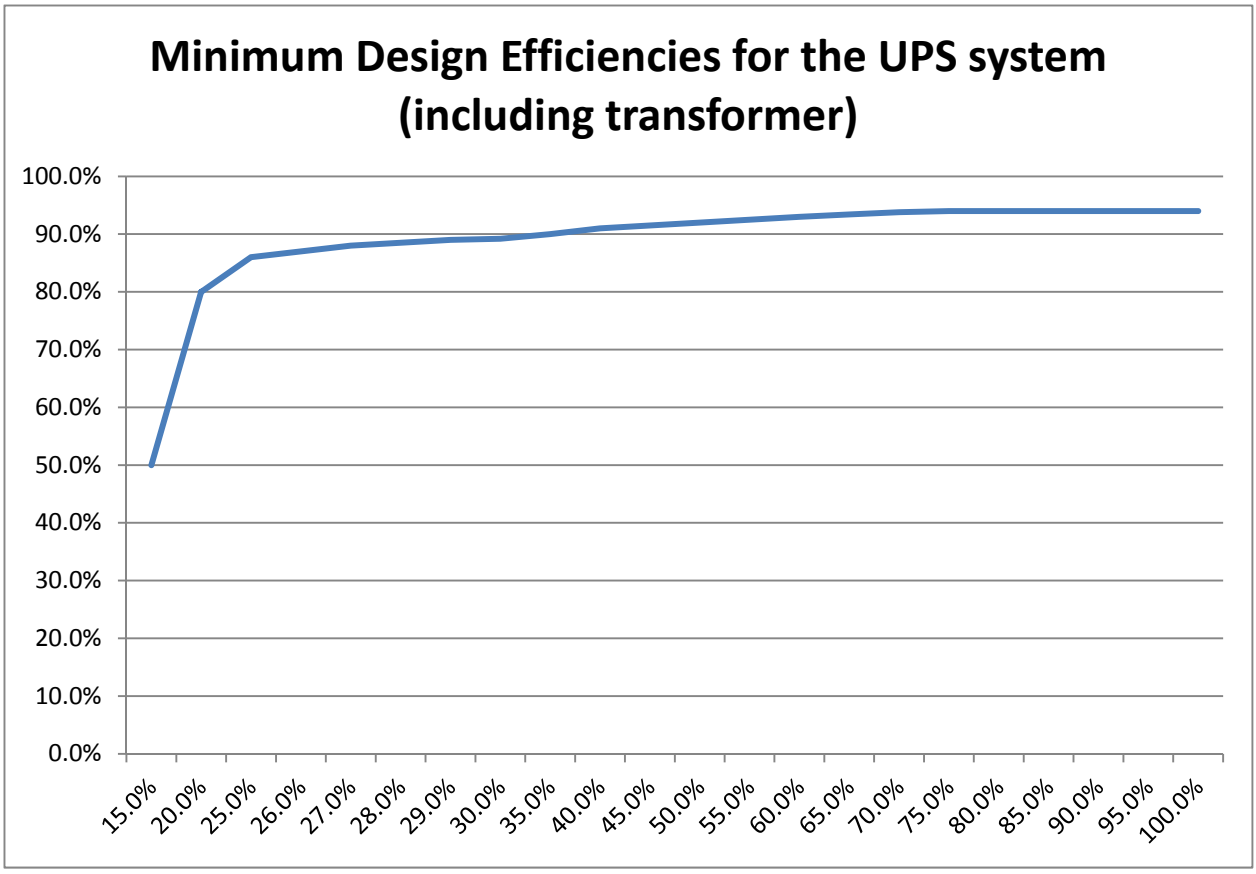
The kW or kVA ratings of the batteries shall be indicated on schematic drawings. ’s attention is drawn to the need to size UPS systems not on kVA but on kW (to cater for a power factor range).

7.2 Available Space and Intended Cooling

Accommodation for the UPS equipment and batteries is limited, and it is imperative that the UPS Installer checks that the offered apparatus/enclosures will fit into the rooms and spaces allowed for them, with ample space for access, operations and maintenance. The UPS equipment will be located in dedicated rooms within plantroom spaces, and it must be assumed that significant volumes of mechanical equipment and associated access space will prevent the allocation of additional space to UPS equipment.

Project Co. shall request guaranteed limits for the heat losses which may be expected from the offered UPS equipment, against which the intended mechanical cooling duty for each UPS Room can be checked. For each UPS unit, losses shall be declared for load conditions of 25%, 30%, 40%, 50%, 60%, 70%, 80%, 90% & 100% of the full rating, and the declared figures shall be inclusive of transformer losses (if transformers are included in the UPS scheme design).

The following graph details the minimum design efficiencies for the UPS system (including transformer). Note that the UPS system efficiencies are shown on the y-axis and the % load on the x-axis.


Minimum Design Efficiencies for the UPS system (including transformer)
100.0%
90.0%
80.0%
70.0%
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
15.0%
20.0%
25.0%
26.0%
27.0%
28.0%
29.0%
30.0%
35.0%
40.0%
45.0%
50.0%
55.0%
60.0%
65.0%
70.0%
75.0%
80.0%
85.0%
90.0%
95.0%
100.0%

7.3 Configuration

7.3.1 General

The UPS shall provide a no-break supply during loss of normal mains power supply and subsequent emergency generator power supply. The UPS System shall be of modular parallel design and will have N+1 redundancy.

Uninterruptible Power Supplies (UPS) shall be provided to serve life-support equipment within area and rooms listed in the table below in accordance with SHTM 06-01 Electrical Services.

UPS Required Table

Level	**Area**	**Rooms**
Basement		
Ground Floor	Emergency Department Co-Joined Radiology	Resuscitation Room(s) 4 Major Treatment Rooms MRI Rooms CT Rooms Gamma Camera Rooms Control Rooms
First Floor	Co-Joined Theatres Critical Care DCN Acute Care	9 Theatres and anaesthetic rooms MRI Room Angiogram Interventional Room Recovery Spaces 24 Cubicle Spaces Receiving / Resuscitation Room
Second Floor	Ehealth	Ehealth Server Room's ventilation/cooling
Third Floor	Medical In-Patients	Transitional Care Rooms
Fourth Floor/Roof	Helipad	Helipad RFFS Accommodation Helipad Fire Suppression System

7.3.2 Battery/Autonomy

Batteries shall be to BS EN 60896 Parts 21 & 22, and shall be selected to provide a design life no less than 10 years.

It is intended that the temperature of the UPS room/battery room be normally between 21ºC+/-2ºC and the required battery performance/autonomy shall be offered against this parameter.

The three UPS units shall be compiled in N+1 configuration, each UPS battery shall be selected to provide an autonomy of 40 minutes which shall allow a full load autonomy at design load of 60 minutes when all three units are in operation.

The individual UPS battery autonomies shall be indicated in Section V44, clauses 350A, 350B & 350C, or on the issued drawings.

7.3.3 Output Neutral reference

The UPS output neutral point shall remain referenced to earth potential under all service scenarios.

7.3.4 Static Switch

A solid-state bypass switch (static switch) shall be incorporated in the UPS design to allow rapid transition to an internal bypass line in the event that an overload or fault condition arises which might damage the UPS inverter.

7.3.5 UPS Switching & Related Control

Each UPS shall include switches to facilitate the complete isolation of each individual UPS, for testing and maintenance. Thus moulded case circuit breakers or isolation switches shall be provided on the input, output and static switch supply of each UPS, and a further switch shall be installed to serve as an internal bypass.

Notwithstanding anything described elsewhere, the UPS shall be fitted with control & interlock features to safeguard the UPS during all conditions of current sharing whilst in parallel and against incorrectly sequenced operation of static switch and bypass switch.

- all inverters within a UPS combination will have a control link to facilitate synchronization, master/slave assignment, and current sharing when in parallel,
- The group will have on its internal bypass switch an early-make late-break auxiliary contact to force closure of the static switch in case a bypass operation was being attempted on the switch without having first activated the static switch.
- The group will additionally have on its internal bypass switch a solenoid release mechanism arranged to release a key (Castell, Ronis or other equal and approved type) which may be used in conjunction with interlocking arrangements on the external (‘wrap-around’) bypass switch, to ensure that the external bypass can be applied only after the internal bypass switch is closed. Other means of achieving the same function may be proposed.

7.3.6 Other Features

Each UPS shall include in the battery charging circuits a facility for temperature compensation of the charging current against temperature measured at the batteries themselves, such temperature measurement envisaged as being obtained from thermocouples fitted to the battery casings.

Each UPS shall include all facilities to allow remote monitoring by means of a telephone or data line connection. The UPS units shall incorporate communication circuits, data encoder, auto-dialler/modem etc. to permit transmission of fault reports to a remote location and allow periodic or on-demand interrogation of the UPS for information on operating status, load readings, alarm and operator logs, and to permit the initiation of diagnostic tests and transmission of results. It shall be possible to assign hierarchical passwords to such remote access and to the running of diagnostics. No settings need be adjusted remotely.

The UPS system shall be supplied and installed complete with remote alarm indicators for the benefit of User Department staff. In all cases, local controls shall permit silencing of an alarm buzzer and selecting/scrolling through the displayed information, but the UPS units shall not be operated in any way from the remote panels.

- In the case of clinical area (theatre), the remote indication shall be provided straight into (and shall be interfaced to suit) the Surgeon's Panel in all operating theatre(s). The output data shall be configurable to display status/alarms as the surgeons may require, but is envisaged as providing :

  - Indications of
    - UPS system healthy and running on three UPS units
    - UPS system operational but running on two UPS units only,
  - Alarm signals for
    - UPS bypassed – output on mains supply
    - Mains fail – UPS output derived from battery,
    - UPS alarm – general,
    - UPS alarm – battery low,
    - UPS alarm – shutdown imminent.

- In the case of clinical area (non-theatre) areas, the remote indication shall be provided at a number of simple remote alarm/indication panels located in the respective User Areas. No objection will be taken to the UPS remote alarms and the Isolated Power Supply (IPS) remote alarms [specified elsewhere, for other specialist] being combined into one alarm/indicator panel in each User Area. The signals will be confirmed later, but are expected to comprise :

  - Indications of
    - UPS system healthy and running on three UPS units
    - UPS system operational but running on two UPS units only,
  - Alarm signals for
    - UPS bypassed – output on mains supply
    - UPS alarm/fault.

- The UPS shall interface with the BMS and provide the following:
  - o Indications of
    - UPS system healthy and running on three UPS units
    - UPS system operational but running on two UPS units only,
  - o Alarm signals for
    - Mains fail – UPS output derived from battery,
    - UPS alarm – general,

- Although not a function of the UPS equipment itself, information about the incoming supply conditions (switch status) shall be communicated from the main LV switchboards to the Electrical Network Management System (ENMS). See Appendix B.

7.4 Switchboards

7.4.1 General

Power cabling is covered under the distribution specification.

7.4.2 Input & Output Switchboards

Switchboards shall be constructed to the standards set out in Low Voltage Distribution specification WW.A.P.1.2.20. They shall unless otherwise stipulated be Form 4 Type 2.

The Input and Output Switchboard requirements are indicated schematically on the issued drawings.

On the Input and Output Switchboards, each incomer circuit shall be equipped with a voltmeter and selector switch (to permit local indication of the 3 phase-to-neutral voltages and the 3 line-to-line voltages).

The Output switchboards shall include an interlocking scheme arranged to prevent damage to the UPS equipment when being switched by an Operator into or out of bypass condition or parallel condition. Electrical or mechanical interlocking may be offered, but mechanical interlocking is preferred.

Note that interlocking is not provided to prevent the load being switched off, it is provided to safeguard the equipment and provide some assurance to the operator that he will be prevented from doing damage to the UPS units whilst permitting him to use bypass conditions and paralleling/breaking parallel to keep the loads energised. may modify these as appropriate for the selected equipment.

- During normal operation, and all reasonable switching sequences, it should be possible to keep the load energized (accepting that the load may receive raw mains during switching operations if these involve bypassing the UPS). Reasonable switching sequences are those intended to take a UPS out of service for maintenance or restore it to service after maintenance, or to configure the UPS units for parallel or solo operation (if applicable),
- An internal bypass of a UPS is assumed to require activating the static bypass switch and then operating the internal maintenance bypass switch,

- Putting a UPS system into 'wrap-around Bypass' condition is assumed to require operating first the static switch, then the internal bypass switch, which will force the remaining two UPS units into by-pass and then operating the external bypass switch(es).
- It should not be possible to switch a UPS onto a busbar unless
  - o that busbar is initially de-energised, or
  - o if the busbar is live, unless
    - the UPS is selected for internal bypass and the busbar is already energised via that UPS's wrap-around bypass, or
    - the UPS is selected for internal bypass and the bar is already energised via the other UPS which is itself selected for internal bypass
- There should be no interlocking constraint as to order of switching (or on which switch parallel is made or broken) providing all other conditions are met.

No interlocks need be provided on the Input Switchboard, as the Operator can be expected to follow switching instructions for bypass & paralleling on only the downstream side of the UPS, and he may be expected to check the voltmeter readings for assurance that all incoming supplies are available before he switches.

7.4.3 "Wrap Around" Bypass

The UPS System shall be provided with an external wrap-around maintenance bypass facility which shall render the UPS entirely safe for maintenance and trouble shooting to the extent that a complete UPS unit can be 'swapped out' if necessary.

As described in the previous section, interlocking devices shall be provided to ensure that the load is transferred from UPS to mains, or vice versa, in a controlled manner. The supply shall not be interrupted during the transfer. The UPS shall not be damaged by back-feeding from maintenance bypass supply with the UPS output terminals.

7.5 Operation on System Healthy

The load shall be equally shared between each UPS of a paralleled group.

On reinstatement of power after a period of power failure the UPS units shall protect the load and the batteries shall be recharged. The UPS shall be capable of limiting the recharge current such that the value of the load plus the recharge current does not exceed the rating of the supply circuit breakers. As described under UPS features, section 7.3.6, the charging circuits shall include a temperature compensation feature which optimizes the charging current according to the measured temperature of the battery.

7.6 Operation on Failure of One UPS

The total load shall be transferred to the healthy UPS units. In the case of paralleled UPS units, the communication/control link shall permit the failed UPS to block its inverter output and the healthy UPS units to take over the whole of the load. (It will be permissible for all UPS units to enter static bypass condition for a short period, should this be necessary as part of the process).

The UPS system will provide the stated autonomy at full design load in its normal operative state. If a UPS unit fails or is being maintained and the supply to the healthy UPS unit fails then the UPS system will provide 66% of the autonomy at full design load. The design does not allow for two concurrent failures by design and this is considered to be a failure upon failure scenario. This is in accordance with SHTM 06-01 clause 10.7 which permits a reduced battery autonomy when one of the UPS units is not available.

7.7 Software

Open protocol industry standard software must be used. All software shall be 'backwards compatible'.

V44 Uninterruptible power supplies

To be read with Preliminaries/ General Conditions

PRODUCTS

310 UNINTERRUPTIBLE POWER SUPPLY (UPS) EQUIPMENT (THREE-PHASE)

- Standards: To BS EN 62040-1 and -3. Submit certification.
- Type: On-line.
- Manufacturer: Board's choice.
  - Product reference: Board's choice – subject to Technical Approval.
- Configuration: Parallel redundant (n+1) with bypass for UPS units.
  - External input and output isolators for each unit: Required.
- Service conditions: Site specific.
- Input power supply: 400V ac.
- Maintenance bypass: External fully interlocked
- Galvanic separation between input and output: Not specifically required, but output side neutral shall remain referenced to / connected to earth for all operating conditions (Board to submit proposals).
- Rated output apparent power (batteries): As detailed on UPS schematic.
- Overload capability: 125% for 10 minutes, 150% for 1 minute and 200% for 100milliseconds.
- Voltage: Three phase and neutral 400 V a.c. ±2%.
  - Voltage waveform: Sinusoidal.
    Total harmonic distortion: Less than 5%.
    Even harmonic distortion: Less than 1%.
- Frequency: 50 Hz ±2%.
- Output power factor: 0.9.
- Batteries: Required, and with 10 year life assuming 20°C environment.
  - Arrangement: Within UPS equipment enclosure or on separate free-standing multi-tiered racking (no more than 4 tiers high).
  - Recharge time:
    To 80% capacity: Manufacturer's standard.
    To 100% capacity: Manufacturer's standard
  - Battery monitors: Required.
- Re-charging regimes: Manufacturer's recommended charging method, but including temperature compensation for variation in battery temperature.
- Generated harmonic distortion at point of incoming supply: In accordance with ENA
- Engineering Recommendation G5/4-1.
  - Evidence of compliance: Submit evidence for 25%, 50%, 75%, and 100% load, with declarations for harmonic current for all harmonics to 25^{th}, and odd harmonics from 27^{th} to 49^{th}.
- Controls, indicators and alarms: Manufacturer's standard.
- Enclosure: Manufacturer's standard.
- Factory tests: Required.

320 SITE SPECIFIC SERVICE CONDITIONS

- Altitude: Less than 1000 m above sea level
- Environmental conditions: Normal indoor.

340 MANUFACTURER'S INFORMATION

- General arrangement drawings: Submit fully dimensioned and detailed general arrangement drawings including:
  - Confirmation that equipment fits in available (allocated) UPS Rooms.
  - Weight of each UPS unit.
  - Total weight of complete UPS assembly (with batteries if integrated).
  - Weight of separate battery (including enclosure or racks).
  - Rating and connection plate details.
  - Enclosure base details.
  - Arrangement and connection drawings for ancillary equipment.
- Batteries:
  - Submit design life details to confirm no less than 10 years for a 20°C environment.
  - Submit service life details assuming battery environment is controlled to 25 +/-1°C.
- Type test certificates: Submit details including:
  - Temperature rise.
  - Sound level in normal mode.
  - Sound level in battery mode.
  - Rated input current.
  - Maximum continuous input current (curve of current against time).
  - Inrush current expressed as a percentage of normal rated current.
  - Harmonics: Full details of input current harmonic distortion at 25%, 50%, 75% and 100% load.
  - Overall efficiency: Submit details at 25%, 50%, 75% and 100% load
  - Heat losses: Submit maximum loss details at 25%, 30%, 40%, 50%, 60%, 70%, 80%, 90% and 100% of rated capacity.
- Mean time between failures: Submit details.

350 BATTERIES FOR UPS

- Type: Lead-acid valve regulated (VRLA) to BS 6290-4, BS EN 60896-21 and BS EN 61056-1
- Voltage: Board's choice
- Battery autonomy (stored energy time at rated power): UPS SHALL BE CONFIGURED AS INDEPENDENT BUT SYNCHRONISED UNITS. EACH INDIVIDUAL UPS SHALL HAVE A BATTERY WITH AUTONOMY OF 40 minutes (giving a total system autonomy of 60 minutes).
- Fused parallel battery strings: Two (minimum).
  - Automatic disconnection of a faulty string: Required
- Impact resistant plastic shields to intercell terminal and output terminals: Required.
- Battery supply d.c. circuit breaker with overload and short circuit protection: Required.
- Ripple free battery charger with automatic temperature and float voltage compensation: Required.
- Battery recharge time: As manufacturer's recommendations

360 BATTERY MONITORS

- Type: Microprocessor based.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.

- Features:
  - Automatic battery discharge test at adjustable time intervals;
  - Battery voltage;
  - Detection of faulty battery;
  - Detection of excessive temperature;
  - Estimated remaining battery service life; and
  - Standby time remaining

365 BATTERY SHELVING RACKS

- Type: Free standing.
- Complete with cladding to form cabinets
- Manufacturer: Board's choice.
  - Product reference: Board's choice.

370 CONTROLS, INDICATORS AND ALARMS

- Indicator type: LCD display.
- Controls:
  - Automatic/ manual;
  - Display select button; and
  - On/ off/ bypass.
- Display:
  - Readings:
  - Battery voltage;
  - Input voltage;
  - Output voltage;
  - Input frequency;
  - Output frequency;
  - Input current;
  - Output current;
  - Output load kW; and
  - Output power factor.
  - Status indicators:
  - Battery operation;
  - End of autonomy;
  - Load on bypass;
  - Mains healthy;
  - Mains failed;
  - Normal operation; and
  - Time of load on battery autonomy.
  - Faults: Supply voltage and frequency faults.
  - Alarms: Required.
- Local audible alarm systems: Minimum 65 dBA sounder with xenon flashing beacon

380 CUSTOM ENCLOSURES

- Minimum degree of protection to BS EN 60529: IP31
- Material and construction: Welded mild steel. Assemble to prevent distortion when the complete enclosure is lifted or transported.
- Finish: Manufacturer's standard
- Lockable access doors: Required.
- Cable entry with removable gland plates: For top entry cables
  - Type: Manufacturer's standard

- Duplicate forced ventilation fans: Required.
  - Type: Manufacturer's standard.
  - Controls: Manufacturer's standard.
  - Fan failure alarms: Local and Remote
- Noise emission:
  - Sound pressure level in normal mode (maximum): Refer to Acoustic Strategy for limits
  - Sound pressure level in battery mode (maximum): Refer to Acoustic Strategy for limits
  - Anti-vibration mountings: Integral.

COMPLETION

910 CLEANING AND GENERAL INSPECTION

- Dust and debris: Remove.
- Enclosures: Inspect.
- Earthing: Verify.
- Cable terminations: Inspect.
- Inspection report: Submit.

915 LABELLING

- Identification label: Required.

920 TESTING AND COMMISSIONING

- Method statement: Submit.
- Phase rotation: Verify.
- Emergency and safety circuits: Check.
- Correct operation of alarms and controls: Confirm.
- Insulation resistance tests: Test interconnecting cables and test forced cooling fan motors.
- Type Tests: Perform all tests in accordance with BS EN 62040-3 Table 3.
- Routine Tests: In accordance with BS EN 62040-3 Table 4, perform the following.
  - Operational tests:
  - a.c. input failure test;
  - a.c. input return test;
  - Rated stored energy time test;
  - Simulation of parallel redundant UPS fault test;
  - Synchronization test;
  - Transfer test;
  - UPS auxiliary devices test.
  - Output tests:
  - Harmonic components measurement;
  - Load tests:
  - Light load test;
  - Full load test.
  - Standby generator compatibility tests: Required

940 DOCUMENTATION

- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with the proposed document management system
- Operation and maintenance instructions: Submit.
- Record drawings: Submit.
  Test certificates: submit
  System certification: submit

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.25 JB G1547**
Performance Specification Title	**Earthing and Bonding**	Date	**August 2014**
Prepared By	**JB**	Checked By	**PM**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	PM
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
EARTHING & BONDING

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include, but not be limited to the following:-

- Earthing system generally
- Earth electrode system & installation
- Earthing of MV Network, Energy Centre & Generators
- Earthing of Substations
- Main equipotential bonding conductors
- Supplementary bonding conductors
- Neutral to earth point(s)
- Circuit protective conductors

- Conduits and conduit fixings
- Switch and riser cupboard earthing and bonding
- Server and hub rooms earthing and bonding (functional earth for comms/data)
- Imaging equipment earthing
- Earthing within MEIGaN areas
- High integrity earthing
- Cabling and containment earthing and bonding
- Earthing for Isolated Power Supplies
- Generator star point
- Earth resistor earthing
- Measurements & tests on the installed earthing system

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Specification:-

- Earthing connections to specialist equipment.
- Earthing connections to lightning protection system.

4.0 INTERFACES AND DEMARCATIONS

Final connection of Earthing & Bonding systems to other systems (e.g. Imaging equipment, server racks, comms equipment, etc.) – schedule of responsibilities:-

- Imaging equipment final earthing connection to imaging Earth Reference Bar (ERB) provided by the Electrical Installer - by the Imaging Specialist.
- Server racks in server rooms and IT hub rooms connection to standard and separate (IT/instrument) earth bars provided by the Electrical Installer - by the IT System Specialist.
- Communication or other equipment requiring connection to a functional earth bar provided by the Electrical Installer – by the Specialist.

5.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of current legislation, regulations and standards stated in the materials & workmanship clauses.

The Earthing & Bonding System shall be in accordance with;-

- The IET Wiring Regulations, BS7671 17th Edition;
- SHTM 06-01;
- The Medical Electrical Installation Guidance Notes (MEIGaN) v2.0 September 2007;
- Requirements of Scottish Power Energy Networks, should any arise;
- IEE Wiring Regulations Guidance Note 7;
- Electricity at Work Regulations;
- BS 7430 & BS EN 50310;
- ESI Engineering Recommendation S34

6.0 LIAISON

The Electrical Installer shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, the Electrical Installer shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Other Specialist. The Electrical Installer shall liaise with other specialist's as necessary to ensure that all interfaces between the Earthing & Bonding System and other systems are allowed for.

Any other member of the Project and Hospital teams concerned with the planning and administration of the earthing and bonding system and policies.

7.0 EARTHING & BONDING SYSTEM

This section shall be read in conjunction with NBS clause V81 – Earthing and Bonding.

Earthing system generally

The whole of the electrical installation RHSC-DCN Building shall be effectively earthed and bonded to fully comply with the requirements of BS 7671 (17th Ed.), BS 7430 and MEIGaN v2.0 September 2007.

The entire earthing & bonding installation including switchboards, distribution boards, trunking, tray, ladder, basket tray, conduits, circuit protective conductors together with the metallic sheathing of cables shall be electrically continuous throughout forming a completely bonded system.

Earth electrode system & installation

An earthing system shall be installed to achieve a resistance to earth of less than one ohm. It is anticipated that the system will include connections to the building foundations. Where reinforced concrete foundations or piles are to be used as supplementary earth electrodes, connection to the re-bars shall be via a dedicated supplementary re-bar (minimum 12mm diameter) brought out through a connection box set into the concrete and at which connections to copper conductors/ strips can be made. The dedicated conductor re-bar shall be continuous (welded section to section if necessary) and shall be bound onto the structural re-bars.

The earth electrodes shall be solid high conductivity copper rods of 15 mm diameter, not less than 1.2 m long, be driven into the ground to a minimum depth of 2.4 m and be set out to meet the earth site and soil conditions. In addition, and where soil conditions allow such benefit, the electrodes may be buried lengths of high conductivity copper tape of size not less than 100mm x 3mm unless otherwise stated.

The earth electrodes shall be connected to form the earth network via high conductivity tape by means of a purpose made clamp below ground level in a proprietary brand of concrete inspection pit with a removable cover. A label shall be affixed within the inspection pit indicating the driven length of the earth electrode and its measured resistance value at time of test.

The high conductivity tape shall be installed in square and symmetrical lines with links provided in the tape system so that periodic tests may be carried out.

The earthing tape shall be LSOH sheathed or LSOH wrapped where run externally, through walls and floors or in situations where it may be liable to corrosion. PVC insulation may be used where copper tape is buried in the ground external to the building and where the use of such insulation contributes to the control of touch voltages or is required for separation reasons. Sheaths and wrappings shall be green and yellow. All insulated earthing tape when installed above ground or in floor trenches shall be secured at intervals not exceeding one metre by means of suitable saddles.

All joints in exposed sections shall be protected against moisture and corrosion by the application of two coats of anti-corrosion paint.

Each substation earth electrode system shall be bonded to the adjacent substation earth electrode system.

Earthing of MV Network, Energy Centre & Generators

The Energy Centre is to be provided with a MESH or common bonding network (CBN) for earthing of its electrical systems and for protection against the effects of lightning strikes. These systems shall be arranged such that multiple paths are provided to earth for all fault currents and over voltages.

The MV earthing systems to be provided principally comprise the Earth Electrodes (foundations, pits or ring conductors), Cables, Earth Bars and neutral Earthing panels indicated on the Drawings all designed/connected to safely conduct earth fault currents to the origin of the supply while the MV circuit protection recognises and clears the earth fault.

The CSA of the cables and earth bars will be as shown on the drawings.

The Generator Neutral Earth Panels shall be controlled to ensure:-

- that only one Generator neutral-earth connection is provided for all paralleled generators;
- the generator neutral is not earthed while the generators are paralleled with the Mains;

The Neutral Earthing Panel shall be automatically controlled by the Electrical Network Management System (ENMS).

Earthing of Substations

Refer to the earthing schematic for diagrammatic detail.

At each substation (11kV step down substation within the Hospital) the Electrical Installer shall provide a main earth bar within each LV switchroom for the 'A' side and 'B' side which shall be connected in a loop thereby providing an earth connection to each MV substation in accordance with SHTM 06-01.

The main earth bar shall comprise a 50 mm x 6 mm (minimum) high conductivity copper earth bar mounted on top of the LV switchboard.

A main earthing conductor shall be connected to the earth electrode network for each substation which shall be not less than 185mm^2. The main earthing conductor shall terminate at the main earth bar within each LV switchroom via removable test links.

A 11kV switchgear & transformers shall be bonded to the main earth bar. In addition the armour of all sections of 3-core 11kV cable shall be connected to the respective casings and bonded to the main earth bar.

The circuit protective conductors for the outgoing LV sub-mains cables shall be connected to the main earth bar.

Supplementary bonding conductors shall be provided together with all necessary clamps and cable terminals from the main earth bar to any extraneous conductive parts of metallic items located within the substation to maintain an equipotential zone.

Main equipotential bonding conductors

All main equipotential bonding conductors shall be in accordance with BS 7671 (17th Ed.).

A main equipotential bonding conductor shall be installed from the main earth bar located in the LV switchroom of each substation to all incoming main metallic piped services except Telecommunication systems, main pipework at boilers & chillers and to the main ductwork at air handling units. Where these services enter the building at basement level the main equipotential bonding conductors shall be bonded to earth bars within the basement serving a group of services and each earth bar shall be bonded to the main earth bar located in the LV switchroom of each associated substation.

The extraneous conductive parts of all other separate metallic services particular to the building shall be connected including medical gases, compressed air and vacuum systems, lightning protection system and any exposed metallic parts of the building fabric.

Local earth bars may be installed in the plantrooms to reduce the cost of this installation and plantroom earth bars shall be connected to the main earth bar by means of main equipotential bonding conductors.

All main equipotential bonding conductors shall comprise individual single core copper conductors with a green/yellow LSOH sheath.

Main Equipotential Bonding Conductors shall have a cross-sectional area not less than half the cross-sectional area required for the earthing conductor serving that part of the installation.

Local equipotential bonding and protective earth continuity between equipment and the associated mains supply isolator(s) shall not depend solely upon the continuity of conduits, cable braiding, ducts or trunking; it shall be achieved by means of a dedicated copper earth cable connected with brass or copper fittings.

Supplementary bonding conductors

All supplementary bonding conductors shall be in accordance with BS 7671 (17th Ed.).

Supplementary bonding conductors shall be provided to extraneous metal work such as, but not limited to, metal sinks and work surfaces, air transfer grills, medical gas outlets, heating pipes and radiators, water pipes, drug cupboards, ceiling mounted hardware, conduits, trunking and cable trays, metalwork above the ceiling line, steel or wire basket cable trays, steel floor ducts (lids to be fly-lead tagged), steel floor plates (in or below floor line), metal support plates, metal cable outlet plates, metal suspended ceiling tiles (cross-bonded) and ‘computer’ flooring (cross-bonded).

Where practicable and so indicated, or in substations, switchrooms and sections of the Hospital and Energy Centre housing plantrooms or server rooms, the supplementary bonding shall be extended to the main metallic reinforcement in constructional reinforced concrete.

All supplementary bonding conductors shall comprise individual single core copper conductors with a green/yellow LSOH sheath.

A supplementary bonding conductor connecting two extraneous-conductive-parts shall have a cross-sectional area not less than 2.5 mm^2 if sheathed or otherwise provided with mechanical protection or 4 mm^2 if mechanical protection is not provided. All other supplementary bonding conductors shall have a cross sectional area not less than 4 mm^2.

Neutral to earth point

The neutral to earth connection point shall be derived at the substation as indicated on the earthing schematic.

Measurements & Testing

Project Co. shall at stages during, and upon completion of, the earthing installation perform & record measured results of tests to:-

- Check the integrity of the installed earth electrode & earthing system;
- Confirm the overall earthing resistance of the complete system and record test readings (which can be repeated in subsequent years by maintenance teams) to illustrate continued integrity, interconnections & performance.

Project Co. shall measure the overall resistance to earth of each part of the earth electrode network such as each zone of earth rods (i.e. earthing nests), contribution of buried services (e.g. water pipes) constructional foundations, pile caps and crane bases.

A number of readings shall be taken in order that averages can be derived and bands of uncertainty gauged. Tests shall be proposed & recorded for all parts of the earth electrode network.

Project Co. shall provide a group of fully documented tests intended to record the resistance of interconnections on key parts of the earthing installation. Tests should, without disconnection of earthing conductors, permit confirmation that bonds/ connections are in place and should record the connection resistance of at least:-

- Links between substation earth bars and metal work on switchboards, transformers, etc.
- Underground external links as may be used to connect any gates, barriers, etc to the earthing system.

Circuit protective conductors

A separate circuit protective conductor shall be installed together with the phase and neutral wiring for all circuits including sub mains cabling.

The earth terminal of all socket outlets shall be solidly earthed to the system.

Conduits and conduit fixings

Metal conduits crossing expansion joints shall be fitted with proprietary couplings with an earthing clip at each side of the coupling, connected by a 4 mm^2 copper stranded conductor and LSOH insulated.

Switch and riser cupboards earthing and bonding

In each riser cupboard at each floor, the Electrical Installer shall provide a high conductivity copper earth bar an earth bar linked to the main earth bar of the respective main low voltage panel within the LV switchroom.

This shall be used to connect all supplementary and equipotential earthing conductors for the area of the building served by that riser.

Server and hub rooms earthing and bonding

A local standard earthing bar shall be installed in the main core server room and hub rooms, and shall be connected by a green/yellow LSF insulated conductor back to the supply substation's main earth bar.

An additional earth bar (for earthing of IT/ hub equipment/ instruments only) shall be installed in the core server room and hub rooms, and shall be connected by green/yellow LSF conductor (separately from the standard earth bar connection above) back to the supply substation's main earth bar.

Functional earths generally

In the event that communications, imaging or other equipment requires a functional earth then, as for server & communications rooms above, a separate copper earth bar shall be installed and connected back to a designated earth bar using cream coloured LSF conductor.

Connection to anti-static floors/ conductive floors.

Where anti-static or conductive floor surfaces are to be installed, Project Co. shall provide (after liaison with the floor installer) one or more connection terminal(s) bonded to the local earth reference bar, and the floor installer shall be responsible for laying/ connecting all under floor tapes, tails, etc and for testing the finished floor parameters.

Imaging equipment earthing

Earthing in diagnostic imaging and radiotherapy rooms / suites such as dental X-ray equipment, ultrasound, nuclear medicine, bone density, MR, CT, PET as well as conventional radiotherapy, radiographic and fluoroscopic equipment, shall be compliant with MEIGaN V2.0 published by MHRA.

Sub-mains cables for imaging equipment shall be armoured, refer to Low Voltage Distribution specification (WW.A.P.1.2.20), however the steel wire armour (SWA) is intended to provide mechanical and electro-magnetic compatibility protection and shall not be used as the main earth conductor. Connection to earth shall be achieved by means of a copper conductor, having a cross sectional area (CSA) greater than or equal to that of the phase conductors. Where the medical device supplier specifies a greater cross sectional area, the supplier's instructions shall be followed. The copper earth conductor shall be connected to the source of the supply unless it can be shown that a more local distribution panel can provide a copper conductor of adequate CSA from the earth reference bar (ERB) to the earth distribution bar of the sub-station (verify by inspection). The cable supplying power to a three-phase installation shall be a five core cable, and the cable supplying power to a single-phase installation shall be a three core cable.

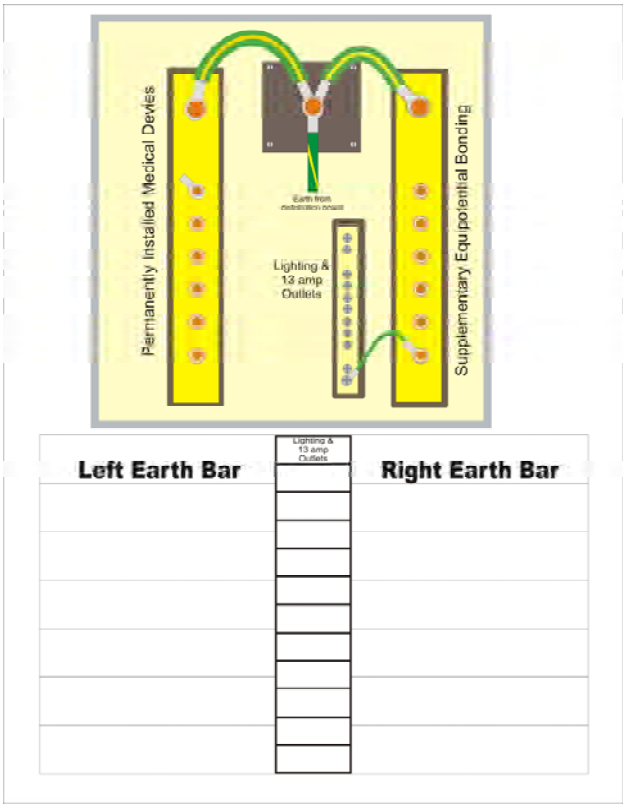
An earth reference bar (ERB) shall be provided in the following areas, subject to design development, within the RHSC-DCN Building:-

Floor	Department	Room Name	Room Number
*	*	*	*

(To be completed during detailed design stage)

The ERB shall be constructed as follow:

- 1st earth connection bar: serves all equipotential conductors for all permanently installed medical devices in the imaging room.
- 2nd earth connection bar: for supplementary bonding of all other extraneous metalwork within the imaging room. A small earth bar shall be connected to this bar for equipotential bonding of socket outlets and lighting.
- 3rd earth connection bar / stud: mains supply protective conductor. Bars 1 and 2 shall be bonded to bar 3.



The copper connection bars shall be insulated from the building. Each copper connection bar shall have a cross sectional area capable of carrying the maximum predicted short circuit current and shall have tapped holes able to take studs mechanically and electrically compatible with the peak current and cable size. The connection bars shall be connected to the incoming earth conductor by means of flexible removable links, which will facilitate the use of a current-measuring probe. The links shall have a cross sectional area sufficient to carry the maximum rated current. The additional smaller bar to accommodate the protective earth and equipotential bonding conductors from the socket outlets and lighting shall be rated to carry the maximum short-circuit current of the socket outlet supply.

Generally, each ERB shall be bonded back to the earth bar in the local electrical riser by means of a protective conductor of equal cross section as the phase conductor of the mains supply to the room however in imaging rooms served by IPS systems the imaging ERB shall also be bonded to the protective earth terminal (PET) within the IPS serving the sockets within the room.

The imaging ERB installation shall comply with the following requirements:

- The mains supply protective earth conductor entering the location shall be terminated at the imaging ERB.

- The imaging ERB shall be close to the mains supply isolator in an accessible position at a height of 1200mm AFFL.

- The imaging ERB shall be installed in an enclosure with a cover that requires a tool to open it and shall be marked ‘Earth Reference Bar’.

- Each protective earth and equipotential bonding conductor shall be separately terminated and connected to the relevant connection bar by means of crimped connections.

- All circuit protective earth and equipotential bonding conductors shall be identified and a list of connections made, a copy of which shall be available in the imaging ERB cabinet.

- All exposed conductive surfaces of installed equipment shall be earthed to the imaging ERB. This includes the enclosures of warning lights, injectors, water baths, contrast media warming equipment, viewing boxes, powered drug cabinets surgical lamps etc. All such items shall be returned to the imaging ERB by means of a cable having a cross sectional area sufficient to ensure that the bonding resistance between the imaging ERB and the earth connection on any installed device is less than 0.1 Ω (this includes the earth receptacle of all 13 A mains outlets) or as specified by the equipment manufacturer.

- All fixed non-powered equipment with metal surfaces (extraneous conductive surfaces) shall be similarly bonded to the imaging ERB. This includes protective screens (including wings), metal sinks and work surfaces, air transfer grills, medical gas outlets, heating pipes and radiators, water pipes, drug cupboards, ceiling mounted hardware, conduits, trunking and cable trays, steelwork above the ceiling line (Unistrut or Marstrut for example) (cross-bonded), steel or wire basket cable trays, steel floor ducts (lids to be fly-lead tagged), steel floor plates (in or below floor line), metal support plates, metal cable outlet plates, metal suspended ceiling tiles (cross-bonded), ‘computer’ flooring (cross-bonded). All such items shall be returned to the imaging ERB by means of a cable having a cross sectional area sufficient to ensure that the bonding resistance between any two conductive surface in the room is less than 0.2 Ω. Earthing by means of trunking, conduits or screening alone is not permitted, a copper conductor shall be provided.

- The installation of socket outlets shall ensure that the circuit protective conductors together with the equipotential conductor achieve an earth resistance value of less than 100 milliohms between any socket outlet and the imaging ERB.

The SWA of the mains supply cable for the medical device is intended to provide mechanical and electro-magnetic compatibility protection; it shall not be used as an earth path. Connection to earth shall be achieved by means of a copper conductor, having a cross sectional area greater than or equal to that of the phase conductors unless the medical device supplier specifies a greater requirement. If the medical device manufacturer stipulates an electromagnetic interference (EMI) screen for the mains supply cables, the SWA shall be terminated with a zoned earthing and neutral (ZEN) gland.

The SWA shall be earthed only at the distribution board unless that would conflict with the equipment manufacturer's instructions for earthing arrangements for electromagnetic compatibility (EMC).

The imaging ERB for the MRI suites shall be located on the equipment room side of the Faraday cage at the earth connection point specified by the manufacturer. The brass stud used to connect each side of the Faraday cage is deemed to be the incoming earth to the diagnostic room. This stud shall be securely connected to the Faraday cage. The imaging ERB enclosure shall be non-metallic, or at least non-ferrous, to prevent interaction with the high magnetic field. The supply-side conductor shall be one cable directly connected to the incoming supply equipotential conductor.

High integrity earthing

All power circuits and accessories shall be provided with high integrity earthing in accordance with Section 543.7 within Chapter 54 of BS 7671 (17th Ed.)

Small power circuits wired by means of 4mm^2 radial circuits in metal conduit will achieve high integrity earthing without the need for any further special measures.

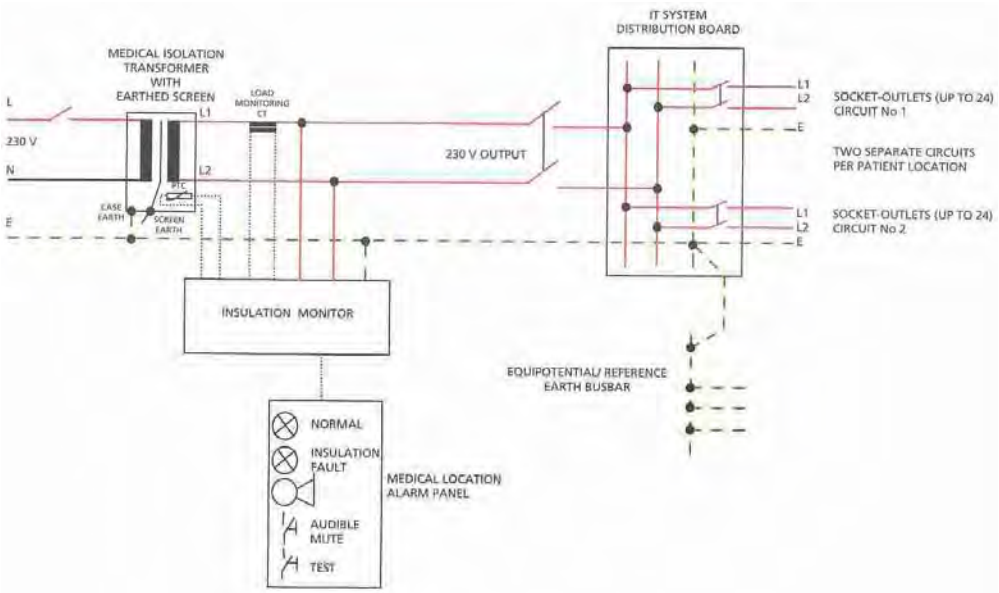
Cabling and containment earthing and bonding

Earth cabling shall be contained on the ladder rack and tray work distribution serving the LV cabling systems, as required. Tray work for the containment of vertical earthing cabling to and from points of termination shall be provided as necessary.

IT cabinet earthing shall be contained on the ladder rack and tray work distribution serving the LV cabling systems.

Earthing for Isolated Power Supplies

The PET integral to the IPS shall be earthed via the CPC of the Isolated Power Supply incoming sub-main cable, and shall act as an equipotential earth only, as far as the final circuits are concerned. These final circuit equipotential bonding conductors shall be sized as indicated on the distribution board schedules. Refer to the following diagram, figure 10.1B, taken from IEE Guidance Note 7 (Chapter 10) for typical arrangement of Isolated Power Supply earthing.



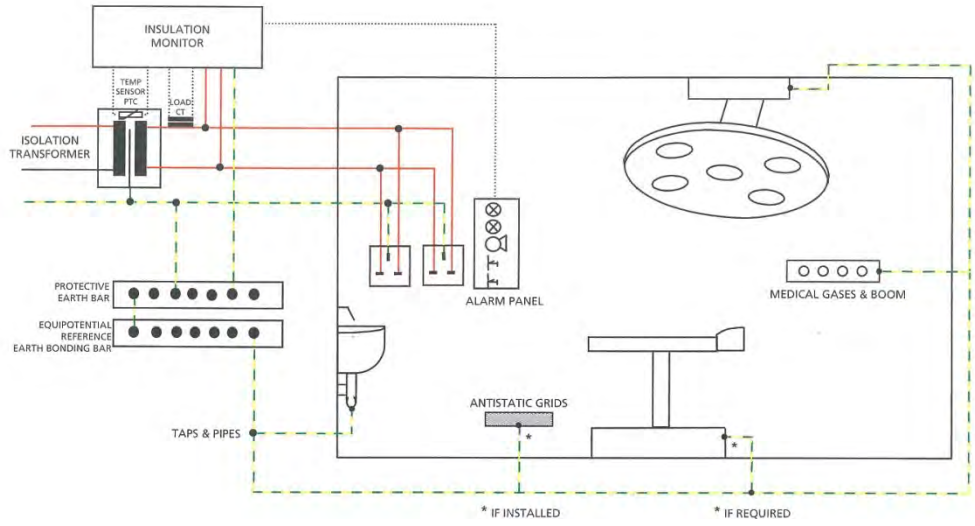
The earth terminals of socket outlets fed from the IPS shall be connected via equipotential bonding conductors to the protective earth bar within the isolated power supply unit.

Supplementary equipotential bonding conductors within the area served by the IPS shall be installed and connected to the PET integral to the IPS for the purpose of equalising potential differences between the following parts, located in the “patient environment”:

- Protective conductors;
- Extraneous-conductive-parts;
- Screening against electrical interference fields, if installed;
- Connection to conductive floor grids, if installed;
- Metal screen of the isolating transformer, if any.

The resistance of the conductors, including that of the connections, between the terminals for the protective conductor of socket-outlets and of fixed equipment or any extraneous-conductive-parts and the bonding busbar shall not exceed 0.2 Ω. The adequacy of the bonding shall be verified to ensure the touch voltages within the patient zone are not exceeded.

Note: The earthing and bonding in the operating theatres and similar medical locations shall comply with figure 10.1A of IEE Guidance Note 7 (Chapter 10), see below. The protective earth bar (or PET) shall be integral to the IPS and the required equipotential reference earth bonding bar shall be located adjacent to each Isolated Power Supply unit.



Earthing for Pendants in general

Pendants and all powered outlets within shall be earthed in accordance with the pertinent requirements for isolated power supplies, standard power outlets, equipotential bonding, etc as described above.

In addition, for Theatres and for any other areas so notified, if a Patient Earthing Terminal is incorporated in the pendant of other equipment design, it shall be connected to the relevant theatre earth reference bar by means of a dedicated copper (insulated) cable no less than 6mm^2.

V81 Earthing and bonding systems

To be read with Preliminaries/ General conditions.

GENERAL

110 EARTHING AND BONDING SYSTEMS GENERALLY

- Main incoming earth: Separate earth electrode network per MV substation.
- Size of main earthing conductor: To BS 7671 Regulation 543.1.3.
- Main earth electrode type: Earth rods.
- Main equipotential bonding
  - Connect the following to the main earthing terminal:
    All extraneous-conductive parts of an installation including, but not limited to:
    water service pipes,
    gas installation pipes,
    other service pipes and ducting,
    central heating and air conditioning systems,
    exposed metallic structural parts of the building,
    the lightning protective system.
  - Cable type: LSZH singles, as section V32.
  - Size: To BS 7671 Regulation 544.1.1.
- Supplementary equipotential bonding: Bond the following:
  exposed conductive parts,
  extraneous conductive parts.
  Refer to particular section.
  - Cable type: LSZH singles, as section V32.
  - Size: Minimum of 2.5 mm² if sheathed or where mechanical protection is provided, otherwise minimum 4 mm², and in areas with IPS units subject also to constraints imposed by interconnection impedance limits.
- Circuit protective conductors
  - Type: Refer to cable and distribution board schedules .
  - Size: Refer to cable and distribution board schedules.
- Earth terminal: main earth bar mounted on LV switchboard in each main LV switchroom. Separate wall mounted earth bar in each riser cupboard at each floor. Separate functional and general earth bar in each server and hub room. Separate reference earth bar installed in each diagnostic imaging and radiotherapy room/suite.
- Earthing of metal fencing around substations: Required.
- Accessories:
  - Earth bar;
  - Earth clamps; and
  - Soil conditioning agent

SYSTEM PERFORMANCE

210 DESIGN

- Standards: To BS 7671 and in accordance with BS 7430.
- Design: Complete the design of the earthing and bonding systems.
- Proposals: Submit drawings, technical information, calculations and manufacturer's literature.

220 ELECTRICITY DISTRIBUTOR'S REQUIREMENTS

- Electricity distributor: Comply with the requirements of the Electricity Distributor.
  - Evidence of compliance: Submit.

230 EQUIPOTENTIAL BONDING IN BUILDINGS WITH INFORMATION TECHNOLOGY EQUIPMENT

- Standard: To BS EN 50310.
- Objectives: Serving the two main server rooms.

250 GENERATOR EARTHING DESIGN

- Standard: To BS 7430 and in accordance with the Electricity Distributor's requirements.
- Independent earth electrode network: Provide.
  - Individual earth electrode resistance (maximum): 20 ohm.
  - Overall resistance to earth of earth electrodes in combination (maximum): 1 ohm.
- Generator operation: Short term parallel with mains electricity supply.
- Earth connection to generator: Provide.

255 MOBILE GENERATOR EARTHING

- Mobile generator earthing: Provide an earthing system with ‘user terminal’ capable of being connected to a mobile generator.
  - Mobile generator position At energy centre.

260 HIGH INTEGRITY EARTHING DESIGN

- Scope: Applies to all small power circuits, and accessories, serving socket outlets.

270 DESIGN FOR HAZARDOUS AREAS

- Standard: To BS EN 60079-14.

280 DESIGN FOR THE SAFE USE AND HANDLING OF FLAMMABLE LIQUIDS

- Design: In accordance with HS(G) 140 from UK Government Health & Safety Executive.

PRODUCTS

310 PRODUCTS GENERALLY

- Standards: To BS 7671 and in accordance with BS 7430.

320 EARTHING AND BONDING CONDUCTORS general

- Type: Bare, tinned, LSZH-covered and lead-covered copper tape to BS EN 13601.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.

360 EARTH RODS

- Standards: In accordance with BS 7430 and Energy Networks Association Technical Specification 43-94.
- Type: Solid copper rods.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Size (diameter): As per particular specification, schematics and drawings.

370 COPPER EARTH PLATES

- Standard: To BS EN 13601.
- Type: Board's choice.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Size: Board's choice.
  - Thickness: Board's choice.

380 EARTH ELECTRODE INSPECTION PITS

- Type: Concrete.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Load rating (minimum): 5000 kg.
- Identification: Permanently identify with the wording 'SAFETY EARTH'.

390 MAIN EARTH BARS GENERALLY

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Hard drawn copper to BS EN 13601.
- Location: As per particular specification, schematics and drawings.
- Size:
  - Profile: As per particular specification, schematics and drawings.
  - Length: Board's choice but minimum 1000mm MV for and 450mm for earth bars associated with LV installation elsewhere within the Hospital & Energy Centre.
- Predrilled connections: Board's choice.
- Disconnecting links: 2.

440 EARTHING AND BONDING CLAMPS

- Standard: To BS 951.

460 SOIL CONDITIONING AGENTS

- Type: Submit proposals.

EXECUTION

610 GENERAL INSTALLATION

- Standards: To BS 7671 and in accordance with BS 7430.

660A INSTALLING EARTH RODS

- Position: In undisturbed ground.
  - Location: At least 2 m from building and metal fencing, avoiding communications cabling.

- Rod separation:
  - General earth installations: Space the rods apart by at least 1.25 times the depth of the longest rod.
- Rod alignment: Vertical.
- Rod length (minimum): 2.4 m.
- Couplings: Apply corrosion inhibiting paste to the threads and enclose so that rods meet at centre of coupling.
- Earth rod heads: Enclose and position within 100 mm of ground level.
  - Enclosure: Concrete inspection pit.
- Earth rods: Interconnect with PVC insulated copper tape.
  - Tape size: 25 mm x 6 mm.
  - Tape depth: 750 mm below ground.
  - Jointing method: Exothermic.
- Internal earth rods: Provide seals.

670 INSTALLING SURFACE BARRIERS AROUND EARTH RODS

- Non-conducting barriers: Install to prevent personnel or livestock contact with the ground within 2 m of earth rods.
  - Location and design: Submit proposals.

680 INSTALLING EARTH PLATES

- Earth plates: Install vertically. Backfill immediately following installation.
  - Depth of plate top (minimum): 1000 mm below finished ground level.
  - Location: Board's choice .

700 INSTALLING EARTH BARS

- Main earth bar location: Next to the main switchboard.
- Multiple earth bars: Connect with a conductor ring.
- Mounting: Insulated supports.
  - Support spacing: 300 mm for 25 mm bar and 450 mm for 50 mm bar.
  - Clearance between wall and earth bar (minimum): 30 mm.

710 INSTALLING MAIN EARTHING CONDUCTOR

- Conductor location: Install between the main incoming earth and the main earthing terminal in one continuous length.
- Connection: Make with compression lugs and phosphor bronze nuts and bolts and spring washers.
- Earthing conductor route: Board's choice.
- Connection to earth electrodes: Heavy duty copper alloy mechanical clamps.
- Protection to main earthing conductor: Not required.

720 INSTALLING MAIN EQUIPOTENTIAL BONDING CONDUCTORS

- Separate and continuous connections: Install between each service and the main earth terminal.
- Bonding conductor routes: Board's choice.
- Bonding connections at main earth terminal: Connect with compression lugs and phosphor bronze nuts and bolts and spring washers.

730 INSTALLING SUPPLEMENTARY BONDING CONDUCTORS
- Earth connections: Connect with compression lugs.

740 INSTALLING EARTH ELECTRODE PITS
- Locations: Submit proposals.
- Inspection pit lid: Install flush with the finished ground surface.

750 DISSIMILAR METALS
- Connecting dissimilar metals: Prevent electrolytic action.

760 EARTHING AND BONDING OF STREET FURNITURE
- Standards: To BS 7671 and in accordance with the Electricity Distributor's requirements.
- Supplies to street furniture: Use cables with separate phase, neutral and protective conductors.

770 EARTHING OF METAL FENCING AROUND SUBSTATIONS
- Type: Connected to substation earthing system.

COMPLETION

910 INSPECTION AND TESTING
- Standards:
  To BS 7671 and in accordance with BS 7430.
  To guidance/ procedures described in MEIGaN V2.0
- Notice before commencing tests (minimum): 24 h.
- Continuity of protective conductors:
  - Parallel earth paths: Isolate before testing.
  - Equipment: Continuity tester with short circuit current not less than 200 mA, and a no load d.c. or a.c. voltage between 4 V and 24 V.
- External earth fault loop impedance: Direct measurement.
- Earth fault loop impedance:
  - Method: Direct measurement.
  - Measurement locations: Origin, switchgear, fixed equipment and outlets, and circuit extremities.

920 NOTICES AND LABELS
- Standard: To BS 7671.
- Material: Face engraved rigid plastics laminate.
- Colour:
  - Background: White.
  - Lettering: Red.
- Typography:
  - Font: Helvetica medium.
  - Size: Submit proposals.
- Earth bars: Describe each connection and label with _SAFETY ELECTRICAL CONNECTION – DO NOT REMOVE_.
- Main earthing and bonding connections: Describe each connection and label with _SAFETY ELECTRICAL CONNECTION - DO NOT REMOVE_.
- Telecommunications functional earth connections: Label with "TELECOMMS EARTH - DO NOT REMOVE".

930 IDENTIFICATION OF FUNCTIONAL EARTHING

- Labelling: Identify the purpose of functional earth cables along their length using clip-on cable markers.
  - Spacing (maximum): 3 m.

940 DOCUMENTATION

- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with the proposed document management system
- Operation and maintenance instructions: Submit.
- Record drawings: Submit.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.26 JB G1547**
Performance Specification Title	**Water Detection Systems**	Date	**August 2014**
Prepared By	**JB**	Checked By	**PM**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	PM
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
WATER DETECTION SYSTEMS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Specification shall include, but not be limited to the following:-

- Sensing cable type water detection systems
- Sensing probe type water detection systems

Drawings

Project Co. shall prepare general arrangement drawings of the Water Detection Systems based on the Architect's base drawings and co-ordinated with other services and building elements.

The drawings shall indicate as a minimum:-

- Areas protected
- Sensing cables/probes
- Alarm panels

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this element of the Specification:-

- Power wiring
- Main cable containment (other than final run outs of conduits)
- Major leak detection (i.e. by differential pressure detection to pipework)

4.0 INTERFACES AND DEMARCATIONS

The Water Detection Systems shall be integrated with a host Internet Protocol network which will support communication, interaction, data transfer and data retrieval from and between the various engineering systems in the building. The Water Detection Systems shall be connected to the host network via gateways. The Building Management System (BMS) will be provided with a Graphical User Interface which will permit the interrogation of the Water Detection Systems down to component level. It is not intended that the BMS will control the system but rather will monitor component status and provide fault alarm indication at the Graphical User Interface.

5.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of current legislation, regulations and standards stated in the materials & workmanship clauses.

6.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

7.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

The Hospital. Project Co. shall include for liaison in conjunction with the Board with members of the Hospital's team with an interest in the planning and administration of the Water Detection Systems.

8.0 SYSTEMS

Water detection shall be provided at:-

- Perimeter of core server room (sensor cable);
- Perimeter of all Hub rooms (sensor cable);
- Plant room bunds above or immediately adjacent to Theatre Department and Radiology departments.

Sensor probes shall be provided within the basement sumps to indicate high level warning.

Panels

Wall mounted water detection panels shall be located on the fully loaded drawings.

The panels specified herein shall be self-rebooting following mains failure and generator test conditions.

Sensor Cables

Water sensing cables shall be provided in core server room shall be laid around the perimeter of the room and in parallel strips 2m apart on the floor.

Water sensing cables shall be provided in Hub rooms shall be laid around the perimeter of the room and in parallel strips 2m apart on the floor.

Sensor probes

Sensor probes shall be provided in the sumps within the Basement and shall be floor mounted.

Sensors shall be suitable for plantroom environments and provided with a robust protective housing.

Cables linking the sensors and local panels shall be run in robust containment systems.

Alarms

In the event of local leakage, local audible and visual alarms shall be raised and repeated at the BMS front end.

W58 Water detection and alarm systems

To be read with Preliminaries/ General conditions

GENERAL

110 WATER PRESENCE DETECTION AND ALARM SYSTEMGENERALLY

- System manufacturer: Board's choice.
- Areas to be protected: Refer to Particular Specification.
- Zones: Refer to Particular Specification.
- Sensor types: Cable and Probe.
- Control panels: Required.
- Connection cable to sensors: Required.
  - Cable type: System manufacturer's standard.
  - Containment: Rigid metallic conduit, as section Y63.
  - Rewireable installation: Required.
  - Concealed installation: Required.
- Alarm indication:
  - Internal: Submit design and cost proposals.
  - External: Submit design and cost proposals.
- Completion: Submit design and cost proposals.

SYSTEM PERFORMANCE

210 DESIGN

- Design: Complete the design of: The water leak detection and alarm system.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.
- Zone diagram: Submit for water presence detection and alarm system.

220 ZONING AND IDENTIFICATION FOR WATER PRESENCE AND ALARM SYSTEM

- Zoning: Divide the installation into separately controlled and identifiable zones.
- Sensor identification: Individual address.

230 INTEGRATION WITH OTHER ALARM AND SECURITY SYSTEMS

- Objectives: Integration with BMS.
- Systems to be integrated: Building monitoring and management systems, as section Y41.

PRODUCTS

310 CABLE SENSORSFOR SERVER ROOMS, HUB ROOMS AND PLANTROOM BUNDS.

- Type: Four wire with LSZH sheath.
- Manufacturer: System manufacturer.
  - Product reference: Board's choice.
- Cable length: Submit proposals.
- Accessories: Hold down clips and Identification tags.

330 PROBE SENSORSFOR BASEMENT AND TUNNEL SUMPS.

- Type: Floor mounted.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals .
- Accessories: Protective housing.

350 CONTROL PANELS GENERALLY

- Manufacturer: System manufacturer.
  - Product reference: Board's choice.
- Features:
  - Individual zone alarm indicators;
  - Individual zone fault indicators;
  - Individual zone healthy indicators; and
  - BMS interface.
- Integral battery back up: Not required.
  - Low battery alarm: Required.

  Alarms:
  - Audible;
  - BMS connection;
  - Remote; and
  - Visual.
- Accessories: 50 event log.

370 VISUAL ALARM SIGNAL DEVICESGENERALLY

- Manufacturer: System manufacturer.
  - Product reference: System manufacturer.
- Type: LED.
- Flash rate
  - (Minimum): 30 per minute
  - (Maximum): 130 per minute
- Lens:
  - Material: Polycarbonate.
  - Colour: Clear.
- Enclosure ingress protection to BS EN 60529: IP44.

EXECUTION

630 INSTALLING CABLE AND TAPE SENSORS

- Fasteners:
  - Floors and ceilings: Self adhesive clips.
  - Pipework: Reusable wrap around bands.
- Contact between sensor and item being monitored: Required.
- Coverage: Lay in loops or wave pattern.
- Spacing between cables and between tapes (maximum): Submit proposals.

640 INSTALLING POWER SUPPLIES

- Equipment to be connected: Control panels.
- Power supplies: As Circuit schedule.
  - Final connection accessory type: Unswitched fused connection unit.

660 INSTALLING PROBE SENSORS

- Fixing: Screw fix.
- Spacing between probes (maximum): 2 m.

670 INSTALLING CONTROL PANELS

- Location: As SPA1046 on Architect's fully loaded layouts and WW electrical services plantroom layouts.
- Connection to sensors: Required.

COMPLETION

910 DOCUMENTATION

- Operation and maintenance instructions, record drawings & test/commissioning certificate to be compatible with Zutec system
- Operation and maintenance instructions: Submit.
- Record drawings: Submit.

930 SENSOR IDENTIFICATION AND TESTING

- Sensor identification: Label devices with a unique identity.
- Sensor testing: Verify the operation of each sensor. Submit a schedule of sensors, including the device test methods and results.

940 BATTERY BACK UP TESTING

- Mains power supply: Isolate.
- Quiescent mode: Measure current supplied by standby source when water presence detection and alarm system is operating in the quiescent mode. Submit results.

950 TESTING ACTUATION, INTEGRATION AND INTERFACING WITH ALARM AND SECURITY SYSTEMS

- Connections with other systems and equipment: Verify and demonstrate operation of the systems and equipment under leak and fault conditions.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Electrical**	Sheet	**WW AP.1.2.27 JB G1547**
Performance Specification Title	**Lightning Protection System**	Date	**August 2014**
Prepared By	**PM**	Checked By	**JB**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	JB
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
LIGHTNING PROTECTION SYSTEM

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre to the South of the hospital houses heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Performance Specification shall include the following:-

- Design and installation of concealed Lightning Protection system
- Risk assessment, in accordance with BS 62305, on the requirements for additional transient overvoltage surge suppression devices (SPD) in addition to the surge suppression devices installed in the main LV switch boards, refer to WW Low Voltage Distribution specification WW.A.P.1.2.20
- Attendance on site at various stages of construction
- Testing and commissioning

3.0 PERFORMANCE SPECIFIED SYSTEMS

The Lightning Protection system is a performance specified system and this specification outlines the requirements to be met by the system.

4.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of current legislation, regulations and standards stated in the Materials & Workmanship clauses.

5.0 DESIGN CRITERIA

General

The Lightning protection systems shall be designed to reduce the risk of lightning causing injury to occupants, failure of crucial electrical, data/telecommunications and M&E systems, or damage to the building fabric or structure.

The Engineering services in the RHSC-DCN are vital for the correct and safe continued operation of the hospital and the well-being of staff and patients. Accordingly, great care shall be taken to ensure that the lightning protection systems provide an appropriate level of protection against the effects of lightning strikes to:

- the building
- the services entering the building
- other buildings with services connections to the building.

As an initial guide for information only, a preliminary review has been carried out of the lightning protection requirements for the RHSC-DCN, to provide an estimate of the Lightning Protection System Classification based upon the recommendations of BS EN 62305.

The resulting estimate indicates that a Class I lightning protection system is required for its structure. The Specialist shall, as part of the detailed design, carry out a detailed assessment in accordance with BS EN 62305, to verify the precise Classification of the required system.

In accordance with BS EN 62305, the Specialist shall perform a risk assessment on the requirements for additional transient overvoltage surge suppression devices on cables entering/exiting the building, local to equipment such as IT racks and for any other electrical systems on the roof, in addition to the surge suppression devices installed within the main LV switch boards, refer to the Low Voltage Distribution specification, WW AP.1.2.20, for further details.

Earthing of the electrical distribution systems and bonding of extraneous metalwork is specified under a separate package (refer specification WW AP.1.2.25). Inasmuch as there may be connection between the lightning protection systems and the electrical system earthing, the Specialist shall take heed of relevant design standards for earthing generally (such as SHTM 06-01, BS 7430 Code of Practice for Protective Earthing of electrical installations, BS7671 (17th Ed) BS EN 50310 Application of equipotential bonding & earthing in buildings with IT equipment) and shall co-ordinate the earthing connections.

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

Drawings

As part of the development of the design the Specialist shall prepare general arrangement drawings of the Lightning Protection System based on the Architect's base drawings and coordinated with other services and building elements.

The drawings shall indicate as a minimum:-

- Lightning Protection Systems roof plans
- Lightning Protection Systems elevations
- Connection details for Air Termination Network to steel frame, perimeter tapes and down conductors
- Connection details for down conductors
- Earth termination provisions and electrode/pile layouts
- Details of down conductor to earth termination network connection
- Details of test points and access provisions
- Details of bonding to services
- Details of bonding to curtain walling/cladding
- Details of integration with concrete frame
- Details of integration with building fabric
- Details of additional transient overvoltage surge suppression devices and installations

The Specialist is reminded of the requirement for Record Drawings (as-built), to be submitted prior to completion, (refer to section W60)

Liaison

The Specialist shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of Parts A, B and C of this specification, the Specialist shall include for close liaison with Health and Safety professionals including the Trust's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

The Hospital. The Specialist shall include for liaison in conjunction with the Board with members of the Hospital's team with an interest in the planning and administration of the Lightning Protection System.

The Project Teams. Any other member of the Project and Board concerned with the planning and administration of Lightning Protection Systems.

6.0 LIGHTNING PROTECTION SYSTEM

General

The Specialist shall design and install a Lightning Protection System for the new RHSC-DCN building. The Specialist shall carry out an assessment and develop the detailed design requirements for the lightning protection system based on building details and detailed construction information.

The Specialist shall be responsible for the final selection of all equipment, tape and cabling and detailing of bonding and interconnection of any structural steel and reinforcing bars used in the Lightning Protection System.

The Specialist shall provide advice during the design phase on the most cost effective approach.

The systems to be provided shall principally comprise roof mounted air terminations connected to down- conductors with these in turn connected to the general mass of Earth.

The Specialist shall, for equipotential bonding purposes, bond together all metallic current paths available as part of the building construction and the lightning protection system. These shall include:

- Tape down conductors
- Reinforcement bars in the floor slabs
- Reinforcement bars in the pile caps
- Metallic roof coverings where suitable
- Roof edge tapes and air termination system

The completed systems shall accord with the recommendations of BS EN 62305.

The Specialist shall develop the concept into a design fully compliant with BS EN 62305 and provide a fully compliant installation. Where requested, the specialist shall provide copies of his calculations to prove the compliance of the design.

The completed system shall be provided with facilities that allow the system to be regularly tested.

The system shall be designed to provide the minimum necessary mesh width to reduce circulating currents throughout the building.

Finials

Finials shall be provided as appropriate at positions of around the building to reduce the risk of direct strikes to structure. These shall be connected to the linear air terminations and/or down conductors.

Air Terminations

The installation shall, where practicable and as far as possible, make use of the metal construction of the roofs as part of the air termination network.

Perforation of the metallic skin of the roof due to lightning strikes is not permissible.

Where necessary, supplementary conductor tape shall be installed to ensure a continuous roof termination network. Where required, e.g parapets, the conductor tape shall be PVC insulated and colour coordinated with the building.

The air termination network shall be bonded to the metallic roof coverings.

All antennae and other roof mounted exposed extraneous metalwork components of the building such as, but not limited to, the Helipad and its access ramp, handrails, plant housings, TV aerials, satellite dishes, radio masts, flag posts, CCTV brackets and towers, etc shall be bonded to the air termination network and protected by finials where necessary.

The Specialist shall note that use of “green roofs” and shall allow for these to be suitably incorporated into the system.

Down Conductors

Where down conductors, other than natural down conductors, are required they shall be copper tape or rods.

Down conductors shall be concealed behind the building cladding system. The Employer’s Requirements prohibit down-conductor tapes being installed exposed on the surface of the cladding system.

The Specialist shall liaise with the curtain walling and cladding specialists and include for adequate bonding to the metal supporting frames of these cladding systems.

Earth Terminations

The Specialist shall consider all appropriate methods of earthing the Lightning Protection System, to ensure an effective earth termination network taking into account the construction of the foundations. The earthing shall be achieved by using a combination of:

- the structural foundations
- earth rods
- a ring conductor

Earth electrodes shall be provided within purpose-made inspection pits with a lockable, hinged lid. Where these are located under hard surfaces they shall be suitable for pedestrian or vehicular traffic as appropriate.

Connections between the down conductors and the earth electrodes shall be contained in suitably sized earthing pits with removable covers.

The Specialist shall provide an effective means of decoupling the Lightning Protection System from the earth termination network for test purposes in accordance with BS EN 62305.

The Specialist shall carry out earth resistivity tests to determine the earthing properties of the ground on site.

Helipad

A helipad will be constructed above the DCN. This will have a steel structural frame and an access ramp also of steel framework construction. The structure of the helipad and ramp shall be bonded to the lightning protection system, and may be incorporated as part of the air termination system if the construction details are suitable.

Bonding of Building Fabric and Structure

Project Co. shall advise on the detailed requirements for bonding the building fabric and structure to the lightning protection system, and for the mutual bonding of the various components of the fabric and structure. This shall include the reinforcement bars and concrete frame and floors of the structure, the cladding system sub-frames, the Helipad and any ancillary metalwork such as the maintenance hoist rails, and the mutual bonding between separate sections of any floor slab across construction, expansion and movement joints etc.

Transient Overvoltage Surge Suppression Systems

In accordance with BS EN 62305, the Specialist shall perform a risk assessment of the requirements for additional transient overvoltage surge suppression devices in addition to the surge suppression devices installed within the main LV switch boards, refer to the Low Voltage Distribution specification, WW AP.1.2.20, for further details. Such systems which may require additional surge suppression, dependent on the outcomes of the risk assessment are listed below:-

- Helipad
- Roof mounted warning lights
- PV installation, consider surge suppression at coupling point with electrical distribution network
- Aerials/satellite dishes and associated system electronics
- Roof level perimeter tracks and their associated cleaning system
- Power & data cables entering/exiting the building including external lighting cables and copper telephone cables
- Equipment such as IT racks/servers
- etc

Should additional surge suppression devices be required, the Specialist shall design co-ordinated systems of transient overvoltage surge protection for the incoming electrical and data/telecommunications services and their distribution systems.

The Specialist shall review the transient overvoltage surge suppression requirements for the LV installation to provide complete transient overvoltage protection to the whole LV system, using the minimum necessary number of levels of protection. If further levels of protection are required, in addition to those located at the main LV switchboards, these shall be included at the sub LV panel boards, and at local distribution boards. The Specialist shall be responsible for defining the types of surge protection device at each level (Types I, II or III SPDs) as part of the design process.

The transient overvoltage surge suppression system for the data and telecommunications systems shall be designed based on the withstand properties of the data and telecommunications equipment being installed by the Data/Telecommunications Specialist.

Project Co. shall liaise closely with the Board, the and Data/Telecommunications Specialist to review and confirm the necessary details of the LV distribution system and the data/telecommunications installations, and shall carry out the detailed design of the transient overvoltage surge suppression (SPD) installations accordingly.

Attendance

Attend site at various stages of construction to:-

- Test the conductivity of the ground and to determine the most appropriate means of achieving the earth termination network
- Test the air termination network to ensure continuity
- Test the connection between the lightning protection system components to ensure complete continuity from the air termination network through the down conductor system to the ground termination network

Testing

Upon completion of the whole system, tests shall be conducted and the results included within the project record documentation.

MATERIALS AND WORKMANSHIP CLAUSES

W60 Lightning protection systems

To be read with Preliminaries/General conditions

GENERAL

110 BUILDING CONSTRUCTION FOR INFORMATION GENERALLY

- Substructure: In-situ concrete piles.
- Superstructure: Pre-cast sectional concrete columns, In-situ concrete floor slabs, partial in-situ concrete core structures.
- Roof structure: Steel framed; and/or - concrete in-situ roof with pre-cast sectional concrete columns
- Roof coverings: Sheet aluminium; and/ or in-situ concrete slab with special "Green" roof; in-situ concrete with membrane and paving slab; various other details; Refer to Architect's roof drawings.

120 LIGHTNING PROTECTION SYSTEM GENERALLY.

- System manufacturer: Submit proposals.
  - Registration: A member of the Association of Technical Lightning and Access Specialists (ATLAS).
- External LPS type: Submit design and cost proposals.
- Internal LPS: Submit design and cost proposals.
- Protection against explosive or highly flammable contents: Not required.
- Protection of electrical and electronic systems: Required.
- Air termination system:
  - Air terminals;
  - Copper tape;
  - Use roof covering; and
  - Submit design and cost proposals.
- Down conductors:
  - Copper tape concealed behind cladding;
  - Use superstructure; and
  - Submit design and cost proposals.
  - Lateral connections: Submit proposals.
- Earth termination system:
  - Earth rods;
  - Ring earth electrode;
  - Use substructure; and
  - Submit design and cost proposals.
- Accessories:
  - Earth rod inspection pits;
  - Notices and labels;
  - Soil conditioning agents;
  - Surge protective devices as section Y67; and
  - Submit design and cost proposals.
- Completion:
  - Electrical identification: As section V80.

SYSTEM PERFORMANCE

210 DESIGN

- Standards: To BS EN 62305-2, BS EN 62305-3 and BS EN 62305-4.
- Design: Complete the design of the lightning protection system.
- Class of LPS to BS EN 62305-2: I.
- Coverage of LPS: External and Internal.
- Internal equipment to be protected: Incoming services; all electrical systems; all electronic equipment; fire alarm system; tv and radio distribution; access control, CCTV and security systems; intruder alarm systems; public address systems; nurse call systems; data and telephone systems .
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

PRODUCTS

310 AIR TERMINALS GENERALLY.

- Standard: To BS EN 50164-2.
- Manufacturer: System manufacturer .
  - Product reference: Board's choice.
- Material: Copper.
- Type: Board's choice.
- Size: Board's choice.

340 COPPER TAPE GENERALLY.

- Standards: To BS EN 13601 and BS EN 50164-2.
- Manufacturer: System manufacturer .
  - Product reference: Board's choice.
- Size: Board's choice.
- Cover: PVC where exposed to view (e.g. roof).
  - Colour: Board to submit proposals for agreement with Architect.

370 EARTH RODS GENERALLY

- Standards: To BS EN 50164-2 and ENA Technical Specification 43-94 and in accordance with BS 7430.
- Type: Threaded copperbond rods.
- Manufacturer: System manufacturer .
  - Product reference: Board's choice.
- Size:
  - Diameter: Board's choice.
  - Length: Board's choice.

390 RING EARTH ELECTRODES GENERALLY.

- Standards: To BS EN 13601 and BS EN 50164-2.
- Material: Bare copper tape.
- Manufacturer: System manufacturer.
  - Product reference: Board's choice.
- Tape size: Board's choice.

410 CONNECTION COMPONENTS

- Standard: To BS EN 50164-1.
- Manufacturer: System manufacturer.
  - Product reference: Board's choice.

- Lightning current withstand classification: Class H.
- Material: Match conductor material.

415 EARTH ROD INSPECTION PITS
- Type: Concrete.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Load rating (minimum): Board's choice.
- Identification: Permanently identify with the wording "EARTH ROD".

420 METALLIC DIRECT CONTACT CLIPS
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Copper and aluminium alloy.

430 NON-METALLIC DIRECT CONTACT CLIPS
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: Non-brittle, UV stabilized high grade polypropylene.
  - Colour: Match tape.

440 NOTICES AND LABELS
- Material: Screen printed plastics.
- Colour:
  - Background: Board's choice.
  - Lettering: Board's choice.
- Typography:
  - Font: Board's choice.
- Size: Submit proposals.
- System notice wording: "THIS STRUCTURE IS PROVIDED WITH A LIGHTNING PROTECTION SYSTEM THAT IS IN ACCORDANCE WITH BS EN 62305-3 AND THE BONDING TO OTHER SERVICES AND MAIN EQUIPOTENTIAL BONDING SHOULD BE MAINTAINED ACCORDINGLY."

445 SOIL CONDITIONING AGENTS
- Type: Board's choice.

EXECUTION

630 INSTALLING LIGHTNING PROTECTION SYSTEMS
- Installation: In accordance with BS 62305-3.
- Substructure: When used as the earth terminal network measure its resistance to earth during the construction period.
- Results: Submit.

640 INSTALLING AIR TERMINALS
- Location: Board's choice.

650 INSTALLING TAPES

- Location: Down-conductors - concealed within wall cavity; Roof - exposed.
- Number of joints: Minimize.
- Contact surfaces: Clean. Coat with corrosion inhibitor.
- Bimetallic joints: Do not cross-contaminate.
- Conductors passing through roofs: Provide puddle flanges.

660 INSTALLING EARTH RODS

- Location: Board's choice.
- Rod separation: Space the rods apart by at least 1.25 times the depth of the longest rod.
- Rod alignment: Vertical.
- Couplings: Apply corrosion inhibiting paste to the threads and enclose so that rods meet at centre of coupling.
- Earth rod heads: Position below ground within 100 mm of ground level.
- Internal earth rods: Provide waterproof seals.

690 INSTALLING EARTH ROD INSPECTION PITS

- Inspection pit lid: Install flush with the finished ground surface.

700 INSTALLING RING EARTH ELECTRODES

- Earth rods: Interconnect with ring earth electrode.
- Depth: Pass below incoming services.
- Jointing method: Exothermic.

710 INSTALLING TEST JOINTS

- Location: Within earth rod inspection pit.
- Labelling: Provide a plate indicating the position, number and type of earth electrodes above each test point.

715 BONDING

- Standards: To BS EN 62305-3 and BS EN 62305-4.
- Bond the following to the lightning protection system:
  - Antennae;
  - Base of a down conductor to the main switchgear earthing terminal;
  - Base of down conductor to base of vertical steelwork in lift shaft;
  - Metal fire escape;
  - Metal flue pipe;
  - Shields of incoming services; and
  - Vertical steelwork in lift shaft to structural steelwork of building at eaves and ground levels
  - Helipad access ramp
  - Building Maintenance Access Hoist steelwork
  - Metal cladding support work.
- Bonding conductor sizes: To BS EN 62305-4.
- Locations of bonds: Board's choice.

720 DISSIMILAR METALS

- Connecting dissimilar metals: Prevent electrolytic action.

730 INSTALLING SOIL CONDITIONING AGENTS

- Location: Board's choice.

750 INSTALLING NOTICES AND LABELS

- Location: Within main switchrooms.

COMPLETION

910 INSPECTION AND TESTING

- Inspection and test: In accordance with BS EN 62305-3 and BS EN 62305-4.
- Results: Submit.
- Log book: Required.

940 DOCUMENTATION

- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system
- Operation and maintenance instructions: Submit.
- Record drawings: Submit.

Y67 Transient overvoltage surge suppression devices

To be read with Preliminaries/ General conditions

PRODUCTS

310 TRANSIENT OVERVOLTAGE SURGE SUPPRESSION DEVICES FOR MAINS POWER SUPPLIES WHERE REQUIRED FOR LOW VOLTAGE DISTRIBUTION SYSTEM - MAIN LV BOARDS

- Manufacturer: Board's choice.
  - Product reference: Submit proposals.
- Standard: BS EN 61643-11 and IEEE C 62.41.
- Operating voltage and frequency (nominal): 400 V at 50 Hz.
- Operating voltage (maximum): 500 V .
- Phase arrangement: Three.
- Surge current (minimum) between any two conductors: 10 kA.
- Let-through voltage (maximum): Must not exceed the equipment transient design level (ETDL) supplied by the equipment manufacturer. Submit proposals..
- Current rating: Submit proposals.
- Thermal overload protection: Submit proposals.
- Mode of protection: Lines to earth, lines to neutral, neutral to earth.
- Protection status indicators: Full protection status
- Remote indication of status (including loss of phase/ supply): Required.
- Effect on mains power supplies during normal operation:
  - No corruption to normal mains supply.
  - No break or shutdown of mains supply.
  - No excessive earth leakage current.
- Enclosure: Within LV switchboard, or in separate enclosure adjacent. Submit proposals.

310A TRANSIENT OVERVOLTAGE SURGE SUPPRESSION DEVICES FOR MAINS POWER SUPPLIES WHERE REQUIRED FOR LOW VOLTAGE DISTRIBUTION SYSTEM - SECONDARY LV PANEL BOARDS

- Manufacturer: Board's choice.
  - Product reference: Submit proposals.
- Standard: BS EN 61643-11 and IEEE C 62.41.
- Operating voltage and frequency (nominal): 400 V at 50 Hz.
- Operating voltage (maximum): 500 V .
- Phase arrangement: Three.
- Surge current (minimum) between any two conductors: 10 kA.
- Let-through voltage (maximum): Must not exceed the equipment transient design level (ETDL) supplied by the equipment manufacturer. Submit proposals..
- Current rating: Submit proposals.
- Thermal overload protection: Submit proposals.
- Mode of protection: Lines to earth, lines to neutral, neutral to earth.
- Protection status indicators: Full protection status
- Remote indication of status (including loss of phase/ supply): Required.
- Effect on mains power supplies during normal operation:
  - No corruption to normal mains supply.
  - No break or shutdown of mains supply.
  - No excessive earth leakage current.

- Enclosure: Within secondary panelboard, or in separate enclosure adjacent. Submit proposals.

310B TRANSIENT OVERVOLTAGE SURGE SUPPRESSION DEVICES FOR MAINS POWER SUPPLIES FOR LOW VOLTAGE DISTRIBUTION SYSTEM - DISTRIBUTION BOARDS (WHERE REQUIRED)

- Manufacturer: Board's choice.
  - Product reference: Submit proposals.
- Standard: BS EN 61643-11 and IEEE C 62.41.
- Operating voltage and frequency (nominal): 400 V at 50 Hz.
- Operating voltage (maximum): 500 V .
- Phase arrangement: Three.
- Surge current (minimum) between any two conductors: 10 kA.
- Let-through voltage (maximum): Must not exceed the equipment transient design level (ETDL) supplied by the equipment manufacturer. Submit proposals..
- Current rating: Submit proposals.
- Thermal overload protection: Submit proposals.
- Mode of protection: Lines to earth, lines to neutral, neutral to earth.
- Protection status indicators: Full protection status
- Remote indication of status (including loss of phase/ supply): Required.
- Effect on mains power supplies during normal operation:
  - No corruption to normal mains supply.
  - No break or shutdown of mains supply.
  - No excessive earth leakage current.
- Enclosure: Within distribution board.

330A TRANSIENT OVERVOLTAGE SURGE SUPPRESSION FOR DATA AND TELECOM SUPPLIES - ALL DATA, COMMUNICATIONS, CCTV AND OTHER ELV CABLES ENTERING OR LEAVING THE BUILDING

- Manufacturer: Board's choice.
  - Product reference: Submit proposals.
- Standard: To BS EN 61643-21, ITU-T K20 and ITU-T K21.
- Operating voltage (nominal): To be compatible with system protected.
- Bandwidth: To be compatible with system protected.
- Operating voltage (maximum): To be compatible with system protected.
- Surge current (minimum) per signal wire: To be compatible with system protected.
- Let-through voltage (maximum): To be compatible with system protected.
- Current rating (signal): To be compatible with system protected.
- Thermal overload protection: Submit proposals.
- Mode of protection: Lines to earth, lines to lines.
- Enclosure: Submit proposals.

340 ENCLOSURES.FOR SEPARATELY MOUNTED DEVICES

- Manufacturer: Board's choice.
  - Product reference: Submit proposals.
- Ingress protection (minimum): Submit proposals.
- Material: Manufacturer's standard.
- Finish: Manufacturer's standard.
- Colour: Manufacturer's standard.

EXECUTION

620 INSTALLATION GENERALLY

- Standards:
  - To BS 7671;
  - DD CLC/TS 61643-12; and
  - DD CLC/TS 61643-22.
- Equipment: Provide electrical supplies to equipment requiring power.
- Fixings: Non-corroding and compatible with the environment where they are installed.

630 INSTALLING TRANSIENT OVERVOLTAGE SURGE SUPPRESSION DEVICES FOR MAINS POWER SUPPLIES AND DATA AND TELECOM SUPPLIES

- Point of installation: secondary panelboards and distribution boards if necessary, submit proposals.
- Transient overvoltage suppression devices: Interconnect.
- Control cables between transient overvoltage suppression devices and BMS: Interconnect.
- Interconnecting cable:
  - Cable type: Submit proposals.
  - Cable size: submit proposals.
  - Cable length (maximum): 250 mm.
  - Cable installation: Tightly bind connecting leads together.
- Fuse protection: Provide fuse protection to transient overvoltage surge suppression devices.
- Isolation: Not required.

650 LABELLING

- Electrical equipment: Labels indicating the purpose of the equipment.
- Safety signs: Install where voltages above ELV exist.
- Voltage warning notices: Label equipment where voltage exceeds 230V.
- Format: To BS 5499-5. Include warnings of the voltage present.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.28 JB G1547**
Performance Specification Title	**Photovoltaic System**	Date	**August 2014**
Prepared By	**JB**	Checked By	**BR**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	BR
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
PHOTOVOLTAIC SYSTEMS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central energy centre to the South of the hospital houses heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Performance Specification shall include, but not be limited to the following:-

- Photovoltaic systems
- AC/DC switchgear and associated cabling.
- Roof mounted cable containment.
- Connection to LV system in accordance with G59/2.
- Metering
- Roof mounting and fixing system including ballast.

3.0 PERFORMANCE SPECIFIED SYSTEMS

The Photovoltaic System is performance specified and this specification outlines the requirements to be met by the system.

4.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this element of the performance specification:

- Main cable containment within the building from roof level to the basement LV switchboard.
- Final connection to the LV switchboard.

5.0 INTERFACES AND DEMARCATIONS

The Project Co. specialist shall liaise with the services engineer, structural engineer and architect to ensure that his design co-ordinates with the building fabric, roof make up, electrical and mechanical services in the plant room, roof drainage outlets and gullies, lightning protection, ventilation turrets, structural elements and all other elements of the building and the installations therein. The specialist shall liaise with all relevant and interested parties regarding the design of the PV system, specification of components, the method of fixing to the roof, any impact on roof drainage outlets, penetrations through the roof for cables, point of connection to the electrical installation.

6.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of current legislation, regulations and industry standards unless otherwise stated.

7.0 DESIGN CRITERIA

Drawings

Project Co. shall prepare general arrangement drawings of the Photovoltaic System coordinated with other services and building elements.

The drawings shall indicate as a minimum:

- Locations of components
- Wiring routes
- Wiring diagrams
- Cable containment provision
- Interfaces with the building and with the electrical infrastructure
- Roof mounting details
- Switchboard locations and sizes
- Any drawings necessary to satisfy the requirements of this specification as regardstechnical submittals

8.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

The Hospital. Project Co. shall include for liaison in conjunction with the Board with members of the Hospital's team with an interest in the planning and administration of the Photovoltaic System.

9.0 SYSTEMS

9.1 Photovoltaic System

General

For the avoidance of doubt, this is a Performance Specification. The specialist shall as a minimum:

- Proactively produce the design
- Agree and record key design decisions
- Produce installation drawings and specifications
- Submit proposals for review
- Advise on necessary liaisons with supply authorities
- Submit design proposals where required in the Materials and Workmanship clauses
- Procure, install and commission the PV systems

Array

The system shall be designed for a net area of 80m2, achieved from an array of PV panels horizontally mounted mounted onto the building roof.

The solar photovoltaic system shall consist of a number of individual panels connected in series, mounted on a proprietary fixing system. Each panel shall be made of Polycrystalline cells and shall be provided with a framework support system coordinated with the roof system. The panels shall have an efficiency no less than 14.5% understand test conditions.

The panels shall then be connected as a single or multiple string, complete with all meters and isolators, to an appropriate number of inverters, which shall be located within a dedicated GRP style enclosure at roof level within the external plant enclosures. The direct current (DC) electricity generated fed into the inverter will be converted into a standard 230V / 400V alternative current (AC), which shall be feed into a dedicated LV distribution board, located within the LV switchroom at ground level. Depending on the load generated the specialist will be responsible to provide sufficient number of inverters to be able to handle the maximum generated capacity of the particular array.

The DC wiring shall be provided as high quality solar cable resistant to UV light and high temperatures. The DC strings shall be provided with all plugs and sockets required to ensure a complete and operational system. The DC cable size shall be designed by the PV specialist to suit each array.

A DC isolator shall be provided on the DC side of the inverters, located immediately adjacent to the invertors and labelled appropriately. On the AC side there shall be an AC isolator with the facility to lock off, also labelled appropriately. Each incoming DC string to each inverter will require a DC isolator and an AC isolator.

XLPE/LSF armoured cable/s shall be provided from the inverter, run on containment within the GRP enclosure, and terminated at the MCB/MCCB in the distribution board.

The array shall have a low reflectance so as not to create glare that may impact on the use of the tower roof level helipad.

Electrical equipment

The PV specialist shall provide all panelboards, distribution board, c/w incoming and outgoing MCB/MCCB circuit protection, to be located within the plantroom for the incoming AC supplies from the PV systems and the connection of the grid via an import/export meter and the utility connection.

Switchboards shall be form 4 type 2.

The system shall be installed by the specialist Board c/w all meters, isolators and G59 synchronization relays as necessary.

All metering shall be provided at the ground level within the LV switchroom, as a FIT meter for measuring the generated electricity. The metering shall be linked on a site wide BUS network for central monitoring of the side wide PV system electricity generation at the management suite.

There shall be provided a structural support system by the PV specialist together with additional framing systems required to integrate the PV system with the structural and architectural building elements. The PV Specialist shall liaise with the roof Boards, the Structural Engineer and Architect to determine the appropriate mounting and fixing type.

The PV specialist shall advise the structural engineer of loadings and wind pressure, and shall incorporate suitable fixings to ensure a structurally sound integrated installation.

All systems, inclusive of any framing, shall be earthed and bonded to the lightning protections systems at roof level and surge protection devices shall be provided at each distribution board.

All PV panels shall be fully accessible for maintenance purposes.

Refer to specification WW-532-201 Low Voltage Distribution.

Refer to specification WW-532-247 Common Electrical Materials and Workmanship Clauses for clauses relating to Low Voltage Cabling, Electrical Identification, Conduit, Trunking and Ducting, Cable Supports and Electrical Accessories.

V14 Photovoltaic systems

GENERAL

110 GRID CONNECTED PHOTOVOLTAIC SYSTEM

- Located on the roof.

- System manufacturer: Microgeneration Certification Scheme accredited.
- PV modules: Required.
  - Mounting: Proposals to be submitted including earthing as required.
- By-pass diodes: Required.
- String fuses: Required.
- Blocking diodes: Required.
- d.c. switchboard: Submit design proposals.
- d.c. isolation switches: Submit design proposals.
- Junction boxes to connect parallel arrays: Required.
- Power conditioning units (PCUs): Required.
- a.c. switchboards: Submit design proposals.
- a.c. isolation switches: Submit design proposals.
- Energy meters: Required.
- Cable type: Submit design proposals. LSF insulation required. - Sizes: Submit design proposals.
- Rewireable installation: Required.
- Concealed installation: Required.
- Cable containment: Submit design proposals. Containment shall be galvanised steel.
- Ensure cables are protected from the heating and UV effects of direct sunlight.
- Lightning protection: Submit design proposals, make provision for bonding to lightning protection system.
- Transient over-voltage surge suppression devices: Submit design proposals.
- Accessories: Submit design proposals.

SYSTEM PERFORMANCE

210 DESIGN

- Design: Complete the design of the photovoltaic system.
- Standards: To IEC 60364-7-712, to BS 7671, to BS EN 62124 and in accordance with BS 6399-2, ER G59/2-1 and ER G83/1-1.
- Testing and commissioning: Incorporate adequate measures to allow full testing and commissioning of the completed system.
- Proposals: Submit drawings, technical information, calculations and manufacturers' literature.
- Approvals: Obtain written approval of the Electricity Distributor and Obtain planning approval from the relevant authorities.

230 ELECTRICAL ARRANGEMENT

- Arrangement: Submit proposals. Submit wiring diagrams. Submit proof of compliance with BS7671.

240 PHOTOVOLTAIC ARRAYS

- PV array: Inter-connect modules to form an array.
  - Nominal output:
    Power: nominal output of total array.
    Voltage: Submit proposals.
    Current: Submit proposals.

PRODUCTS

310 PHOTOVOLTAIC MODULES

- Standard: Submit proposals.
- Manufacturer: Microgeneration Certification Scheme accredited.
  - Product reference: Submit proposals.
- Type: Framed modules.
- Colour: Submit proposals – liaise with architect.
- Module interconnections: Submit proposals.
  - Module connectors: Suitably rated for the applicable d.c. voltage and current.
  - Protection to BS EN 61140: Class II.
  - Degree of ingress protection to BS EN 60529: Submit proposals.
  - Safety labelling: "Danger, do not disconnect under load. Isolate a.c. supply at inverter first".
- Module rating: submit proposals.
- Nominal output of module:
  - Power : submit proposals.
  - Voltage: Submit proposals
  - Current: Submit proposals
- Output warranty: 80% power output after 25 years.
- Framework material: Submit proposals.

315 MOUNTING FRAMEWORK

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.

320 BY-PASS DIODES

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Type: Submit proposals.
- Minimum rating: 1.25 x string short circuit current, and 1.15 x string open circuit voltage.

330 STRING FUSES

- Standard: To BS EN 60269-1.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Type: Submit proposals.
- Minimum rating: Submit proposals.

340 BLOCKING DIODES

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Type: Submit proposals.
- Minimum rating: 1.25 x string short circuit current, and 2 x string open circuit voltage.

350A D.C. JUNCTION BOXES

- Standard: Submit proposals.
- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Material: Non-conductive.
- Degree of protection to BS EN 61140: Class II.
- Degree of ingress protection to BS EN 60529: Submit proposals.
- Separate positive and negative junction boxes: Required.
- Bus bar rating: submit proposals.
- Removable string fuses: Submit proposals.
  - Fuse rating: Submit proposals.
- String isolators: Submit proposals.
  - Type: Double pole switch-disconnector.
  - Rating: Submit proposals.
- Test points: Incorporate.
- Labelling:
  - Identification labels: "PV array junction box".
  - Safety labels: "Danger, contains live parts during daylight".

380 D.C. BATTERY CHARGE CONTROLLERS

- Standards: To pr EN 50314-1, pr EN 50314-2 and pr EN 50314-3.
- Manufacturer: System manufacturer.
  - Product reference: Submit proposals.
- Type: Pulse width modulation (PWM).
- Rating: Submit proposals.
- Degree of ingress protection to BS EN 60529: submit proposals.
- Accessories:
  - Battery temperature compensation;
  - Discharge control;
  - Overcurrent protection;
  - Reverse polarity protection;
  - State of charge display; and
  - Surge protection.

385 ENERGY METERS

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Standard: To BS EN 62052-11.
- Ofgem accreditation: Required.

410 POWER CONDITIONING UNITS

- Standards:
  - To BS EN 61000-3-2;
  - To BS EN 61727;
  - In accordance with ER G59/2-1; and
  - In accordance with ER G83/1-1.

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Degree of ingress protection to BS EN 60529: submit proposals.
- Degree of protection to BS EN 61140: Class II.
- Number required: Submit proposals.
- Arrangement: String inverters.
- Ratings (kW): Submit proposals.
- Input voltage: Submit proposals.
- Output: Three phase and neutral 400/230 V.
- Isolating transformer to BS EN 61558-1: Incorporate in PCU.
- Maximum power point tracker (MPPT): Incorporate in PCU.
- Electricity grid utility interface: Incorporate in PCU.

EXECUTION

620 INSTALLATION GENERALLY

- Installer: Microgeneration Certification Scheme accredited.
- Installation: Submit method statement.
- Standards:
  - To BS 7671.
  - In accordance with ER G59/2-1;
  - In accordance with ER G83/1-1; and
  - To IEC 60364-7-712.
- Materials: Separate dissimilar metallic materials to prevent bi-metallic corrosion.
- Fixing equipment: Fix independently of any other systems installation with zinc electroplated fasteners indoors and stainless steel fasteners outdoors.
- Location of equipment: Conveniently accessible for operation inspection and maintenance.

630 INSTALLING PV ARRAYS

- Standards:
  - To AAMA 501.2-03
  - To BS 5534
  - To BS 7671
  - To BS 8200
  - To BS EN 12154
  - To BS EN 60900
  - To BS EN 60903
  - To BS EN 61140
  - HSE HSG33; and
  - IEC 60364-7-712
- Safety: Use insulated tools, gloves and insulated matting. Only undertake external work in dry weather.
- Location: As drawings.
- Fixings: Suitable for wind loading.
- PV modules: Interconnect.
- Ventilation of PV array: Submit proposals.
- Interconnecting string cable routes: Submit proposals.

640 FRAMEWORK FOR MOUNTING MULTIBOX ASSEMBLIES
- Arrangement and fixings: Submit proposals.
- Treatment to cut metalwork, fasteners and fixings: Zinc-rich paint to BS 4652.
- Paint thickness: At least that of original layer.

650 INSTALLING COMPONENTS
- Location: Submit proposals.

670 INSTALLING A.C. ISOLATION SWITCHES
- Location:
  - Next to power conditioning unit;
  - Next to point of connection to a.c grid; and
  - Submit proposals.

675 INSTALLING D.C. ISOLATION SWITCHES
- Location: Next to power conditioning unit.

680 INSTALLING A.C. SWITCHBOARDS
- Location: Submit proposals.

685 INSTALLING D.C. SWITCHBOARDS
- Location: Submit proposals.

730 INSTALLING POWER CONDITIONING UNITS
- Location: Submit proposals.
- Ventilation: Provide.

740 INSTALLING ENERGY METERS
- Location: Submit proposals.
- Meters to show:
  - a.c. output of complete PV system;
  - d.c. output of each string; and
  - d.c. output of total PV array.
- Digital metering equipment: Connect to building management system.

750 INSTALLATION OF TRANSIENT OVER-VOLTAGE SURGE SUPPRESSION DEVICES
- Location: Submit proposals.

760 CONNECTION TO ELECTRICITY DISTRIBUTION NETWORK
- Standards: In accordance with ER G59/2-1.
- Location: Submit proposals.

770 INSTALLING INTERCONNECTING CABLES
- Cable routes: Submit proposals.
- Point of connection to a.c. grid: Spare way in local distribution board.
- d.c. cabling: Complete before installing PV array.

780 EARTHING AND EQUIPOTENTIAL BONDING
- Standards: To BS 7671, BS 7430, BS EN 62305-3 and BS EN 62305-4.
- Earthing of d.c. section of the system: Not required.

790 CONNECTION TO LIGHTNING PROTECTION SYSTEM

- Standard: To BS 6651.

COMPLETION

910 GRID CONNECTION

- Standards: In accordance with ER G59/2-1.
- Electricity Distributor's approval to operate: Obtain.

920 LABELLING

- Dual supply warning notices (grid connected systems only): Provide danger warning notices stating that the system has a dual supply and is energized from more than one source.
  - Location: PV a.c. isolation switch.
  - Electricity Distributor's approval of text: Obtain.
- PV modules: Label with warning notices describing the presence of live terminals.
- a.c. isolation switches: Label with notices stating "PV system - Point of emergency switching".
- Circuit diagram: Provide at point of interconnection.
- Details of protective settings incorporated in the PCU: Provide at point of interconnection.
- Contact telephone number for the maintainer of the system: Provide at point of interconnection.
- Fuses, terminal blocks and other assembly components: Label describing their purpose.
- Spare fuses: Label, describe their rating and purpose.

930 CLEANING AND GENERAL INSPECTION

- Dust and debris: Remove.
- PV array: Inspect for damage.
- Enclosures: Inspect.
- Earthing: Verify.
- Cable terminations: Inspect.
- Inspection report: Submit.
- Installation checklist in accordance with Appendix C of the DTI report Photovoltaics in buildings -testing commissioning and monitoring guide: Submit.

940 TESTING AND COMMISSIONING GENERALLY

- Standards:
  - To AAMA 501.2-83;
  - To BS 7671;
  - In accordance with ER G59/2-1; and
  - In accordance with ER G83/1-1.
- Method statement: Submit.
- Approval: Obtain written approval of the Electricity Distributor.
- Specialist commissioning engineer: Employ.
- Test equipment calibration certificates: Submit.
- Inspection and testing of electrical system: To BS 7671 and In accordance with

- Electricity Distributor requirements.
- Test for water tightness (for facades and roofing): Not required.
- Pre-commissioning checks: Undertake.
- Witnessing of testing and commissioning: Required.
- Notice before testing and commissioning: 7 days.

950 PRE-GRID CONNECTION COMMISSIONING TESTS

- Inspection and testing of electrical system: To BS 7671 and In accordance with Electricity Distributor requirements.
- PV array performance test: Undertake.
- Test conditions: Minimum irradiation level 600 W/m².
- Controls: Check operation.

960 DOCUMENTATION

- Type test certificates: Submit.
- Factory test results: Submit.
- Site test results and system performance analysis: Submit.
- System commissioning completion certificate: Submit.
- Operation and maintenance instructions: Submit.
- Record drawings: Submit.
- Approval of Electricity Distributor (grid connected systems only): Submit.
- Warranty for system: Submit.
- Microgeneration Certification Scheme: Submit certificate.

970 SPARES AND CONSUMABLES

- Supply the following spares:
  - Deliberately operated devices: 2 of each type and Protective switches.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.30 JB G1547**
Performance Specification Title	**Lighting Installation**	Date	**August 2014**
Prepared By	**JB**	Checked By	**PM**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	PM
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
LIGHTING INSTALLATION

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

APPENDICES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this specification shall include, but not be limited to the following:-

- Lighting installation
- Emergency lighting installation
- Metal encased prefabricated wiring system
- Automatic lighting controls
- Emergency lighting automatic test system

3.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this elements of the specification:-

- Lighting calculations and luminaire selection, refer to Performance Specification WW-541-248
- Helipad lighting (by Project to Specialist)

4.0 INTERFACES AND DEMARCATIONS

The emergency lighting test system shall be integrated with a host Internet Protocol Network which shall support communication, interaction, data transfer and data retrieval from and between the various engineering systems in the building. The emergency lighting test shall be connected to the host network via gateways. The Building Management System (BMS) shall be provided with a Graphical User Interface which shall permit the interrogation of the emergency lighting test system down to component level. It is not intended that the BMS shall control the system but rather shall monitor component status and provide fault alarm indication at the Graphical User Interface.

5.0 APPLICABLE STANDARDS

All elements of the works shall comply with the requirements of current legislation, regulations and standards stated in materials and workmanship clauses.

The general lighting system shall comply with CIBSE Code for Interior Lighting BSEN12464-1, CIBSE Lighting Guide 2 ‘Hospitals and Health Care Buildings’, CIBSE LG3, LG7 & LG11, BS4533, SHTM06-01 and Table 1 (and it's accompanying notes) of the ILE Guidance notes for the reduction of obtrusive light - 2011,.

The emergency lighting system shall comply with BSEN 1838, BSEN 50171, BSEN 50172, BS 5266-1, BS 5266-8, relevant European Directives, BS 7671, CIBSE Lighting Guide for Lighting in Hospitals and Healthcare Premises (LG2) & LG 12, , CIBSE technical memorandum TM12, SHTM 06-01, BSEN 12464-1.

6.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

7.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital’s Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

8.0 LIGHTING INSTALLATION

8.1 Lighting

Wiring

The distribution board ways allocated to internal lighting shall be indicated on the distribution board schedules. Lighting circuitry and switching details shall be shown on the design drawings. Lighting circuits shall be wired by means of 2.5 mm^2 LSZH thermosetting insulated single core copper conductors with 2.5 mm^2 earth, protected by 10 A Type C mcbs. Circuit breakers shall be selected to withstand the fault levels indicated on LV schematic diagrams. The only exception to this rule is that examination lamps and circuits serving bath and shower room lighting shall be protected by means of 10A, 30mA RCBOs; affected circuits are clearly identified on the drawings.

The residual current characteristic these RCBOs shall be A type (not to be confused with type A, B, C, D overcurrent characteristic of MCBs and RCBOs).

Refer to Common Electrical Clauses WW AP.1.2.2 Clause V32 for cable specifications.

A and B side cables shall be run in separate containments.

The wiring system shall generally be a metal encased prefabricated wiring system. Armoured flexible conduits shall be laid on wire cable baskets. Refer to accompanying clause V50.

The electrical containment drawings indicate routes and sizes of wire cable baskets for metal encased prefabricated wiring. The Board's prefabricated wiring system provider shall inspect the drawings and confirm the adequacy of the wire cable baskets shown.

An exception to the above is lighting in areas with inaccessible ceilings, such as in Theatre suites, in which case the wiring and conduit system shall be by means of the 'loop-in' system where access to wiring shall be at accessories and luminaires only.

Through access luminaires which shall permit services access into the ceiling void through the body of the luminaire are to be installed in the following areas with Category 1 ceilings (ceiling categories as per the ADB Room Data Sheets)

i) Operating theatres
ii) Anaesthetic rooms

Installation Requirements

Final luminaire locations shall be indicated on the reflected ceiling plans.

Flush-mounted modular luminaires, which are to be installed in exposed grid suspended ceilings, shall generally be supported by the ceiling grid. Where a concealed suspended ceiling is used, support brackets shall be provided by the luminaire manufacturer to suit the specified ceiling grid construction.

Luminaires to be installed recessed in suspended non-modular plasterboard or similar ceilings shall generally be supported by the ceiling, with suitable fixings to suit the specified ceiling grid construction.

Recessed luminaires shall be tied back to the soffit to prevent fall.

Surface-mounted luminaires mounted on suspended ceilings shall be supported from the ceiling grid using methods appropriate for the type of ceiling and the particular luminaire.

Luminaires which are smaller than the ceiling grid module shall be mounted on the ceiling tiles using a suitable non-combustible backing board (provided and cut by ceiling Board).

Project Co. shall ensure that the ceiling installer is made aware of the weights and positions of luminaires so that adequate supports and trimmers can be provided. Heavy luminaires that exceed the maximum weight limits of the ceiling type used shall be supported from the soffit.

Lamps, Diffusers and Louvres

Luminaires shall be supplied complete with lamps, louvres and diffusers attachments, as specified in the Luminaire Schedule. All prismatic diffusers shall be of the TP(a) type.

Lamps shall be as specified in the Luminaire Schedule.

The luminaire schedule indicates luminaires which shall be fitted with lamps with a colour rendering index Ra ≥90. All other lamps shall have a colour rendering index Ra ≥ 85.

Illuminated Warning Signs

Refer to clauses 405A & 405B in Materials & Workmanship section V59.

Illuminated warning signs shall be provided as detailed in the equipment schedule.

Laser and x-ray warning lights shall be interfaced with the laser/x-ray machines.

The mounting heights/locations shall be installed in strict accordance with the drawings, wall elevations and manufacturer requirements.

The wording on the illuminated signs shall be as detailed on the Room Data Sheets unless advised otherwise by manufacturer.

Theatre Operating Table Luminaires

Refer to equipment schedule for details.

The mountings shall be supported off the structural soffit, which is reinforced concrete. In particular, the positional, height and levelling requirements of the mounting stem shall be fully complied with. The height and levelling (vertical and horizontal) are particularly important in order to allow proper operation. Project Co. shall either employ the operating light specialist to install the stems for all operating lights, or shall have the installation monitored and verified by the operating light specialist to ensure that all such requirements are complied with.

Power supply units for the luminaires shall be located in theatre plant room. The luminaires shall incorporate a no-break battery backup of 3-hour duration. Batteries shall be VRLA with a life expectancy of 10 years. Conduit wireways to each luminaire shall be provided for camera cabling.

Plantroom Lighting

Final mounting heights and layout shall suit final plantroom layouts.

Examination Lights

Refer to equipment schedule for details. The mountings shall be supported off the structural soffit, which is reinforced concrete. The mounting stems of ceiling-mounted lights shall be installed in strict accordance with the specialist supplier/manufacturer's instructions, especially concerning heights and levels (vertical and horizontal). The luminaire supplier shall confirm fixing details and structural loads for approval.

Automatic Lighting Control

A global automatic lighting control system shall be installed which through the means of automatic controls shall make use of available daylight where described elsewhere in this specification, regulate lighting levels, monitor luminaires for lamp failure and permit easy reconfiguration.

The automatic lighting control system shall be run over the KNX BMS system and all components used shall be KNX/DALI compatible.

The system shall include a head end in the security room which shall provide the ability to control, monitor and schedule lighting.

The following paragraphs the automatic lighting control philosophy within various areas, refer also to the lighting control schedule in Appendix B.

<u>Absence Detection where Indicated on the Drawings.</u>

Manual switching shall be provided to turn lighting "ON" and "OFF". In addition, automatic presence detectors shall be provided in these areas for switching "OFF" lighting when areas are unoccupied. Presence detectors shall not switch lighting on. Automatic presence detectors shall be provided with adjustable time delay and shall be set to 10 minutes.

In general absence detection will be required to:

- Offices
- Consulting rooms
- Interview rooms,

Further guidance is provided in Appendix B.

The sequence of operation shall be:-

i) Operation of manual switch at entrance to room shall turn lighting “ON”.

ii) Subsequent operation of manual switch whilst lighting is illuminated shall switch lighting OFF.

iii) After a predetermined unoccupied period (achieved by the adjustable time delay on automatic presence detector) the automatic presence detector shall switch lighting “OFF”.

The above shall require switching of the momentary retractive type.

Presence Detection where Indicated on the Drawings

Automatic presence detectors only shall be provided for switching lighting “ON” when areas are occupied and switching lighting “OFF” when areas are unoccupied. No light switches shall be provided in these rooms. Automatic presence detectors shall be provided with adjustable time delay which shall inhibit the extinguishing of luminaires for a predetermined period. The time delay shall be set to 20 minutes.

In general presence detection will be required to:

- Bedroom En-Suites
- Store rooms
- Linen cupboards
- Toilets
- Bathrooms
- Ward kitchens/pantries
- Plant rooms (see lighting control matrix)
- Services risers/cupboards
- Shower rooms
- Changing rooms
- Departmental corridors and hospital streets (but see below)

Further guidance is provided in Appendix B.

The sequence of operation shall be:-

i) Upon entrance to room and whilst the room is occupied the automatic presence detector shall turn lighting “ON”.

ii) Upon exit from the room and whilst the room is unoccupied after a predetermined unoccupied period (achieved by the adjustable time delay timer on automatic presence detector) the presence detector shall switch the lighting “OFF”.

The presence detection in the departmental corridors and hospital streets shall be configured such that after a predetermined unoccupied period the presence detection shall regulate the lighting to 50% on schematic of normal output rather than 0% (i.e. the space is always illuminated).

Atrium Lighting Control

The lighting within the atrium will be automatically controlled as detailed in the section above.

Ceiling mounted automatic presence detectors shall be located within the occupied areas and shall control the lighting in the detection areas.

The lighting control system within the Atria shall be configured to permit different lighting 'scenes' as detailed by the lighting designer and agreed with the Board.

Note that the luminaires delivering the lighting within the Atrium comprise a mix of different forms of control gear such as DALI, 1-10V, & HF ballasts therefore provision shall be made to ensure all luminaires can be switched by the same action.

Daylight Linking

In rooms provided with automatic absence detection and which benefit from natural daylight, luminaires near the windows shall be automatically dimmable, regulated by the amount of daylight available. Any deviation from this shall require prior agreement with the Board. Combined presence/daylight sensors shall be utilised to achieve this requirement and shall directly switch/regulate the luminaires. Manual override of automatic dimming is not required. This does not apply to departmental corridors or hospital streets.

The sequence of operation shall be as follows:-

i. Unoccupied room, lights "off".
ii. Person enters room – makes decision not to turn on lighting. Lights remain off, regardless of daylight availability.
iii. Person enters room- makes decision to turn on lighting. Press retractable light switch(es) – luminaires "on".
iv. Daylight sensor checks available light and regulates luminaires nearest window to achieve a preset lux level. Luminaires shall not be regulated to less than 10% of their normal output. (This is to reassure occupant that luminaires are not defective.)
v. As daylight fluctuates luminaire output shall be adjusted (after pre-set time delay).
vi. Person leaves room – manually extinguishes lighting. In the event that person does not manually extinguish lighting after a predetermined unoccupied period all lighting shall be switched off.

Note that the daylight linking system does not interface with the blinds. If the blinds are closed, no benefit can be had from natural daylight therefore the lights will not dim automatically.

Daylight Control of Bedroom Lighting

Bedrooms will not be provided with movement detectors, however the luminaire nearest the window shall be daylight controlled as follows:

An external light sensor shall be fitted to each face of the ward accommodation to control appropriate luminaires.

The mode of operation shall be as follows:

- It shall not be possible to switch on the controlled luminaire nearest the window if there is sufficient daylight.
- When there is insufficient daylight it shall be possible to switch on the controlled luminaire manually.
- The external light sensor shall not automatically switch on the luminaire.
- When there is sufficient daylight the light sensor shall automatically switch off the luminaire.
- A light switch shall be provided in the bedroom which shall allow the luminaire to be switched on ONLY when there is insufficient daylight available.

The above provision will be a relatively crude means of energy conservation and will require careful 'tuning' over a period of several days. The light sensors shall be adjusted so that the luminaire nearest the window in the lowest floor bedrooms cannot be switched on when the daylight available in the half of the room nearest the window reaches 100 lux average.

Further details to provide via a technical submission.

Daylight Control of Atria Lighting

The Atria lighting shall be daylight linked regulated by the amount of daylight available to achieve the illumination levels stated in the Environmental Matrix.

External light sensors shall be fitted externally to the Atria in appropriate locations. These sensors are independent of those required for the daylight control of bedroom lighting.

Ward Corridors

Ward corridors shall be provided with manual switches to permit staff to regulate light output to preset levels of 0%, 50% or 100% Refer to lighting layouts for switch locations.

Manual Switching

The lighting drawings shall indicate switching arrangements and nominal locations of lighting switches. The Architect's loaded 1:50 drawings shall be used for final locations of switches, and they shall be assessed in relation to Scottish Building Regulations.

Where several accessory plates are located together, these shall be mounted at the same height, in a horizontal row, as appropriate, unless indicated otherwise on Architects drawings.

All lighting outlet boxes shall be fitted with an earth screw terminal pillar. Accessory units shall be bonded to this terminal using green/yellow coloured LSF insulated cable in compliance with BS7671.

Light switch back boxes in imaging rooms shall be plastic.

Light switches shall be recessed within wall finishes.

Surface mounted switches shall be of the metal-clad pattern.

Plate and grid switches shall be rated at 20 A, rated for high frequency ballast / inductive load.

Pull cords shall be ceiling-mounted independently supported and provided where indicated on the lighting drawings.

Permanent labelling shall be provided on all multi-gang light switches, identifying each switch control. This shall be carried out using a proprietary labelling system.

Ward switches shall be labelled to indicate general lighting and night lighting.

Where reading lights for patient use are provided at bedheads they shall be controlled by a switch at the bedhead and at the patient handset.

Samples of the labelling system shall be provided prior to installation for approval.

Lighting switches shall be IP56 protected where indicated as splash-proof on the Room Data Sheets.

Manual Dimming

Manual dimming shall be provided in clinical areas where required for the operation of the room.

A schedule shall be provided to indicate the extent of dimmable rooms.

LED/Fluorescent luminaires, which are to be manually dimmed, shall have control gear suitable for dimming and shall be controlled by momentary retractive switches. The same switches shall provide the on/off control. All dimming shall be via digital control ranging from 1% to 100% of normal output. Luminaire dimmable control gear shall be fully compatible with the selected dimmer controllers. It shall be the responsibility of to ensure that selected dimmable high frequency control gear and dimmers shall be mutually compatible.

Consideration shall be made to the inrush current on the dimming controls when the luminaires are first switched on. Appropriate rating of the dimmer switch shall be made for this.

8.2 Emergency Lighting

General

Self-contained units shall be utilised throughout and shall be connected to an addressable emergency lighting test system to reduce the maintenance burden.

Addressable Emergency Lighting System

The system shall comprise:-

- Central control and reporting computer
- Local test panels
- Addressable emergency lighting luminaires fitted with test interface
- Hand held programmers (1 and spare)
- Networking Cabling

The central PC for the test system shall be located in the main control room in the FM department, exact location to be agreed.

Each self contained emergency lighting luminaire shall be fitted with a test interface which shall communicate with the central control PC via a control bus. Each test interface shall be allocated a unique address code.

The test system shall enable scheduling of testing so that tests are automatically carried out at a convenient time. The system shall enable groups of luminaires to be tested on a rolling schedule to minimise disruption. The system shall be configured so that no area is left without cover even immediately after a full discharge.

The system shall continuously monitor the health of all connected components and provide fault alarms within seconds.

The test system shall log failures.

The system shall provide pinpoint location of any items in need of attention.

Local test panels shall be networked and shall provide central control and reporting. Test panels shall be loaded to no more than 80% of full capacity. It is preferred that the central battery self-test system and the self-contained emergency test systems shall form an integrated networked whole.

The test system shall suit all lamp types specified.

Batteries shall be 5 year design life.

Control wiring shall be installed in accordance with the manufacturer's recommendations, with particular reference to voltage drop limitations.

The Board shall submit details of his proposed test system.

Manual Emergency Lighting System

Emergency luminaires within tenanted retail units will be tested manually by key switches. These luminaires will not be linked to the central addressable emergency lighting system. The tenant shall be responsible for the testing of their own luminaires.

External Lighting

Refer to WW-A.P.1.32 for further details.

V50 General lighting systems

To be read with Preliminaries/ General conditions.

GENERAL

110 HARD WIRED GENERAL LIGHTING SYSTEM GENERALLY

- Origin of supply: Low voltage distribution system, as section V30.
- Final circuit cabling:
  - Types: LSZH singles, as section V32.
  - Sizes: As Circuits schedule.
- Containment: Rigid conduit, as section Y60 or Trunking or ducting, as section Y60.
- Rewireable installation: Required.
- Concealed installation: Required.
- Partial installation: Not required.
- Connections to luminaires: Ceiling roses/connector.
- Luminaires and lamps:
  - Luminaire types: As section V59.
  - Lamp types:
  - Tungsten halogen lamps, as section V59;
  - Tubular fluorescent lamps, as section V59 ;
  - Two and four pin compact fluorescent lamps, as section V59;
  - Self ballasted compact fluorescent lamps, as section V59;
  - Metal halide lamps, as section V59;
  - High pressure sodium lamps, as section V59;
  - Low pressure sodium lamps, as section V59; and
  - High pressure mercury lamps, as section V59.
  - Operating voltage: Low voltage and Separated extra low voltage.
- Lighting controls:
  - Light switches, as section Y65;
  - Dimmer switches and controls, as section Y65; or
  - Separate combined daylight and occupancy detection, as section V51.
- Completion:
  - Electrical identification: As section V80.

120 GENERAL LIGHTING SYSTEM WITH PREFABRICATED WIRING GENERALLY.

- The Board shall ensure that there is at least one spare circuit available in each home run cable.

Origin of supply: Low voltage distribution system, as section V30.

- Standards
  System generally: BS 8488
  Connectors: BS EN 61535 and BS EN 61984 as appropriate

Final circuit cabling:

- Types: Prefabricated LSZH insulated singles metal encased in flexible conduit.
- Sizes: As Circuits schedule.
- Containment: Cable basket, as section Y63.
- Rewireable installation: Required.
- Concealed installation: Required.
- Partial installation: Not required.

- System components:
  - Home run cables;
  - Lighting circuit distribution boxes;
  - Lighting extender leads;
  - Luminaire connection cables;
  - Master distribution boxes;
  - Starter leads;
  - Switch connection leads;
  - Switch modules; and
  - T connector.
- Connections to luminaires: 'T' connector.
- Luminaires and lamps:
  - Luminaire types: As section V59.
  - Lamp types:
  - Tungsten halogen lamps, as section V59;
  - Tubular fluorescent lamps, as section V59 ;
  - Two and four pin compact fluorescent lamps, as section V59;
  - Self ballasted compact fluorescent lamps, as section V59;
  - Metal halide lamps, as section V59;
  - High pressure sodium lamps, as section V59;
  - Low pressure sodium lamps, as section V59; and
  - High pressure mercury lamps, as section V59.
  - Operating voltage: Low voltage and Separated extra low voltage.
- Lighting controls:
  - Light switches, as section Y65;
  - Dimmer switches and controls, as section Y65; and
  - Separate combined daylight and occupancy detection, as section V51.
- Completion:
  - Electrical identification: As section V80.

PRODUCTS

305 PREFABRICATED WIRING PRODUCTS GENERALLY

- Connectors:
  - Standard: To BS 61535 and BS EN 61984 as appropriate. Submit certification
  - Type: Board's choice.

310A CEILING ROSES/CONNECTORS

- Standard: To BS 67.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Rating: 6 A.
- Mounting type: Submit proposals.
- Connection type: Plug-in.
- Flex length (maximum): 3 m (unclipped to allow easy replacement).
- Colour: White.

315 HOME RUN CABLES Prefabricated wiring system.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Cable type: Prefabricated LSZH insulated singles metal encased in flexible conduit.
  - Number of cores: 6 or 9 circuit.
  - Size: Board's choice.
- Length: Board's choice.
- Connector arrangement: One fully shrouded male connector and one free cable end.

320 LIGHTING CIRCUIT DISTRIBUTION BOXES Prefabricated wiring system.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Distribution box: Galvanized sheet steel with recessed input and outgoing connections.
- Connectors:
  - Power input connection: Via prefabricated wiring and plug-in connectors .
  - Power output connector: Fully shrouded female connector.
- Outgoing connections:
  - Quantity: Board's choice.
  - Poles: Board choice.

330 LUMINAIRE SUPPORTING COUPLERS General.

- Standard: To BS 6972.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Rating: 6 A.
- General luminaires: White plug with white cover.
- Emergency luminaires: Red plug with red cover.
- Plug type: Rewireable, independent.
  - Pin configuration: To suit requirements for KNX/DALI system.
- Cable type: Manufacturer's standard.
  - Cable size: 0.75 mm².
- Flex length (maximum): 2 m.

335 PREFABRICATED LSZH INSULATED SINGLES IN FLEXIBLE CONDUIT

- Standards:
  - Cable: To BS 7211.
  - Flexible conduit: To BS EN 61386-23. Submit certification
- Approval: British Approvals Service for Cables (BASEC) certified.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Flexible thermosetting insulated single core cables (LSZH singles, H07Z-K):
  - Construction: To BS 7211, table 3b.

345 LIGHTING EXTENDER LEADS Prefabricated wiring system.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Cable type: Prefabricated LSZH insulated singles metal encased in flexible conduit.
  - Number of cores: Board's choice.

- Size: Board's choice.
- Length: Board's choice.
- Connectors:
  - Arrangement: One fully shrouded male connector and one fully shrouded female connector.
  - Poles: Board choice.

350 LUMINAIRE CONNECTION CABLES Prefabricated wiring system.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Cable type: Prefabricated LSZH insulated singles metal encased in flexible conduit.
  - Number of cores: Board choice.
  - Size: Board's choice.
- Length: Board's choice.
- Connectors:
  - Arrangement: Board choice.
  - Poles: Board choice.

355 MASTER DISTRIBUTION BOXES Prefabricated wiring system.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Distribution box: Galvanized sheet steel with recessed input and outgoing connections.
- Rating: 16 A.
- Connectors:
  - Power input connection: Hard wired via home run cable.
  - Power output connector type: Fully shrouded female connector.
- Outgoing connections:
  - Quantity: Board's choice.
  - Poles: Board choice.

360 SWITCH CONNECTION LEADS Prefabricated wiring system.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Cable type: Prefabricated LSZH insulated singles metal encased in flexible conduit.
  - Number of cores: Board choice.
  - Size: Board choice.
- Length: Board choice.
- Connectors:
  - Arrangement: One fully shrouded male connector and one free end.
  - Poles: Board choice.

365 STARTER LEADS Prefabricated wiring system.

- Manufacturer: Board choice.
  - Product reference: Board choice.
- Cable type: Prefabricated LSZH insulated singles metal encased in flexible conduit.
  - Number of cores: Board choice.
  - Size: Board choice.
- Length: Board choice.

- Connectors:
  - Arrangement: Board choice.
  - Poles: Board choice.

370 SWITCH MODULES Prefabricated wiring system.

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Type: Board choice.
- Cable type: Prefabricated LSZH insulated singles metal encased in flexible conduit.
  - Number of cores: Board choice.
  - Size: Board choice.
- Rating: 16 A.
- Length: Board choice.
- Connectors:
  - Arrangement: One fully shrouded male connector and one fully shrouded female connector.
  - Poles: Board choice.

375 T CONNECTORS Prefabricated wiring system.

- Standard: To BS EN 61535. Submit certification
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Type: Board's choice.
- Cable type: Prefabricated LSZH insulated singles metal encased in flexible conduit.
  - Number of cores: Board choice.
  - Size: Board choice.
- Length: Board choice.
- Connectors:
  - 'T' arrangement: One fully shrouded male connector and one fully shrouded female connector.
  - Connection to luminaire: Fully shrouded male connector.

EXECUTION

610 INSTALLING GENERAL LIGHTING SYSTEMS

- Standard: To BS 7671.

640 LIGHTING CIRCUITS

- Rooms smaller than 4 m²: Restrict lighting circuits to one electrical phase.

650 MANUAL CONTROLS

- Location: As drawings.
- Staircases: No switching except into plant areas.

660 INSTALLING PREFABRICATED WIRING

- Connection arrangement: Form circuits using a male connector working away from any master distribution boxes.
- Fixing master/ lighting distribution boxes: Suspended from drop rods.

- Fixing cabling:
  - Maximum distance between clips:
    Prefabricated LSZH insulated singles metal encased in flexible conduit: 1500 mm.
  - Clipped in accordance with manufacturers recommendations.
  - Bends: Not permitted within 150 mm of connectors.

COMPLETION

905 TESTING AND INSPECTION OF FIXED ELECTRICAL WIRING

- Testing and inspection: To BS 7671.
- Test results: Submit.
  - Number of copies: 2.

910 TESTING AND COMMISSIONING OF GENERAL LIGHTING SYSTEMS

- Commissioning: In accordance with CIBSE Commissioning code L
- Controls: Check operation.
- Lamps: Check operation.
- Test results: Submit.
  - Number of copies: 2.

920 PHOTOMETRIC SURVEY

- Standard: In accordance with CIBSE Code for lighting.
- Locations: One sample of each room type.
- Daylight control: Full blackout.
- Average illuminance measurement method: Full grid.
- Illuminance variation measurements:
  - Diversity.
  - Uniformity.
- Measured values: Submit.
- Maintained average illuminance: Submit based upon measured values.
- Illuminance variation:
  - Diversity: Submit based upon measured values.
  - Uniformity: Submit based upon measured values.
- Survey photographs: Submit for each location.

930 DOCUMENTATION

- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system
- Operation and maintenance instructions: Submit.
- Plug & play schedule of components: Submit.
- Record drawings: Submit.
  - Number of copies: 2.

V51 Automatic lighting controls

To be read with Preliminaries/ General conditions

PRODUCTS

340 PHOTOELECTRIC CONTROL UNITS External
- Standard: To BS 5972.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Equipment interconnectivity: Wired.
- Inductive switching capacity: 25 A.
- Minimum degree of ingress protection to BS 60529: IP56.
- Switching settings:
  - Adjustable switching time delay: Required
  - On lighting level: Adjustable.
  - Off lighting level: Adjustable.
  - Timed on: Programmable 7 day 24 h clock.
  - Timed off: Programmable 7 day 24 h clock.
- Remote setup/ override: By infrared controller
- Mounting: Outdoor.

350 INTERNAL DAYLIGHT SENSOR
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Equipment interconnectivity: Wired.
- Daylight sensitivity: Adjustable.
- Remote setup/ override: By infrared controller.
- Mounting: Ceiling .
- Minimum degree of ingress protection to BS 60529: Board's choice.

350A EXTERNAL LIGHT SENSOR
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Equipment interconnectivity: Wired.
- Daylight sensitivity: Adjustable.
- Remote setup/ override: Not required.
- Mounting: Outdoor and Wall .
- Minimum degree of ingress protection to BS 60529: IP44.

360 EXTRA-LOW AUTOMATIC PRESENCE DETECTORS
- Type: Microwave.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Equipment interconnectivity: Wired.
- Occupancy sensitivity: Adjustable.
- Remote setup/ override: By infrared controller.
- Mounting: Ceiling.
- Minimum degree of ingress protection to BS 60529: Board's choice.

370 MAINS VOLTAGE AUTOMATIC PRESENCE DETECTORS

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Type: Microwave.
- Inductive switching capacity: 10 A.
- Occupancy sensitivity: Adjustable.
- Switching delay: Adjustable.
- Remote setup/ override: By infrared controller.
- Mounting: Ceiling .
- Minimum degree of ingress protection to BS 60529: Board's choice.

380 COMBINED PRESENCE/ DAYLIGHT SENSORS

- Manufacturer: Boards choice.
  - Product reference: Boards choice.
- Daylight sensitivity: Adjustable.
- Equipment interconnectivity: Wired.
- Occupancy sensitivity: Adjustable.
- Remote setup/ override: By infrared controller.
- Mounting: Ceiling.
- Minimum degree of ingress protection to BS 60529: Board's choice.

390 REMOTE INFRARED CONTROLLERS

- Quantity: 4.

410 CENTRAL CONTROLLERS

- Type: Microprocessor controlled.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Equipment interconnectivity: Wired.
- Control protocol: Digital addressable lighting interface (DALI) to BS EN 60929 Annex E.
- Inputs:
  - Combined das;
  - Daylight sensors;
  - Extra-low voltage occupancy sensors;
  - Mains voltage occupancy sensors;
  - Photoelectric control units ;
  - Remote infrared controllers; and
  - Laptop computers.
- Outputs: To building monitoring and management system, as section Y41.
- Enclosure: M's standard.
  - Minimum degree of ingress protection to BS EN 60529: IP23.
  - Material and construction: Manufacturer's standard.
  - Finish: M's standard.
- Mounting: Board's choice.

EXECUTION

610 INSTALLATION GENERALLY

- Interconnection: Interconnect sensors, controllers and luminaires.
- Positions of sensors: As drawings.

620 CABLE INSTALLATION GENERALLY

- Standard: To BS 7671.
- Timing: Do not start internal cabling until building enclosure provides permanently dry conditions.
- Cables: Install in one uninterrupted run with jointing at equipment and terminal fittings only.
  - Installation method: Submit proposals.
- Cables routes generally:
  - Concealed cable runs to wall accessories: Run vertically from the accessory.
  - Exposed cable runs: Submit proposals.
  - Cables from other systems: Segregate and cross at right angles.
  - Terminations: Support cable within 150 mm of termination.
- Balanced twisted-pair cabling:
  - Maximum untwist at terminations: 12 mm.

630 INSTALLING PHOTOELECTRIC CONTROL UNITS

- Location: Not influenced by luminaires.
- Connection: To adjacent luminaire .

640 INSTALLING DAYLIGHT SENSORS

- Location: Representative of the daylight level in the area under control.
- Connection: To adjacent luminaire .

650 INSTALLING OCCUPANCY SENSORS

- Location: To suit the occupancy pattern of the area under control. Shield from erroneous influences.
- Connection: To adjacent luminaire .

COMPLETION

910 CLEANING AND CABLE INSPECTIONS

- Detector lenses: Clean using anti static cleaning fluid.
- Cable connections: Verify.

915 LABELLING

- Equipment and sensor identification labels: Provide.
- Central controller: Label describing its purpose.
  - Output circuits: Label.

920 TESTING AND COMMISSIONING

- Commissioning: In accordance with CIBSE Commissioning Code L.
- Notice before commissioning (minimum): 14 d .
- Witnessing: Arrange for site testing to be witnessed by the contract administrator.
- Pre-commissioning checks: Undertake.
- Pre-commissioning certificate: Submit.
- Sensor settings: Submit proposals. Calibrate and commission.
- Test equipment calibration certificates: Submit.
- Operation of sensors and control devices: Check and verify. Submit results.
- System commissioning certificate: Submit.

940 SPARES AND CONSUMABLES

- Manufacturer's recommended spares: Supply one set

V55 Self-contained emergency lighting and signage systems

To be read with Preliminaries/General conditions.

GENERAL

110A SELF-CONTAINED EMERGENCY LIGHTING AND SIGNAGE SYSTEMGENERALLY

- System manufacturer: Submit proposals.
- Origin of supply: Low voltage distribution system, as section V30.
- Final circuit cabling:
  - Cable type: LSZH singles, as section V32.
  - Sizes: As Circuits schedule.
- Containment: Rigid conduit, as section Y60 or Trunking or ducting, as section Y60.
- Rewireable installation: Required.
- Concealed installation: Required.
- Partial installation: Not required.
- Connections to luminaires: Ceiling roses, as section V50.
- Emergency luminaires and lamps
  - Luminaire types: As section V59.
  - Lamp types:
  - Tungsten halogen lamps, as section V59;
  - Tubular fluorescent lamps, as section V59 ;
  - Two and four pin compact fluorescent lamps, as section V59; and
  - Self ballasted compact fluorescent lamps, as section V59.

  Test facility: Automatic test facility.

SYSTEM PERFORMANCE

PRODUCTS

320 EMERGENCY LUMINAIRES GENERALLY

- Standard: To BS EN 60598-2-22.
- Third party product certification: ICEL 1001. Submit certification
- Housing: Locate components necessary for the operation of the luminaire (including batteries, charger, lamp, and control gear) within the luminaire body.
- Indicators:
  - Charging: Green light-emitting diodes.
  - Fault: Flashing red light emitting diodes.
  - Test in progress: Flashing green light emitting diodes.
  - Position within luminaire: Readily visible. Fix to luminaire body.
- Batteries:
  - Standard: To BS EN 61951.
  - Type: Sealed nickel-cadmium.
  - Life (minimum) when operating under normal conditions at 25°C and subject to complete charge and discharge every 6 months: 4 years.
  - Labelling: Indelibly mark with year of manufacture and installation.

330 GENERAL LUMINAIRES RE-ENGINEERED FOR EMERGENCY USE

- Standards: To BS EN 13032-1 and -3.
- Third party product certification: ICEL 1004: Submit completed model test record certificate.
- Photometric data: Submit for re-engineered luminaires.

395 AUTOMATIC TEST FACILITY
- Standard: To BS EN 62034.
  - Type: PRN.
- Manufacturer: Board's choice.
  - Product reference: Board's choice.

EXECUTION

630 INSTALLATION GENERALLY
- Standards: To BS 7671 and in accordance with BS 5266-1.
- Locations: As drawings.

675 INSTALLING AUTOMATIC TEST CONTROLLER
- Location: At BMS front end.
- Interconnections with emergency luminaires: Complete.
  - Cables: Manufacturer's standard.
- Remote data transmission: Required.

678 INSTALLING LUMINAIRE AUTOMATIC TEST MODULES
- Installation: In each emergency luminaire.
  - Position: As manufacturer's recommendation.

COMPLETION

910 INSPECTION AND TESTING
- Inspection and testing: In accordance with BS 5266-1.
- Controls: Check operation.
- Full discharge test: Required. Following restoration of the normal supply verify the operation of charge indicators.
- Results: Submit.

920 EMERGENCY LIGHTING PHOTOMETRIC SURVEY
- Locations: Throughout.
- Timing: During the hours of darkness.
- Extraneous light: Minimize.
- Measured values: Submit, stating levels of extraneous light.

930 DOCUMENTATION
- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system
- Documentation: In accordance with BS 5266-1.
- Certificate of testing: Submit.
  - Standard: In accordance with BS 5266-1, Annex B.
  - Number of copies: 2.
- System log book: Required.

940 CERTIFICATION FOR RE-ENGINEERED LUMINAIRES
- Certification: Submit completed ICEL 1004 model test record certificate.

V59 Luminaires and lamps

To be read with Preliminaries/General conditions.

PRODUCTS

310 LAMPS GENERALLY
- Manufacturer: As recommended by luminaire manufacturer.
- Lamps of the same type and rating: Same manufacturer.
- Fluorescent ballasts: Separate for each lamp.

320 TUNGSTEN FILAMENT LAMPS
- Not permitted

325 TUNGSTEN HALOGEN LAMPS
- Not permitted

330 TUBULAR FLUORESCENT LAMPS
- Standards:
  - Double-capped lamps: To BS EN 60081 and BS EN 61195.
- Lamp diameter: 6 mm and 16 mm.
- Colour temperature: As Luminaire schedule.
- Colour rendering index: As Luminaire schedule.

335 TWO AND FOUR PIN COMPACT FLUORESCENT LAMPS
- Standards: To BS EN 60901 and BS EN 61199.
- Types: As Luminaire schedule.
- Control gear: As Luminaire schedule.
- Colour temperature: As Luminaire schedule.
- Colour rendering index: As Luminaire schedule.

339 SELF BALLASTED COMPACT FLUORESCENT LAMPS
- Standards: To BS EN 60968 and BS EN 60969.
- Type: As Luminaire schedule.
- Colour temperature: As Luminaire schedule.
- Colour rendering index: As Luminaire schedule.

340 METAL HALIDE LAMPS
- Standards: To BS EN 61167 and BS EN 62035.
- Type: As Luminaire schedule.
- Colour temperature: As Luminaire schedule.
- Colour rendering index: As Luminaire schedule.
- Instant re-strike control gear: As Luminaire schedule.
- Integrated protective glass: As Luminaire schedule.

345 HIGH PRESSURE SODIUM LAMPS
- Standards: To BS EN 60662 and BS EN 62035.
- Type: As Luminaire schedule.
- Colour temperature: As Luminaire schedule.
- Colour rendering index: As Luminaire schedule.
- Method of starting: Internal ignitor.

350 LOW PRESSURE SODIUM LAMPS

- Standards: To BS EN 60192 and BS EN 62035.
- Colour temperature: As Luminaire schedule.
- Colour rendering index: As Luminaire schedule.

355 HIGH PRESSURE MERCURY LAMPS

- Standards: To BS EN 60188 and BS EN 62035.
- Colour temperature: As Luminaire schedule.
- Colour rendering index: As Luminaire schedule.

357 INDUCTION LAMPS

- Standards: To BS EN 61347-2-3 and BS EN 60929.
- Colour temperature: As Luminaire schedule.
- Colour rendering index: As Luminaire schedule.

360 AUXILIARY LAMPS

- Function: To provide illumination during main lamp start-up and re-strike periods.
- Lamp type: Tungsten halogen.
- Position: Integral within luminaire.
- Luminaires with auxiliary lamps: As Luminaire schedule.

370 CONTROL GEAR GENERALLY.

- Standard: To BS EN 61347-1.
- Ballasts:
  - Fluorescent lamp ballasts:
  Switched start: To BS EN 60921 and BS EN 61347-2-8. High frequency (A.C supplied): To BS EN 60929 and BS EN 61347-2-3. High frequency (D.C supplied): To BS EN 60925 and BS EN 61347-2-4.
  - Discharge lamp ballasts: To BS EN 61347-2-9 and BS EN 60923.
  - Emergency lighting ballasts: BS EN 60925 and BS EN 61347-2-7.
- Lamp starters generally: To BS EN 61347-2-1 and BS EN 60927.

385 LAMP HOLDERS FOR TUNGSTEN HALOGEN LAMPS

- Lamps<100 W: Bayonet B22d, or Edison screw E27, or Edison screw E14.
- Lamps >100 W,<200 W: Edison screw E27.
- Lamps >200 W: Edison screw E40.

390 BAYONET LAMP HOLDERS GENERALLY

- Standard: To BS EN 61184.
- Type: As Luminaire schedule.
- Material: As Luminaire schedule .
- Protective skirt: Required.
- Mounting: Suspended from ceiling rose.

391 EDISON SCREW LAMP HOLDERS GENERALLY

- Standard: To BS EN 60238.
- Material: As Luminaire schedule.
- Protective skirt: Required.
- Mounting: Suspended from ceiling rose.

392 FLUORESCENT LAMP HOLDERS

- Standard: To BS EN 60400.

395 ENCLOSURES FOR CONTROL GEAR Generally

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Material: As Luminaire schedule.
  - Finish: Match luminaire.
  - Colour: As Luminaire schedule.
- Degree of ingress protection to BS EN 60529: Board's choice.
- Hardware: Cylinder lock and handle. Standardize key type.
- Labelling: Describe control gear purpose.

400 LUMINAIRES GENERALLY General

- Standards: To BS EN 60598-1.
- Approval: Kitemark certified.
- Photometric performance: To BS EN 13032-1.
- Supply circuit conductor connections: Screw terminals .
- Internal fuse: Required for incoming circuit phase connections.

405 LUMINAIRES general

- Manufacturer: As luminaire schedule.
  - Product reference: As luminaire schedule.
- Description: As luminaire schedule.
- Features: As luminaire schedule.
- Ballasts CELMA energy efficiency index (minimum): Manufacturer's standard.
- Control gear position: Integral within luminaire.
- Luminaire power factor: Correct to minimum 0.9 lagging.
- Lamps:
  - Number: As luminaire schedule.
  - Type to PD IEC TS 61231 to ILCOS L: As luminaire schedule.
  - Colour temperature: As luminaire schedule.
  - Colour rendering index: As luminaire schedule.
  - Rating: As luminaire schedule.

405A LUMINAIRES X-Ray, Laser, etc Illuminated Warning Signs

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Legend: As ADB code.
- Mounting: Flush mounted if wall depth permits otherwise surface mounted.
- Lamp: T5 or LED.
- Control gear position: Integral within luminaire.
- Manufactured to BS EN 60598-1.
- To be switched by equipment.

405B LUMINAIRES Do Not Enter, Room In Use, etc Illuminated Warning Signs

- Manufacturer: Submit proposals.
  - Product reference: Submit proposals.
- Legend: As ADB code.
- Mounting: Flush mounted if wall depth permits otherwise surface mounted.
- Lamp: T5 or LED.
- Control gear position: Integral within luminaire.
- Manufactured to BS EN 60598-1.
- To be manually switched within room, refer to Lighting Layouts.

420 AIR HANDLING LUMINAIRES
- Standard: To BS 4533-102.19.

430 SEPARATED EXTRA-LOW VOLTAGE LIGHTING
- Standard: To BS EN 60598-2-23.

440 SEPARATED EXTRA-LOW VOLTAGE LIGHTING TRANSFORMERSGENERALLY
- Standard: To BS EN 61558.
- Type: As luminaire schedule.
- Power rating: Submit proposals.
- Output:
  - Connections: As luminaire schedule.
  - Constant secondary voltage: Maintain irrespective of load.
- Luminaire connections: As luminaire schedule.

450 LIGHTING TRACKGENERALLY
- Standard: As luminaire schedule.
- Type: As Luminaire schedule.
- Class: As luminaire schedule.
- Conductor rating: As luminaire schedule.
- Neutral rating: As luminaire schedule.
- Mounting: As luminaire schedule.

460 LUMINAIRE SMOKE HOODS
- Standard: To BS 476-21.
- Refer to Architect's Fire Strategy drawings.
- Smoke hoods and blankets: Match fire performance of building fabric.

FABRICATION

510 CUSTOM-BUILT LUMINAIRES GENERALLY
- Design and fabrication: Complete the design and fabrication of custom-built luminaires.
- Prototypes: Submit.
- Photometric data: Submit.
  - Standard: To BS EN 13032-1.

520 CUSTOM-BUILT LUMINAIRE General.
- Circumstances of use to BS EN 60598-1: As luminaire schedule.
- Electric shock classification to BS EN 60598-1: As luminaire schedule.
- Degree of ingress protection to BS EN 60529: As luminaire schedule.
- Supporting surface classification to BS EN 60598-1: As luminaire schedule.
- Luminaire light output ratio (minimum): As luminaire schedule.
- Description: As luminaire schedule.
- Features: As luminaire schedule.
- Lamps:
  - Number: As luminaire schedule.
  - Type to PD IEC TS 61231 to LICOS L: As luminaire schedule.
  - Colour temperature: As luminaire schedule.
  - Colour rendering index: As luminaire schedule.
  - Rating: As luminaire schedule.

530 PROPOSALS FOR CUSTOM-BUILT LUMINAIRES

- Content: Submit the following:
  - Overall dimensions.
  - Dimensioned general arrangement drawings, plans, elevations and sections.
  - Degree of ingress protection.
  - Mounting and fixing details.
  - Materials and component details.
  - Details of internal and external paint systems and colour finishes.
  - Means of access to consumable parts.
  - Schedule of labels.
  - Routing of cabling within luminaire.
  - Internal wiring diagrams and location of components.

EXECUTION

610 SAMPLES

- Samples: Before ordering, supply samples of the following luminaires: It is anticipated that samples of each family type shall be provided, a marked up luminaire schedule which details the sample luminaires to be agreed with BM and the Board schedule.
- Submittals: Include manufacturer's technical information with each sample.
- Identification: Label samples with the luminaire references.

620 INSTALLING LUMINAIRES AND LAMPS GENERALLY

- Standard: To BS 7671.
- Location: As drawings.
- Orientation: Parallel with ceiling.
- Lamps and accessories: Provide.
- Supports: Adequate for weight of luminaire.

630 LUMINAIRE CABLE CONNECTIONS

- Cable connection size (minimum): 1.5 mm².
- Conduit mounted: Terminate directly within luminaire.
- Trunking mounted: Terminate directly within luminaire.
- Suspended trunking: From cable connection mounted on side of trunking.
  - Type: Plug and socket outlet to BS 546.
- Rod or chain suspended: Luminaire supporting coupler.
  - Cable type: HR PVC/ PVC cord, clipped to chain or rod. Do not pass cord through chain links.
- Cable entry: Grommet.
- Class 1 earth connections: Connect to luminaire circuit protective conductor.
- Wiring within luminaires: Minimize. Clip at 300 mm intervals.

640 LUMINAIRES MOUNTED AS PART OF A SUSPENDED CEILING

- Luminaire supports: Independent suspension rods.
- Luminaire final connection: Plug and socket outlet to BS 546.
  - Mounting: Surface mounted on side of trunking.
  - Length (maximum): 2 m.

650 INSTALLING LIGHTING TRACK

- Orientation: Level with ceiling.
- Track suspensions: Flexible.

660 INSTALLING EXTRA LOW VOLTAGE LUMINAIRES general.

- Transformer location: Accessible.
- Conductor size for cables connecting transformers and luminaires (minimum): As luminaire schedule.
- Multi-point transformers:
  - Cabling to luminaire: Equal size and length.
  - Lamps: Same power rating.
  - Fixing: Secure to non-flammable materials.

670 INSTALLING CONTROLGEAR

- Location: Adjacent to luminaire.
- Fixing: Secure to building fabric.

680 INSTALLING SUSPENDED LAMP HOLDERS

- Flex length: 0.3 m.

690 INSTALLING LUMINAIRE SUPPORTS

- Support and fixing arrangement: Board's choice
- Luminaire suspensions: Vertical.
  - Multiple suspensions: Provide as necessary.
- Levelling: Adjust the length of suspensions so that luminaires are level.
  - Levelling tolerance: ± 3 mm.
- Conduit supports:
  - Size (minimum): 20 mm.
  - Type: Match cable containment.
  - Conduit boxes: Provide for each luminaire suspension point.
- Rod supports: Continuously threaded rods.
- Chain supports: Steel chain with conduit box hook and cover.
- Ball and socket: Provide as top support and fix cover to circular conduit box. Route cable from conduit box through ball and socket.
- Number of supports for luminaires longer than 600 mm (minimum):
  - Luminaire width<300 mm: 2.
  - Luminaire width >300 mm: 4.

695 INSTALLING SMOKE HOODS

- Support and fixing arrangement: Submit proposals
- Location: Where recessed luminaires penetrate fire rated ceiling. Electrical Board to refer to Fire Strategy drawings to determine locations of Fire Rated ceilings if any.

COMPLETION

910 CLEANING

- Luminaires and lamps: Clean when building works are complete.

920 TESTING AND COMMISSIONING

- Luminaires and lamps: Check operation.

930 SPARE LAMPS

- Quantity to be supplied: 5 of each type installed.
- Labelling: Label the lamps with the corresponding luminaire reference.

V60 External lighting systems

To be read with Preliminaries/ General conditions

GENERAL THIS CLAUSE RELATES TO EXTERNAL LIGHTING IN THE IMMEDIATE VICINITY OF THE HOSPITAL AND ENERGY CENTRE. ie: BUILDING MOUNTED
LUMINAIRES AND TO FOOTPATHS AROUND THE PERIMETER OF THE BUILDING.

REFER TO SPECIFICATION WW-JB-SP-532-248 FOR DETAILS OF SITE WIDE
EXTERNAL LIGHTING

120 AMENITY LIGHTING SYSTEMS GENERALLY

- System manufacturer: as luminaire schedule.
  - Product reference: as luminaire schedule.
- Electrical supply: Low voltage connection, as section V11.
- Low voltage switchgear: Cable distribution cabinet, as section V31.
- Luminaire supports: Steel lighting pedestals.
  - Painting: Factory finish.
- Concrete bases to columns/pedestals: Required.
- Luminaires: As section V59.
  - Operating voltage to BS 7671: Low voltage.
- Controls:
  - Types: Photoelectric control units, as section V51.
  - Configuration: Group.
  - Accessories: Enclosures for control gear .
- System accessories: Electrical cut outs.

130 CABLING AND CONTAINMENT Buried cables

- Cable type: Thermosetting insulated and LSZH sheathed armoured cables, as section V32.
- Containment: Buried in soft, in plastic ducts below roadways..
- Trenches, pipeways and pits: As section P30.
- Accessories: Plastics ducts for underground cables, as section V32.

PRODUCTS

340 STEEL LIGHTING PEDESTALS FOR AMENITY LIGHTING SYSTEMS

- Manufacturer: as luminaire schedule.
  - Product reference: as luminaire schedule.
- Profile: as luminaire schedule.
- Cross section: as luminaire schedule.
- Height (nominal): as luminaire schedule.
- Base: as luminaire schedule.
- Root length: as luminaire schedule.
- Mounting diameter or width (nominal) : as luminaire schedule.
- Factory finish: as luminaire schedule
  - Colour: as luminaire schedule.
- Accessories: as luminaire schedule.

400 ENCLOSURES FOR CONTROL GEAR as luminaire schedule.
- Manufacturer: as luminaire schedule.
  - Product reference: as luminaire schedule.
- Enclosure:
  - Material: as luminaire schedule.
  - Finish: as luminaire schedule.
  - Ingress protection to BS EN 60529: as luminaire schedule.
  - Hardware: Cylinder lock and handle. Standardize key type.
  - Labelling: Describe control gear purpose.

EXECUTION

620 INSTALLING ROADWAY AND AMENITY LIGHTING SYSTEMS GENERALLY
- Standard: To BS 7671.

640 INSTALLING ELECTRICAL CUT OUTS
- Location: At base of pedestals.

650 INSTALLING PHOTOELECTRIC CONTROL UNIT
- Location: As far as practical on each luminaire.

690 SETTING COMPONENTS IN EARTH
- Foundation holes: Form as small as practicable to allow refilling.
- Locating components: Accurately position, plumb and provide secure temporary support.
- Cable ducts: Connect to column cable entry slot and protect against collapse during backfilling.
- Earth for backfilling: Selected material free from stones or lumps of clay exceeding 40 mm in any direction.
- Backfilling: Refill with earth. Fully compact in 50 mm layers as filling proceeds.

750 COLUMN AND PEDESTAL LABELLING:
- Height above ground level: 1.2 m.
- Type: Glued on laminated label.
- Size of numbers and letters: Submit proposals.
  - Background to numbers and letters: white.
- Size of background: Submit proposals.

COMPLETION

910 CLEANING
- Electrical equipment: Clean immediately before handover.

920 INSPECTION AND TESTING
- Standard: To BS 7671.
- Notice before commencing tests (minimum): 24 h.
- Certificates: Submit.
  - Number of copies: 2.

930 COMMISSIONING
- Setting for control devices: Submit proposals and commission.
- Operation of control devices: Verify.
- Orientation of adjustable luminaires: Adjust to give optimum performance.

940 PHOTOMETRIC SURVEY GENERALLY

- Standard: In accordance with CIBSE Lighting guide 6.
- Locations: Around perimeter of RHSC-DCN Building.
- Time of test: Night.
- Average illuminance measurement method: Full grid .
- Measured values: Submit.
- Maintained average illuminance: Submit based upon measured values.
- Illuminance variation: Submit details.
- Environmental conditions: Submit details.
- Extraneous light: Measure and submit results.
- Test equipment: Submit calibration details.

950 DOCUMENTATION

- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system
- Timing: Submit at completion.
- Contents:
  - Full technical description of each system installed.
  - Manufacturers' operating and maintenance instructions for fittings and apparatus including relamping instructions for luminaire types. Identify hazardous lamps that require specialist disposal.
  - Recommended frequency of testing and inspection, both for electrical safety, and for matters such as the corrosion and security of lighting columns and luminaire fixings.
  - Manufacturers' guarantees and warranties.
  - Record drawings showing circuits and their ratings and locations of fittings and apparatus.
  - List of normal consumable items and their sources.

960 SPARE LAMPS

- Quantity of each type to be supplied: 2.
- Labelling: Label the lamps with the corresponding luminaire reference.

APPENDIX A

LIGHTING CONTROL SCHEDULE

The following schedule has been prepared to indicate the design intent.

RHSC – DCN EDINBURGH – LIGHTING CONTROL SCHEDULE							
ROOM TYPE	**A&B CIRCUIT REQUIRED ? (IF IN DUAL CIRCUIT AREA)**	**MANUAL SWITCHING**	**MANUAL DIMMABLE CONTROL**	**PRESENCE DETECTION**	**ABSENCE DETECTION**	**DAYLIGHT LINKING**	**NOTES**
ANAESTHETIC ROOM	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.
ASSESSMENT ROOM	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR AND AT THE PENDANT (WHERE APPLICABLE).
ATRIUM	Y	N	N	(SEE NOTE)	N	Y	AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING “ON” WHEN AREAS ARE OCCUPIED AND SWITCHING LIGHTING “OFF” WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY. DAYLIGHT LINKING TO BE DEVELOPED.
BED BAY/ROOM (CRITICAL CARE/CCU)	Y	Y	Y	N	N	N	LOCAL MANUAL DIMMING CONTROL OF LIGHTING WITHIN EACH BED BAY/BEDROOM. SWITCH LOCATED AT DOOR OR PARTITION OF BAY AND AT THE PENDANT (WHERE APPLICABLE).
BEDROOM (MULTI)	Y	Y	Y	N	N	Y	GENERAL & NIGHT LIGHTING TO BE MANUALLY SWITCHED FROM DOOR, READING & NURSE EXAM LIGHTING TO BE MANUALLY SWITCHED AT THE BEDHEAD TRUNKING. READING LIGHTING TO BE MANUALLY CONTROLLED VIA THE PATIENTS HANDSET. LUMINAIRE NEAR THE WINDOWS SHALL BE AUTOMATICALLY DIMMABLE, REGULATED BY THE AMOUNT OF DAYLIGHT AVAILABLE VIA DAYLIGHT SENSOR
BEDROOM (SINGLE)	Y	Y	Y	N	N	Y	GENERAL & NIGHT LIGHTING TO BE MANUALLY SWITCHED FROM DOOR, READING & NURSE EXAM LIGHTING TO BE MANUALLY SWITCHED AT THE BEDHEAD TRUNKING. READING LIGHTING TO BE MANUALLY CONTROLLED VIA THE PATIENTS HANDSET. LUMINAIRE NEAR THE WINDOWS SHALL BE AUTOMATICALLY DIMMABLE, REGULATED BY THE AMOUNT OF DAYLIGHT AVAILABLE VIA DAYLIGHT SENSOR
CHANGING ROOM	Y	N	N	Y	N	N	AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING “ON” WHEN AREAS ARE OCCUPIED AND SWITCHING LIGHTING “OFF” WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.

RHSC – DCN EDINBURGH – LIGHTING CONTROL SCHEDULE							
ROOM TYPE	**DUAL CIRCUIT REQUIRED**	**MANUAL SWITCHING**	**MANUAL DIMMABLE CONTROL**	**PRESENCE DETECTION**	**ABSENCE DETECTION**	**DAYLIGHT LINKING**	**NOTES**
CLEAN /DIRTY UTILITY	Y	N	N	Y	N	N	LIGHTING TO BE CONTROLLED FROM AN AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY
CLEANERS ROOM	N	N	N	Y	N	N	LIGHTING TO BE CONTROLLED FROM AN AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY
CONSULTING ROOM	Y	Y	N	N	Y	Y	MANUAL SWITCHING TO TURN “ON” AND “OFF”. AUTOMATIC PRESENCE DETECTORS ALSO PROVIDED FOR SWITCHING “OFF” LIGHTING WHEN AREAS ARE UNOCCUPIED. SHOULD THE ROOM BENEFIT FROM NATURAL DAYLIGHT, LUMINAIRES NEAR THE WINDOWS SHALL BE AUTOMATICALLY DIMMABLE, REGULATED BY THE AMOUNT OF DAYLIGHT AVAILABLE VIA COMBINED PRESENCE/DAYLIGHT SENSORS.
CONSULTING/EXAMINATION ROOM	Y	Y	N	N	Y	Y	MANUAL SWITCHING TO TURN “ON” AND “OFF”. AUTOMATIC PRESENCE DETECTORS ALSO PROVIDED FOR SWITCHING “OFF” LIGHTING WHEN AREAS ARE UNOCCUPIED. SHOULD THE ROOM BENEFIT FROM NATURAL DAYLIGHT, LUMINAIRES NEAR THE WINDOWS SHALL BE AUTOMATICALLY DIMMABLE, REGULATED BY THE AMOUNT OF DAYLIGHT AVAILABLE VIA COMBINED PRESENCE/DAYLIGHT SENSORS.
CONTROL ROOM (IMAGING)	Y	Y	(SEE NOTE)	N	N	N	GENERAL LIGHTING WITHIN CONTROL ROOM TO BE MANUALLY SWITCHED FROM DOOR. WHERE APPLICABLE, LOCAL CONTROL OF LIGHTING (NORMAL/DIMMING) WITHIN IMAGING ROOM AS REQUIRED BY THE ROOM DATA SHEETS TO BE PROVIDED AT THE CONTROL DESK.
CORRIDOR (DEPARTMENTAL)	Y	N	(SEE NOTE)	Y	N	N	AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING “ON” WHEN AREAS ARE OCCUPIED AND REGULATE THE LIGHTING TO 25% OF NORMAL OUTPUT WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
CORRIDOR (HOSPITAL STREET)	Y	N	(SEE NOTES)	Y	N	Y	AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING “ON” WHEN AREAS ARE OCCUPIED AND REGULATE THE LIGHTING TO 50% ON SCHEMATIC OF NORMAL OUTPUT WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
CORRIDOR (WARD)	Y	Y	(SEE NOTES)	N	N	N	MANUAL SWITCHES PROVIDED TO PERMIT STAFF TO REGULATE LIGHT OUTPUT TO PRESET LEVELS OF 0%, 25% OR 100%.

RHSC – DCN EDINBURGH – LIGHTING CONTROL SCHEDULE							
ROOM TYPE	**DUAL CIRCUIT REQUIRED**	**MANUAL SWITCHING**	**MANUAL DIMMABLE CONTROL**	**PRESENCE DETECTION**	**ABSENCE DETECTION**	**DAYLIGHT LINKING**	**NOTES**
DINING ROOM	Y	Y	N	N	N	N	LIGHTING TO BE CONTROLLED FROM MANUALLY OPERATED WALL MOUNTED SWITCHES.
DISCHARGE LOUNGE	Y	Y	N	N	N	N	LIGHTING TO BE CONTROLLED FROM MANUALLY OPERATED WALL MOUNTED SWITCHES AT THE STAFF BASE.
DISPOSAL HOLD	Y	N	N	Y	N	N	LIGHTING TO BE CONTROLLED FROM AN AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY
ENSUITE	Y	N	N	Y	N	N	AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING “ON” WHEN AREAS ARE OCCUPIED AND SWITCHING LIGHTING “OFF” WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
EQUIPMENT PARKING BAY	N	(SEE NOTES)	N	(SEE NOTES)	N	N	WHERE EQUIPMENT BAY IS LOCATED OFF A CIRCULATION/CORRIDOR SPACE THEN LIGHTING WILL BE CONTROLLED AS PER THE REGIME EMPLYED WITHIN THAT SPACE. WHERE EQUIPMENT BAY IS independent OF ANOTHER SPACE LIGHTING TO BE CONTROLLED FROM AN AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
EXAMINATION ROOM	Y	Y	N	N	Y	Y	MANUAL SWITCHING TO TURN “ON” AND “OFF”. AUTOMATIC PRESENCE DETECTORS ALSO PROVIDED FOR SWITCHING “OFF” LIGHTING WHEN AREAS ARE UNOCCUPIED. SHOULD THE ROOM BENEFIT FROM NATURAL DAYLIGHT, LUMINAIRES NEAR THE WINDOWS SHALL BE AUTOMATICALLY DIMMABLE, REGULATED BY THE AMOUNT OF DAYLIGHT AVAILABLE VIA COMBINED PRESENCE/DAYLIGHT SENSORS.
EXIT/PARKING BAY	Y	Y	N	Y	N	N	LIGHTING WILL BE CONTROLLED AS PER THE REGIME EMPLOYED WITHIN THE ADJACENT CIRCULATION/CORRIDORS VIA. AUTOMATIC PRESENCE DETECTORS WHICH WILL SWITC“ L”GHTING "ON" WHEN AREAS ARE OCCUPIED AND REGULATE THE LIGHTING TO 25% OF NORMAL OUTPUT WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.

RHSC – DCN EDINBURGH – LIGHTING CONTROL SCHEDULE							
ROOM TYPE	**DUAL CIRCUIT REQUIRED**	**MANUAL SWITCHING**	**MANUAL DIMMABLE CONTROL**	**PRESENCE DETECTION**	**ABSENCE DETECTION**	**DAYLIGHT LINKING**	**NOTES**
EXTERNAL LIGHTING (MAIN ENTRANCE CANOPY)	N	(SEE NOTES)	(SEE NOTES)	(SEE NOTES)	(SEE NOTES)	(SEE NOTES)	LIGHTING CONTROLLED BY EXTERNAL PHOTOCELL AND ADJUSTABLE TIME-CLOCK.
IMAGING ROOM	Y	Y	(SEE NOTES)	N	N	N	LIGHTING TO BE CONTROLLED FROM MANUALLY OPERATED ON/OFF WALL MOUNTED SWITCHES AT THE DOOR. WHERE APPLICABLE, LOCAL CONTROL OF LIGHTING (NORMAL/DIMMING) WITHIN IMAGING ROOM AS REQUIRED BY THE ROOM DATA SHEETS TO BE PROVIDED AT THE CONTROL DESK WITHIN THE ASSOCIATED CONTROL ROOM.
INTERVIEW ROOM	Y	Y	N	N	Y	Y	MANUAL SWITCHING TO TURN "ON" AND "OFF". AUTOMATIC PRESENCE DETECTORS ALSO PROVIDED FOR SWITCHING "OFF" LIGHTING WHEN AREAS ARE UNOCCUPIED. SHOULD THE ROOM BENEFIT FROM NATURAL DAYLIGHT, LUMINAIRES NEAR THE WINDOWS SHALL BE AUTOMATICALLY DIMMABLE, REGULATED BY THE AMOUNT OF DAYLIGHT AVAILABLE VIA COMBINED PRESENCE/DAYLIGHT SENSORS.
KITCHEN (INCLUDING REGEN KITCHENS)	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.
LABORATORY	Y	Y	N	N	N	Y	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.
LINEN CUPBOARD	N	N	N	Y	N	N	AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING "ON" WHEN AREAS ARE OCCUPIED AND SWITCHING LIGHTING "OFF" WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.

RHSC – DCN EDINBURGH – LIGHTING CONTROL SCHEDULE							
ROOM TYPE	**DUAL CIRCUIT REQUIRED**	**MANUAL SWITCHING**	**MANUAL DIMMABLE CONTROL**	**PRESENCE DETECTION**	**ABSENCE DETECTION**	**DAYLIGHT LINKING**	**NOTES**
LOBBY	Y	N	N	Y	N	N	AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING "ON" WHEN AREAS ARE OCCUPIED AND SWITCHING LIGHTING "OFF" WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
OFFICE	Y	Y	N	N	Y	Y	MANUAL SWITCHING TO TURN "ON" AND "OFF". AUTOMATIC PRESENCE DETECTORS ALSO PROVIDED FOR SWITCHING "OFF" LIGHTING WHEN AREAS ARE UNOCCUPIED. SHOULD THE ROOM BENEFIT FROM NATURAL DAYLIGHT, LUMINAIRES NEAR THE WINDOWS SHALL BE AUTOMATICALLY DIMMABLE, REGULATED BY THE AMOUNT OF DAYLIGHT AVAILABLE VIA COMBINED PRESENCE/DAYLIGHT SENSORS.
OPERATING THEATRE	Y	Y	(SEE NOTES)	N	N	N	LIGHTING TO BE MANUALLY SWITCHED ON/OFF FROM DOOR. DIMMABLE CONTROL FOR GENERAL LIGHTING TO BE PROVIDED AS PART OF SURGEONS PANEL. CONTROL OF OPERATING TABLE LAMPS TO BE CONTROLLED FROM SURGEONS PANEL OR AT THE LAMP DEPENDING ON THE DETAILS OF LAMP INSTALLED.
OVERNIGHT STAY ROOM	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.
PATIENT CHANGING CUBICLE	N	N	N	Y	N	N	AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING "ON" WHEN AREAS ARE OCCUPIED AND SWITCHING LIGHTING "OFF" WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
PLANT (PLANT ROOM)	Y	Y	N	N	N	N	MANUAL SWITCHING
PLANT (RISERS & ELECTRICAL CUPBOARDS – IF LIGHTING PROVIDED)	N	N	N	Y	N	N	LIGHTING TO BE CONTROLLED FROM AN AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY
PLAYROOM	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.

RHSC – DCN EDINBURGH – LIGHTING CONTROL SCHEDULE							
ROOM TYPE	**DUAL CIRCUIT REQUIRED**	**MANUAL SWITCHING**	**MANUAL DIMMABLE CONTROL**	**PRESENCE DETECTION**	**ABSENCE DETECTION**	**DAYLIGHT LINKING**	**NOTES**
PREP ROOM	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.
RECEPTION	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.
RECOVERY ROOM	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.
RESUSCITATION ROOM	Y	Y	(SEE NOTES)	(SEE NOTES)	N	N	LIGHTING WITHIN RESUS BAYS TO BE MANUALLY SWITCHED FROM DOOR. WITHIN RESUS AREA CIRCULATION SPACE AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING "ON" WHEN AREAS ARE OCCUPIED AND REGULATE THE LIGHTING TO 25% OF NORMAL OUTPUT WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
SCRUB	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.
SEMINAR ROOM	Y	Y	Y	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.
SERVICES RISER/CUPBOARD	N	N	N	Y	N	N	AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING "ON" WHEN AREAS ARE OCCUPIED AND SWITCHING LIGHTING "OFF" WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
SITTING ROOM	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.

RHSC – DCN EDINBURGH – LIGHTING CONTROL SCHEDULE							
ROOM TYPE	**DUAL CIRCUIT REQUIRED**	**MANUAL SWITCHING**	**MANUAL DIMMABLE CONTROL**	**PRESENCE DETECTION**	**ABSENCE DETECTION**	**DAYLIGHT LINKING**	**NOTES**
STAFF BASE	Y	Y	Y	N	N	N	LIGHTING TO BE MANUALLY SWITCHED LOCALLY. WARD CORRIDOR LIGHTING DIMMED FROM BACK WALL.
STAFF CHANGE	Y	Y	N	N	Y	N	MANUAL SWITCHING TO TURN "ON" AND "OFF". AUTOMATIC PRESENCE DETECTORS ALSO PROVIDED FOR SWITCHING "OFF" LIGHTING WHEN AREAS ARE UNOCCUPIED.
STAFF LOUNGE	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.
STAIRCORE	Y	N	N	(SEE NOTES)	N	N	GENERALLY LIGHTING TO BE PERMANENTLY ON AND SWITCHED AT THE DB WITH THE EXCEPTION OF THE STAIRWAY FROM GROUND TO BASEMENT AND STAIRCORE TO PLANTROOMS WHERE AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING "ON" WHEN AREAS ARE OCCUPIED AND SWITCHING LIGHTING "OFF" WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
STORE	Y	N	N	Y	N	N	AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING "ON" WHEN AREAS ARE OCCUPIED AND SWITCHING LIGHTING "OFF" WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
STUDY ROOM	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.
TOUCHDOWN BASE	(SEE NOTES)	Y	(SEE NOTES)	N	N	N	LIGHTING TO BE CONTROLLED AS PART OF CORRIDOR CONTROL REGIME.
TREATMENT ROOM	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.

RHSC – DCN EDINBURGH – LIGHTING CONTROL SCHEDULE							
ROOM TYPE	**DUAL CIRCUIT REQUIRED**	**MANUAL SWITCHING**	**MANUAL DIMMABLE CONTROL**	**PRESENCE DETECTION**	**ABSENCE DETECTION**	**DAYLIGHT LINKING**	**NOTES**
WAITING AREA	Y	(SEE NOTES)	N	(SEE NOTES)	N	N	WHERE WAITING AREA IS LOCATED OFF A CIRCULATION/CORRIDOR SPACE THEN LIGHTING WILL BE CONTROLLED AS PER THE REGIME EMPLYED WITHIN THAT SPACE. WHERE WAITING AREA IS INDEPENDANT OF ANOTHER SPACE LIGHTING TO BE CONTROLLED FROM AN AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
WC (PUBLIC)	N	N	N	Y	N	N	AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING "ON" WHEN AREAS ARE OCCUPIED AND SWITCHING LIGHTING "OFF" WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
WC (STAFF)	N	N	N	Y	N	N	AUTOMATIC PRESENCE DETECTORS PROVIDED FOR SWITCHING LIGHTING "ON" WHEN AREAS ARE OCCUPIED AND SWITCHING LIGHTING "OFF" WHEN AREAS ARE UNOCCUPIED. AUTOMATIC PRESENCE DETECTOR PROVIDED WITH ADJUSTABLE TIME DELAY.
WORKSHOP	Y	Y	N	N	N	N	LIGHTING TO BE MANUALLY SWITCHED FROM DOOR.

Additional Notes:

1. KNX to interface PIR's with circuits.
2. Daylight linking is proposed where practical (any areas without daylight will obviously not have day light linking.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.31 JB G1547**
Performance Specification Title	**Electrical Network Management System**	Date	**August 2014**
Prepared By	**JB**	Checked By	**PM**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	PM
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
ELECTRICAL NETWORK MANAGEMENT SYSTEM

CONTENTS

APPENDICES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this specification shall include, but not be limited to, the Electrical Network Management Systems (ENMS). For the purpose of this document the ENMS shall be deemed to include the generator control systems.

The ENMS shall comprise two network based control systems with fibre control rings connecting via network interfaces and Input/output modules. The Individual input/output modules being both controllable from each of the A and B networks and displayable on each of the control panels for each of the A and B systems

Outline descriptions of the functional requirements of the ENMS are given in section 7.3.1 of this specification.

The ENMS shall be compatible with all relevant parts of the Building Services installation including the:-

- MV supply and distributions systems
- MV generators and their controls
- SPEN switchgear (Monitoring only)
- CHP systems and their controls
- LV distribution systems and switchgear
- BMS systems
- Power factor correction apparatus

The description given may include some functionality that may be provided by a separate generator control systems. If this is so, Project Co. shall ensure the separate ENMS and generator control systems are compatible and fulfill the whole of the requirements noted hereinafter or indicated on the associated drawings/schedules or noted in specifications and drawings for systems controlled by the ENMS and/or generator control systems.

3.0 SPECIFIC EXCLUSIONS

This specification relates to the Electrical Network Management Systems (ENMS) only. Other systems are detailed in other elements of the specification.

4.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of SHTM 06-01, IEE Wiring Regulations BS 7671 (17th Ed.), current legislation, regulations and industry standards unless otherwise stated.

5.0 DESIGN CRITERIA

5.1 Electricity Supply Characteristics

The site will be provided with two new 11000Volt 50Hz, three phase electrical supplies from Scottish Power Energy Network's (SPEN's) MV network. These individual electrical supplies are derived from two sub-stations and terminate in a SPEN switchboard located adjacent to main MV switch room.

5.2 Drawings and sub-missions

As part of the development of the design the Board shall prepare general arrangement drawings of the works to be provided. These shall be based on the Architect's base drawings and coordinated with other services and building elements. A proposed drawing list shall be submitted with the Tender.

5.3 ITPD Requirements

This specification shall be read in conjunction with the NHS Lothian documents.

6.0 LIAISON

The Board shall include for liaison with:-

SPEN. Project Co. shall include for liaison with SPEN for the design of the services in/for the 11kV sub-station building and for ensuring that he will be able to connect to and monitor the circuit breakers in the main MV panels that SPEN are providing as part of their works.

The Hospital. The Board shall include for liaison in conjunction with the Board with members of the Hospital's team with an interest in the planning and administration of the small power System.

Any other member of the Project and Hospital teams concerned with the planning and administration of small power installations.

7.0 SYSTEMS

7.1 Generally

This specification shall be read in conjunction with the MV and LV systems drawings and specifications

7.2 Incoming Electrical Supplies

SPEN are providing two incoming electrical supplies each with a rating of 3MVA. These are to be arranged such that if either fails the other is capable of taking the complete building load.

The incoming MV electrical supplies will be terminated into the circuit breaker switch board which is designed to supply the electrical needs of the new development and includes an auto change over arrangement and two feeder breakers for the project which all need be monitored by the Electrical Network Management Systems (ENMS).

SPEN shall make volt free contacts available for status monitoring of the 4 devices which shall be run to a wall mounted interface demarcation box.

Project Co. shall liaise with SPEN examining their design drawings and proposals to verify the equipment being provided by SPEN is compatible with both the MV cables and the ENMS monitoring he is providing.

The RHSC-DCN supplies shall be terminated into the RHSC-DCN circuit breaker board which shall be designed to integrate with the generator circuit breaker board and provide supplies to the RHSC-DCN ring mains.

7.3 Electrical Network Management Systems

7.3.1 Generally

The new MV electrical systems will principally comprise two incoming supplies feeding into a distribution network whose principle equipment includes 14 No MV circuit breakers, 4No transformers, 3No MV Generators, including as outputs for the connection of generator testing load bank modules and the CHP unit.

The Main LV systems will principally comprise approximately 4No main LV switch panels, 30No sub-main panels supplying the Life Safety, critical, essential, less-essential and non-essential electrical systems throughout the new development. The Sub-main LV distribution systems comprises sub-main panels, bus-bars, switches/circuit breakers etc as shown on the drawings WW-XX-XX-SC-530.

The Electrical Network Management System (ENMS) will be required to monitor and where necessary automatically control the electrical systems/network during normal and abnormal conditions.

The ENMS will be required to:-

- Work in conjunction with the protection devices provided throughout the MV and LV distribution systems and where necessary carry out alternative switching of the systems as a result of MV or LV devices switching or tripping.
- Provide ‘event’ alarms at each control panel and on each display panel.
- Have password controlled ‘event’ acknowledgement at each control panel and in the FM office.
- Record MV and LV system events and, when required, provide print-outs showing all events.
- Enable authorised persons to control and carry out selective switching of the systems (manual override of any controlled/monitored device). This facility is to be password protected at each control/interface point and shall be available only in the generator control rooms and in the control rooms associated with the main incoming MV switch panel.
- Have separate passwords (higher levels of authorisation) for control of the MV systems.
- Have separate passwords for each user of the system and be able to record which user carried out which operation, alarm acknowledgement etc.
- Provide indication of the condition of the electrical network (hierarchical schematics) including the status of each item connected/monitored. This shall be achieved by the displaying of systems schematics on each of the display panels and identifying which of the devices are Closed, open, tripped withdrawn etc.
- Under partial or total mains failure conditions match the available supplies to the load and where necessary match the connected load to the available supplies.
- Control the switching of loads to meet the load step limits of the mains and the generators under all conditions.
- Provide output enable signals to the BMS to enable the BMS to start and stop (By the absence of the signals) the mechanical plant including chillers, fans, pumps, boilers, humidifiers etc. In this connection it should be noted that the BMS will need to be specially designed to accept the connection or removal of these ENMS signals as ‘priorities’ which need to be acted upon at a speed to suit the switching requirements of the Electrical systems.
- Apply the loads to the generators in an expedient manner to an agreed priority schedule.
- Control the necessary synchronisation with the mains and switching of the systems for both generator testing and when the mains are re-established after mains failure.
- Provide agreed control of the neutral earthing resistors for the various mains/generator paralleling situations.

- Capture and relay switchgear status, energy consumption, harmonic content, operation counter and fault indication to each of the interface control units and display these on the indicated schematics
- Be modular in its nature and be able to be extended
- Have 25% spare capacity.

All power supplies to the ENMS shall be provided via secure battery backed power supply units with sufficient autonomy to maintain the systems for a period of 72 hours under mains failure conditions. Each of these power supply units shall be monitored and alarmed onto each of the BMS and ENMS systems.

The ENMS shall be robustly designed to incorporate 'hot-standby' capability and be installed to provide the highest level of resilience to minimise the possibility of failure affecting the control of the electrical systems.

The ENMS shall use dedicated cables that are not used for any other purpose.

Separate 'A' and 'B' ENMS system control units will be required and will be linked to provide the required hot standby and increased resilience. The linking between the two systems shall be as indicated in the concept schematic.

ENMS user display and control units will be required at the following locations:-

- The Energy Centre control room— control panel and systems display.
- Main MV Switchroom — control panel and systems display.
- Main LV Panel; A1 - systems display
- Main LV Panel; A2 - systems display
- Main LV Panel; B1 - systems display
- Main LV Panel; B2 - systems display
- the Estates Office – display unit and control unit with only facilities to accept alarms (i.e. it shall not be possible to control switching from this location)
- Security Control room – display unit and control unit with only facilities to accept alarms (i.e. it shall not be possible to control switching from this location)

Each systems display unit shall provide hierarchical schematics of the systems showing the status of the devices controlled and/or monitored. This including switchgear status, energy consumption, harmonic content, operation counter and fault indication

Power supplies to local ENMS panels shall be provided from local battery backed power supply units that have sufficient autonomy to maintain the local systems for a minimum period of 72 hours under mains failure conditions. Each of these power supply units shall be monitored such that alarms are raised in the event of a failure.

7.3.2 Systems Operation

General

The ENMS will be arranged/programmed to control the electrical systems to make the best use of the available sources of supply (be that mains and/or generators).

- Matching of the Generators to required load
  - When the load is less than the capacity of the sets available (including synchronised/paralleled units and available non-running units) then a minimum of 500kVA of spinning reserve shall normally be paralleled.

- Matching of the load to the available generators.
  - Low priority numbers (less essential) shall be disabled until sufficient generators are available.
  - Allocation of 'load priorities' to various load centres, energy users, load types etc. all to enable the highest priority loads to be connected first or disconnected last while maintaining the systems within design limits.

Although the exact load prioritisation schedule will need to be agreed with the Hospital Board it is expected to include various priority ratings such as those noted in the table below:-

Priority Rating	Outline description of Load
1	Statutory requirements – Evacuation lifts, smoke extract/pressurisation fans, sprinkler pumps, wet riser pumps etc. Generator auxiliary supplies
2.1	Riser 1 Category 4 and 5 area life safety lighting and small power.
2.2	Riser 2 Category 4 and 5 area life safety lighting and small power.
2.3	Riser 3 Category 4 and 5 area life safety lighting and small power.
2.4	Riser 4 Category 4 and 5 area life safety lighting and small power.
3.1	Riser 1 Category 3 area Heating and Vent systems
3.2	Riser 2 Category 3 area Heating and Vent systems
3.3	Riser 3 Category 3 area Heating and Vent systems
3.4	Riser 4 Category 3 area Heating and Vent systems
4	Essential heating and systems
5	Vertical transportation
6	Imaging equipment supplies
7.1	Less Essential Heating and Ventilation Systems
7.2	Less Essential Heating and Ventilation Systems
8	Imaging equipment supplies
9.1	Chillers and cooling – stage 1
9.2	Chillers and cooling – stage 2
9.3	Chillers and cooling - stage 3

It should be noted that some of these load priorities may, subject to actual loads, be either switched together or switched at different times or even be sub-divided further as the design is finalised.

Mains failure – When RHSC MV systems healthy

Under normal mains failure conditions (when the RHSC-DCN MV infrastructure is healthy) the standby generator systems will be required to start and synchronise sufficient generator sets to permit the following minimum RHSC-DCN loads to be re-connected:-

Elapsed Time from generator start signal	Outline description of loads to be connected	Load STEP to be connected (kVA)
15 seconds	RHSC-DCN and energy centre - Lighting, small power and statutory life safety	1000
25 seconds	RHSC-DCN and energy centre - General loads	1000
35+ Seconds	RHSC-DCN I and energy centre - Non essential loads	1000

Under extreme conditions when generators sets may not be available to start (due to maintenance of individual units or switchgear not being available etc) the 15 and 25 second loads to be applied shall also be as the above table with loads adjusted proportionally for the number of units available to start.

Under Mains failure conditions the initial load sequencing shall be as follows:-

- Start signal to transfer to alternative SPEN supply (Wait 1 second)
- Start Signal to Generator (Wait 2 second)
- Generator Synchronising Period (+12 seconds)
- Transfer to alternative SPEN supply (If available)
- Commence sequential load connection process
- If alternative SPEN supply not available
  - RHSC Main Breakers open
- Review available synchronised generators and commence sequential load connection process

After the initial load sequencing, the ENMS shall continue to match the connected load of the site to the available generators by:-

- Enabling greater loads by enabling further load priority signals and starting of available generators up to the capacity of the generators available
- Starting/synchronising/paralleling of further generators when the site load increases.
- Disabling loads priorities when the site load exceeds the available generator capacity

Mains failure – Elements of MV systems tripped or isolated.

If both the Incoming supplies fail while elements of the MV Systems are out of circuit then the ENMS shall automatically work to restore electrical supplies to the loads without supplies in accordance with the Truth Table (to be progressed at Preferred Bidder stage).

Where the above requires the generators to be started to supply the failed loads then the generator starting and load sequencing shall generally be similar to that noted for normal mains failures. It should however be noted that, unless specifically required by the Truth Table, healthy supplies to RHSC-DCN loads should not be isolated in the process.

Operating Scenarios

The systems will need to be programmed to ensure the best use is made of the available sources. This is expected to include:-

Condition	**Response**
Normal operation-	Electrical systems operates from preferred incoming supply
Single supply failure-	All loads transfer to the single healthy supply.
Twin supply failure- (with normal Generator start conditions)	After the pre-set monitoring period (adjustable 0 - 5 seconds) Generators start and synchronise as one common group. After 15 seconds from the generator start signal the maximum permissible load step is applied to the generators (1.5MVA) After 25 seconds from generator start signal a further maximum permissible load step is applied to the generators (1MVA) The remaining plant load is then introduced
Twin supply failure- (with abnormal Generator start conditions)	After the pre-set monitoring period (adjustable 0 - 5 seconds) Generators start and synchronise as one common group. After 15 second from the generator start signal maximum permissible loads are applied - Loads commensurate with the number of generators synchronised. After 25 seconds from the generator start signals maximum permissible additional loads are applied – Loads commensurate with the number of generators synchronised. At 10 second intervals additional maximum permissible loads are applied until all generators are fully loaded.
Normal running on generators	The number of generators synchronised and supplying load are optimised to ensure that the number of units running matches the load with 2000kW spare. (i.e. N+1 generators on line)

Condition	Response
All operating Generators fail in operation while mains healthy	Load is transferred back to mains in accordance with the agreed load transfer steps.
Partial Generator failure or generator switchgear failure while the generators are supplying the load and the mains is Healthy	Failed generators/switch gear isolated. Load shed to suit the available capacity of the generators synchronised then either:- • If the load shedding requires isolation of the most important load priorities then the Generators shall be taken off-line, the MV systems re-energised from the mains and the loads connected back to the mains in load priority order. Or • If the load shedding does not require isolation of the most important loads then additional generators (where available) shall be started and synchronised before additional loads are connected in load priority order. The load priority level at which the generators are isolated shall be selectable from the ENMS control panels and shall for the purpose of initial set-up shall be agreed with the Board during the detailed design. This to occur quick enough to prevent the remaining generators (or their switchgear) failing on overload.
Single generator fails in normal N+1 operation.	Additional generator starts to regain the N+1 Status of the system. No load shedding
Single generator fails when not in N+1 configuration	Failed generators/switch gear isolated. Load shed to suit the available capacity of the remaining generators. If available offline generator shall start and synchronise before additional loads added to suit the generator capacity
Partial Generator failure or generator switchgear failure while the mains is failed.	Failed generators/switch gear isolated then either:- • Load shed to suit the available capacity of the generators synchronised. (This to occur quick enough to prevent the remaining generators [or their switchgear] failing/tripping on Overload) Or • Generators switch boards isolated and load shedding LV breakers before the MV systems are re-energised and the loads re-applied in accordance with the priority schedule and the number of generators synchronised. If available offline generator shall start and synchronise before additional loads added to suit the generator capacity.

Condition	Response
Supply Restoration (single or both)	Requires manual intervention to transfer loads back to the mains. Load transfer back to the mains may include isolation of lower priority loads (i.e. certain cooling plant) and a generator to reduce the fault level during synchronisation with the mains and transfer of the load before opening the generator circuit breakers.
Failure of an LV supply to critical equipment	The low voltage supply changes-over to the remaining healthy supply

In all cases the ENMS shall note the position and conditions of all connected devices and instantly amend the stored diagrams to show the current condition of the systems on the display panels. It should be noted that under major failure conditions when multiple switching operations need to take place in a short time that these shall take precedence over updating and displaying of the stored diagrams – in which case the display screens shall simply

The final operating sequences for the electrical network will be detailed as the design progresses.

The Systems shall be arranged to permit the testing of generators as follows with each of these only being selectable by MV authorised persons:-

1. All generators by Simulation of mains failure to the main incoming panels. This facility shall have additional higher level access codes as it requires a break in the supplies to the RHSC-DCN.
2. All generators by synchronising with the mains before isolating the mains so the generators supply the RHSC-DCN.
3. Each of the A and B sides of the generators by separating the A and B systems and simulating mains failures to them. This facility shall have additional higher level access codes as it requires a break in the supplies to part of the RHSC-DCN.
4. Each of the A and B sides of the generators by separating the A and B systems and synchronising the A or B half of the generators with their corresponding incoming supply before isolating the incoming supply.
5. Individual generators against Individual load banks without affecting the remaining MV network or the ability of the other generators to act as mains-failure back-up to the site.
6. Each of the A and B sides of the generators against load banks for proving of the systems without the need to supply the RHSC-DCN.

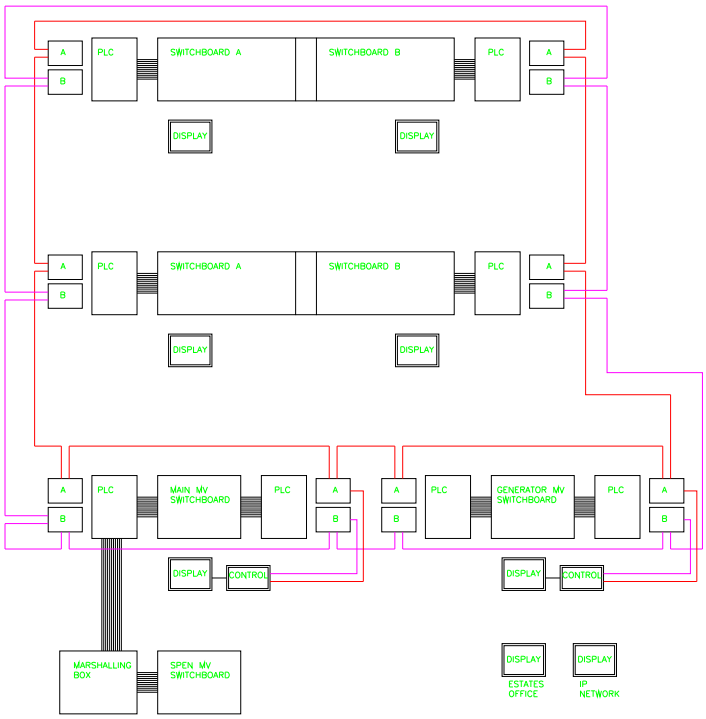
Whenever the generators are tested against the RHSC-DCN load it shall be possible to effect a break-free transfer of the load from the generators after the test period.

Each time the systems require the generators to be synchronised with the incoming supply the systems shall require the input of a higher level security MV authorised access code and shall specifically ask if the synchronisation has been agreed with the SPEN.

Appendix A – Schedule of Drawings

Drawing Title	Drawing Number
MV Distribution Schematic	WW-XX-XX-SC-530-001
LV Distribution Sub-Station No.1 Schematic	WW-XX-XX-SC-530-002
LV Distribution Sub-Station No.2 Schematic	WW-XX-XX-SC-530-003

Appendix B – ENMS Concept Schematic



ENMS CONCEPT SCHEMATIC

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.32 JB G1547**
Performance Specification Title	**Lighting Calculations and Luminaire Selection**	Date	**August 2014**
Prepared By	**JB**	Checked By	**PM**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	PM
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
LIGHTING CALCULATIONS AND LUMINAIRE SELECTION

CONTENTS

LIGHTING CALCULATIONS AND LUMINAIRE SELECTION

1.0 GENERAL

1.1 Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

1.2 Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

1.3 Scope

Provision of:

- Selection of suitable luminaires
- Execution of lighting calculations
- Production of CAD luminaire layout drawings
- Designation of luminaires for emergency lighting

1.4 Exclusions

Design of:

- Lighting controls
- Circuiting
- Switching
- Cabling systems
- Emergency lighting test equipment

1.5 Information

Project Co. shall collate the following:

- CAD files showing luminaires in every room and indicating luminaires to be designated as emergency lighting luminaires
- Computer generated point calculations with contribution from inter-reflected light
  - Luminaire layout drawings
  - Luminaire photometric data including flux fraction ratios, polar intensity curves and utilisation factors
  - Lamp technical information
  - Room surface reflectance values
  - Maintenance factor calculations
  - Isolux contour plots for working plane and room surfaces
  - Schedule of design and calculated maintained average illuminance values
  - Schedule of design and calculated uniformity values
  - Calculated glare index values where deemed necessary by CIBSE LG2

- Luminaire and lamp schedule
- 3D model of the Atria for use within design team
- Data sheet of each luminaire
- Calculation sheets shall indicate wall and ceiling to working plane illuminance ratios

2.0 SELECTION CRITERIA AND STANDARDS

2.1 General

The lighting system shall comply with CIBSE Code for Lighting, and all CIBSE Lighting Guides, BS 4533, BSEN 12464-1, BSEN 60598-2-25, SHTM06-01, BS 5266 (all parts), Table 1 (and it's accompanying notes) of the ILE Guidance notes for the reduction of obtrusive light - 2011, Building (Scotland) Regulations, SLL Lighting Handbook: 2009, SLL Code for Lighting 2012 and SHBNs. The design shall also take due cognisance of “Lighting and Colour for Hospital Design” by Duke (NHS Estates, 2004) and Secure by Design.

2.2 The Lit Appearance

The lighting design shall take into account a number of considerations including:

- provide illumination levels and select luminaires which are appropriate for the task being carried out,
- select and arrange luminaires which are sympathetic, co-ordinate with and compliment the overall interior design concept,
- minimize ongoing maintenance costs by selecting luminaires and lamps from a limited number of sources and types,
- available daylight,
- glare,
- the lit appearance,
- illuminance at task areas,
- lamp colour,
- colour rendering,
- energy efficiency.

The lighting shall aim to promote a sense of well being in the patients and an air of competence and quality throughout the building.

In public areas the emphasis shall be on creating a pleasing environment with gentle but deliberate contrasts. Consideration shall be given to the use of LED luminaires in public spaces.

Computer modelling shall be employed to illustrate the lit appearance of the Atrium. The lighting shall create interest and contrast and highlights architectural features.

Glare shall be controlled and luminaires positioned so as not to cause discomfort to patients who may be in a prone position.

The general lighting shall be used as part of the way-finding strategy to highlight landmarks, reception desks and enquiry desks.

Feature lighting for art components shall be developed in accordance with the art budget.

2.3 Lighting Levels

Maintained illuminance shall take into account “normal” cleaning of luminaires and surfaces and depreciation of lamp output. “Normal” being defined as:

(a) Lamp life
(b) Annual luminaire cleaning
(c) Bi-annual room surfaces clean
(d) Spot lamp replacement

The initial illuminance shall therefore be higher than the maintained illuminance. The maintained illuminance shall be the average illuminance over the reference surface at the time maintenance has to be carried out by replacing lamps and/or cleaning the equipment and room surfaces. The reference surface shall be the working plane at desktop, bench top, floor, bed, couch or other position, as stated in the Room Data Sheets and CIBSE Lighting Guide LG2.

Lighting levels shall be in accordance with the Room Data Sheets and CIBSE LG2: 2008, in that order of precedence.

2.4 Lighting Maintenance Factors

Shall be determined in accordance with SLL Lighting Handbook: 2009

The lighting scheme shall have an overall maintenance factor calculated for the selected lighting equipment, space environment and specified maintenance schedule.

The Specialist shall:

- State the maintenance factor assumed
- Specify lighting equipment suitable for the application environment

2.5 Lamp Temperature

Generally, lamps shall have a colour temperature of 4000 K unless specifically stated otherwise in Room Data Sheets or LG2. Notwithstanding, the Board is encouraged to explore alternative lamp colour temperatures but shall seek approval of the Client for any changes to this specification.

2.6 Lamp Type

Lamps shall generally be high frequency T5 type linear fluorescent. LED lamps shall be utilised where feasible in lieu of compact fluorescent. Display and feature lighting shall utilise LED lamps where feasible.

2.7 Colour Rendering Index

Generally, all lamps shall have a colour rendering index Ra ≥ 85.

In rooms where Ra≥90 is required this shall relate the task area only.

2.8 Control Gear

Normal and emergency luminaires being run over the DALI/KNX network shall be provided with DALI compatible control gear.

Fluorescent luminaires not being run over the DALI/KNX network shall be fitted with high frequency control gear.

2.9 Energy

A ‘DEER’ value of level A shall be achieved, i.e.: a minimum of 66 lamp lumens per circuit watt.

Tungsten and tungsten halogen lamps shall not be used.

2.10 Lighting Controls

Refer to Lighting Installation Specification WW.A.P.1.2.30 for full details.

3.0 LUMINAIRES

3.1 Preliminary Luminaire Schedule

The luminaires shall be of the following type:

Area	Type of luminaire	Lamp type
Staff bases, receptions	Circular downlighter	
Bathrooms, shower rooms and changing rooms	Circular downlighter with sealed IP44	LED
Bed rooms	Wall mounted at bed head, including night lighting	LED
Corridors, wait areas	Recessed or semi-recessed modular fitting with prismatic diffuser or wall mounted prismatic	LED
Offices, admin areas, interview rooms, meeting rooms, seminar rooms	Recessed modular direct/indirect luminaire.	T5 lamps
Treatment room, dirty utility, clean utility, examination room, pantry and kitchens	Recessed modular fitting with prismatic diffuser. Sealed IP44	T5 lamps
Stairwells	Circular surface luminaires, wall mounted	LED
Plant areas and stores	Enclosed with high impact protection	T5 lamps
Atrium and entrance	Decorative	Various including LED
Theatres	Recessed modular fitting with prismatic diffuser. Sealed IP54	T5 lamps
A&E Toilets	Anti vandal luminaire with hidden fixings as required by Secure By Design.	LED

Dimming controls to be provided were indicated in the room data sheets.

3.2 IP Rated Luminaires

In certain areas such as operating theatres, showers and any luminaires exposed to external conditions, luminaires with a suitable IP rating shall be selected.

Rooms with plasterboard ceilings for infection control purposes shall have luminaires of a minimum IP44 rating.

3.3 Ward Luminaires

Ward bed areas shall be provided with a horizontal bed head trunking system, which shall provide varying levels of lighting to allow general lighting, night lighting and reading lighting.

Each high dependency and recovery bed position shall have a wall or bed-head trunking mounted, examination lamp with integral switch.

3.4 Corridor Lighting

BSEN 12464-1:2011 implies that corridors should be lit to 200 lux during the day and 50 lux at night. This is taken to mean that night lighting will be provided to corridors in bedded areas only.

Luminaires to be wall mounted or recessed or semi-recessed LED lay-in luminaire with a shallow projection beyond line of ceiling this will throw light across the ceiling surface increase the perceived brightness of the corridor. Luminaire to be sealed with internal reflector and external prismatic diffuser.

Corridor lighting shall be clear, concise and economic, by means of semi-recessed linear fluorescent fitting running parallel to the line of the corridor and off centre to one side to spill light further horizontally minimising high-level shadow marks on the walls, as well as putting some light onto the ceiling which would otherwise be directly unlit. In specific single patient ward corridors the lighting shall respond to the architectural layout of the rooms and doorways similar to a hotel corridor. Major intersections or nodes along corridors can be marked through a change in lighting or the use of a different luminaire (size, shape, proportion) throughout the building.

3.5 Communal Spaces

Communal and social areas should benefit from interesting lighting, not just in the form of interesting luminaire selection, but also of differing lighting intensities within the space that add interest and life into it. Staff/nurse bases shall be made more visible though increased lighting onto counter surfaces and through wall-washing vertical surfaces behind them to increase their lit presence. Wall hung art work shall be illuminated.

3.6 Plantroom Lighting

Final mounting height and layout shall suit final plantroom layouts.

Accessible plant areas, roof void areas, ducts, lift motor rooms, shafts and similar utility areas shall be illuminated utilising suitably IP rated luminaires with impact resistant covers.

3.7 Food Preparation Areas

Sealed food factory type luminaires shall be provided in areas in which food is prepared, cooked and stored.

3.8 Explosion Hazard Area Lighting

Luminaires in explosion hazard areas shall be suitable for the classification of the area.

The assessment of where hazardous explosive atmospheres may occur is by others.

4.0 EMERGENCY LIGHTING

Emergency lighting shall be by means of self-contained battery/inverter conversion kits which shall be sealed and provide 5 years battery design life.

Emergency lighting shall be in accordance with BS5266, CIBSE Lighting Guide LG12.

External emergency lighting shall be provided to muster points and external escape routes.

5.0 EXTERNAL LIGHTING

General

Helipad lighting and aircraft warning lighting shall be selected by the Specialist in accordance with CAA requirements.

New external lighting systems will be provided to the whole of the area which forms part of the Board's site in accordance with table 2 of LG2.

BREEAM Compliance

ENE 4: External lighting

1. External light fittings for the building, access ways and pathways will be selected such that the average installed efficacy for the site exceeds 50 lamp lumens / circuit Watt when a lamp has a colour rendering index greater than or equal to 60. Or 60 lamp lumens / circuit Watt when a lamp has a colour rendering index less than 60.
2. External lighting for signs and uplighting will be selected such that the average installed efficacy for the site exceeds 60 lamp lumens / circuit Watt where the lamp wattage is greater than or equal to 25W or 50 lamp lumens / circuit Watt where the wattage is less than 25W.
3. External light fittings will be controlled by a combination of time switches and daylight sensors in order to prevent operation during daylight hours, this will take effect from 23:00.

POL 7: Reduction of night time light pollution

1. The external lighting strategy will be designed to comply with ILE Guidance notes for the reduction of obtrusive light.
2. Adjustable time switches will be provided such that external lighting (other than safety and security lighting) can be automatically switched off between selected hours, this will take effect from 23:00.
3. Safety and security lighting will be designed to comply with ILE's Guidance notes.
4. Illuminated advertisements, where specified, will be designed in compliance with ILE Technical Report 5.

Illumination Levels

As per CIBSE Lighting Guide 2 Hospitals and Healthcare buildings.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.33 JB G1547**
Performance Specification Title	**Television & Radio Distribution**	Date	**August 2014**
Prepared By	**JB**	Checked By	**PM**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	PM
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
PERFORMANCE SPECIFICATION TELEVISION AND RADIO DISTRIBUTION SYSTEMS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

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This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Performance Specification shall include, but not be limited to the following:-

<u>TV and Radio System</u>

- TV and radio transmissions distribution cabling
- Provision of the equipment required to enable radio (including hospital radio) and both “freeview” TV services to be distributed.
- Integration of Hospital Radio with TV and radio system.
- Final run out conduits
- Conduits in or on walls

3.0 PERFORMANCE SPECIFIED SYSTEMS

The Television and Radio Distribution system is a performance specified system and this specification outlines the requirements to be met by the system.

4.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Performance Specification:-

- Power wiring
- Main cable containment (other than final run outs of conduits)
- Suitable Hospital Radio system (by Board)

5.0 INTERFACES AND DEMARCATIONS

The Television and Radio Distribution system shall be separate from NHS Lothian Internet Protocol network.

6.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of current legislation, regulations and standards stated in the Materials & Workmanship clauses.

The Television and Radio Distribution system shall be designed in accordance with HTM 08-03 : Bedhead Services.

7.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

Drawings

As part of the development of the design Project Co. shall prepare general arrangement drawings of the Television and Radio Distribution systems based on the base drawings and coordinated with other services and building elements.

8.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, the Specialist Installer shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

The Hospital. The Project Co. shall include for liaison in conjunction with the Board with members of the Hospital's team with an interest in the planning and administration of the Television and Radio Distribution systems.

9.0 SYSTEMS

Low Current Systems action following mains failure/generator test conditions

The low current systems specified herein to be self-rebooting following mains failure and generator test conditions.

9.1 TELEVISION AND RADIO DISTRIBUTION SYSTEMS

General

The television and radio systems as described below shall be made available as a bedhead service.

Television and radio reception and distribution infrastructure such as external aerials/ dishes, containment and cabling/ distribution to enable radio (including hospital radio) and Freeview TV services shall be provided.

Cabling and Cable Containment

The main cabling routes shall be supported by wire basket cable trays.

Cable drops in or on walls shall be run protected in plastic conduit which shall be provided and installed by the Specialist.

In areas of non demountable ceilings, such as in Theatre suites, wiring shall be run in conduit arranged in a ‘loop-in’ basis to allow wiring without access to the ceiling void.

W20 Television and radio distribution systems

GENERAL

110 PATIENT ENTERTAINMENT SYSTEM INFRASTRUCTURE FOR NHS LOTHIAN ENTERTAINMENT SYSTEM

The Board shall submit proposals to provide the infrastructure necessary to enable the future installation of a leased patient entertainment system which will meet the following specification:

- System manufacturer:
  - Member of the Society of Cable and Television Engineers (SCTE);
  - Member of Confederation of Aerial Industries Ltd (CAI);
  - Member of the Independent Digital Standards Commission (IDSC); or
  - Submit proposals.
- Type: Submit design and cost proposals.
- Input signals:
  - Analogue terrestrial television (UHF);
  - Frequency modulated (FM) radio (VHF);
  - Digital audio broadcasting (DAB);
  - Digital terrestrial television (DTT);
  - Pay TV (hotel services);
  - game and internet services
  - telephone
    and
  - Submit design and cost proposals.
- Aerials:
  - DAB;
  - FM;
  - UHF; and
  - Submit design and cost proposals.
- Distribution equipment:
  - Diplexers;
  - Equalizers;
  - Launch amplifiers;
  - Masthead amplifiers;
  - Multiswitches;
  - Splitters; and
  - Submit design and cost proposals.
- Outlets: Television outlets.
- Accessories: Submit design and cost proposals.
- Completion: Submit design and cost proposals.

110B TV & RADIO DISTRIBUTION SYSTEM

The Board shall submit proposals to provide the infrastructure necessary for radio (including hospital radio) and both digital satellite/terrestrial “freeview” TV services which will meet the following specification:

- System manufacturer:
  - Member of the Society of Cable and Television Engineers (SCTE);
  - Member of Confederation of Aerial Industries Ltd (CAI);
  - Member of the Independent Digital Standards Commission (IDSC); or
  - Submit proposals.
- Type: Submit design and cost proposals.

- Input signals:
  - Analogue terrestrial television (UHF);
  - Frequency modulated (FM) radio (VHF);
  - Digital audio broadcasting (DAB);
  - Digital terrestrial television (DTT);
  - Hospital Radio;
- Aerials:
  - DAB;
  - FM;
  - UHF; and
  - Submit design and cost proposals.
- Distribution equipment:
  - Diplexers;
  - Equalizers;
  - Launch amplifiers;
  - Masthead amplifiers;
  - Multiswitches;
  - Splitters; and
  - Submit design and cost proposals.
- Outlets: Data outlets as identified by ADB codes such as, but not limited to OUT121, OUT131, OUT133 & OUT135.
- Accessories: Submit design and cost proposals.
- Completion: Submit design and cost proposals.

120 CABLING AND CONTAINMENT FOR PATIENT ENTERTAINMENT SYSTEM

- Cable: CAT 6A.
- Containment: Cable basket, as section Y63 and plastic conduit for final run outs.
- Rewireable installation: Required.
- Concealed installation: Required.
- Completion: Submit design and cost proposals.

SYSTEM PERFORMANCE

210 DESIGN

- Equipment provided by NHS Lothian.

220 PERFORMANCE

- ITU impairment grade: Submit proposals.

230 WIND RESISTANCE OF ANTENNAE

- An antennae array should be capable of withstanding winds of 100 km/h and gusting of 160 km/h without excessive movement or permanent deformation.

PRODUCTS

310 UHF ANTENNAE

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Approval: CAI Benchmark.
- Forward gain: Board's choice.
- Front/ back ratio: Board's choice.
- Channel group: submit proposals.

320 FM ANTENNAE

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Approval: CAI Benchmark
- Forward gain dB(i): Board's choice.
- Front/ back ratio dB(i): Board's choice.

330 DAB ANTENNAE

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Forward gain: Board's choice.
- Front/ back ratio: Board's choice.

350 MASTHEAD AMPLIFIERS

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Type: Board's choice.
- Channel group: submit proposals.
- Frequency:
  - DAB 217.5 - 230 MHz;
  - FM 87.5 -108 MHz; or
  - UHF 470-862 MHz.
- Noise (maximum): <3 dB.
- Gain: Board's choice.
- Impedance:
  - Input and output terminals: 75 ohm.
- Mains 230 V connection: Required.

360 EQUALIZERS general

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Type: Submit proposals.
- Transmitter source: Board choice .
- Signal loss: Board's choice.

370 LAUNCH AMPLIFIERS

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Type: Board choice.
- Output power (dB µV) Board's choice.
- Frequency: submit proposals.
- Gain: Board's choice.
- Impedance:
  - Input and output terminals: 75 ohm.

380 MULTISWITCHES general

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Frequency:
  - Satellite bandwidth: 950-2150 MHz.
  - Terrestrial bandwidth: 47-862 MHz.

- Inputs:
  - IF: Board choice.
  - Wideband UHF-VHF: Board choice.
- Outputs Board choice.
- Satellite signal loss Board's choice.
- Terrestrial signal loss Board's choice.
- Switching: 13 V, 18 V, 13 V/ 22 kHz, 18 V/ 22 kHz.

390 DIPLEXERS

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Type: Board choice.
- Signal loss: Board choice.

400 SPLITTERS general.

- Manufacturer Board's choice.
  - Product reference: Board's choice.
- Outgoing connection: Board's choice.
- Frequency range: Board's choice.
- Signal loss: Board's choice.

410A PATIENT ENTERTAINMENT OUTLETS

- Manufacturer: Board's choice.
  - Product reference: Board's choice.
- Type: CAT6A.
- Colour: Match electrical accessories.

EXECUTION

620 INSTALLING ANTENNAE AND DISHES

- Installation: In accordance with the CAI Code of practice for the Installation of terrestrial and satellite TV reception systems.
- Locations: Board's choice.
- Position: Board's choice.
- Mounting: Roof.
  - Concrete base: Required.
- Planning permission: Required.

640 INSTALLING CABLING

- Standard: To BS 7671.
- Installation: In accordance with the CAI Code of practice for the installation of terrestrial and satellite TV reception systems.
- Route: Boards choice and Submit proposals.
- Timing: Do not start internal cabling until building enclosure provides permanently dry conditions.
- Cables: Install in one length.
- Cable pulling: Submit proposals. Do not overstress. Prevent kinks and twisting of the cable.
- Bending radius (minimum): 10 times outside diameter of cable.
- Cable fixing: Do not staple.
- Cables passing through walls: Sleeve with conduit or pipe duct. Bush at both ends.
- Jointing: At equipment and terminal fittings only.

650 INSTALLING AMPLIFIERS

- Location: Board's choice and Submit proposals.

660 INSTALLING OUTLET PLATES

- Mounting: Recessed.
  - Height (finished floor level to underside of equipment): as loaded 1:50 drawings.
- Minimum depth of backboxes: 35 mm.

670 CONNECTION TO LIGHTNING PROTECTION SYSTEM

- Connection: In accordance with the CAI Code of practice for the installation of terrestrial and satellite TV reception systems.

COMPLETION

910 TESTING AND INSPECTION

- Method statement: Submit.
- Tests:
  - At receivers: In accordance with CAI Code of Practice for the Installation of terrestrial and satellite TV reception systems. Signal output level at each head end and amplifier: Measure.
  - Carrier to noise ratio at outlets: Measure.
  - Outlets to be tested: All.
- Results: Submit.

920A DOCUMENTATION

- Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system
- Operation and maintenance instructions: Submit.
- TV Aerial Certificates: Submit
- Record drawings: Submit.
  - Number of copies 3.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.34 JB G1547**
Performance Specification Title	**Nurse Call Systems**	Date	**August 2014**
Prepared By	**JB**	Checked By	**PM**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	PM
FC	July 2014	All	Updated for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
NURSE CALL SYSTEMS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 3,

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

2.0 SCOPE

The scope of work covered by this Performance Specification shall include the following:-

Nurse call systems

Controlled drugs cupboard alarms

Final run out conduits

Conduits in or on walls

3.0 PERFORMANCE SPECIFIED SYSTEMS

The Nurse Call Systems are performance specified systems and this specification outlines the requirements to be met by the systems.

4.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Performance Specification:-

Power wiring

Main cable containment (other than final run outs of conduits)

5.0 INTERFACES AND DEMARCATIONS

The Nurse Call Systems shall include a display panel at the main nurse bases with provision for Fire Alarm and Medical Gas Signals.

6.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of current legislation, regulations and standards stated in the Materials & Workmanship clauses.

The Nurse Call System shall be in accordance with SHTM 08-03.

7.0 DESIGN CRITERIA

Drawings

Project Co. shall prepare general arrangement drawings of the Nurse Call Systems.

The drawings shall indicate as a minimum:-

Nurse call panels including integration with other system alarms and indication
Power supply units
Call points
Hand sets
Reset points
Indicator lamps
Audible alarms
Cable containment requirements
Power requirements
Single line schematic diagram for each department
Single line schematic diagram for overall system
Interface arrangements with pneumatic tube transport system.
Interface arrangements with fire alarm indication.
Interface arrangements with Isolated Power Supply and UPS alarms.

8.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, the Specialist Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

The Hospital. Project Co. shall include for liaison in conjunction with the Board with members of the Hospital's team with an interest in the planning and administration of the Nurse Call Systems.

9.0 SYSTEMS

9.1 Nurse Call Systems

System Type

The system shall be of the hard-wired, fully multiplexed type.

All nurse call panels and accessories shall be sealed and wipe clean and capable of being disinfected or sterilized between patient use to protect against the spread of infection.

Nurse Call Indicator Panels

The indicator panels at each staff base or other control stations shall be flush mounted in the staff base desk or local wall as indicated on the loaded 1:50 drawings and the room data sheets.

In addition to the facilities listed in W55, Clause 380A, the following facilities shall be provided on the staff base nurse call indicator panels:-

The nurse call panel shall interface with the pneumatic tube transport system to indicate arrival of a package at the local station.
The nurse call panel shall interface with the fire alarm system to display the information specified in Specification WW.A.P1.2.36.
The nurse call panel shall also integrate the remote Isolated Power Supply alarms (IPS) and UPS alarms as required by Specification WW.A.P.1.2.24
Medical gas alarm.
Door access control.

Staff bases shall be provided with touch screen LCD panels, these panels shall provide audible and visual indication of the calls being made. Porject Co. shall submit, via the Board, a pro forma for completion a minimum of 6 months prior to the final commissioning of the system, and shall allow for at least 2 No. complete iterations of this information.

Power Supplies and Control Units

Space is available in the Low Current section of the departmental electrical cupboards to accommodate power and control equipment. Such equipment shall not be installed in ceiling voids for reasons of fire risk mitigation.

A power supply unit shall be provided for each nurse call indicator panel.

Each power supply unit shall be dedicated to the nurse call system for the area it serves.

Power supply units shall be provided with spare capacity to drive 25% additional points.

Power supply units shall incorporate standby batteries. Batteries shall be valve regulated lead acid, 10 year life, type, and shall provide 5 minutes autonomy.

Action following mains failure/generator test conditions

The nurse call systems specified herein to be self-rebooting following mains failure and generator test conditions.

Outlets

Project Co. shall supply and install the nurse call outlets as indicated on the loaded 1:50 drawings and on the Room Data Sheets. Follow me indicator lights shall be developed by

All areas shall have flush nurse call services installed.

Equipment in wet areas shall be complete with a waterproof membrane.

Where the loaded drawings indicate multiple co-located nurse call outlets these may be incorporated onto the same outlet plate or unit. For example reassurance lamps might be indicated on the loaded drawings separately from pull cord units, or a push button call point and the associated reset might be indicated as separate units; in both of these, and similar, cases it will be acceptable to utilise outlets which incorporate both functions

Patient Call Handsets

Handsets, shall have an electrostatic discharge immunity sufficient to withstand, without damage, the effects of electrostatic discharge that can occur within the environment in which the equipment is expected to operate. They shall meet the ± 4 kV contact discharge and ± 8 kV air discharge electrostatic discharge tests specified in BS EN 61000-4-2:1995, IEC 61000-4-2:1995.

Handsets shall be of maintenance free, sealed for life design.

Where reading lights for patient use are provided at bedheads they shall be controlled by a switch at the door and at the bedhead and shall also be controlled by a switch on the nurse call handset.

Medical Services Trunking and Pendants

Project Co. shall allow for liaison time as necessary with the medical services trunking and pendant specialists so that the medical services trunking and pendants can be procured complete pre-wired with nurse call cabling and accessories.

For wards and similar areas where medical services trunking units are specified they shall incorporate the features required by the loaded 1:50 drawings, union drawings and the Room Data Sheets.

System Wiring

The main arterial runs of cable containment will be installed by outside the scope of this Performance Specification.

Final run outs of cables from the main arterial containment shall be run protected in plastic LSOH conduit.

In areas of non demountable ceilings, such as in Theatre suites, wiring shall be run in conduit arranged in a ‘loop-in’ basis to allow wiring without access to the ceiling void.

System Operation

Project Co. shall provide a “follow me” lamp system which shall indicate to staff the direction that they need to travel in, to locate the call.

Where there is a possibility of two directions of travel, 2 No. “follow me” lamps systems shall be installed, 1 No. indicating each direction.

The “follow me” lamps shall be ceiling mounted and shall be complete with amber lenses.

Nurse call sounders shall be provided.

The system shall permit the reconfiguration of the “follow me” lamps following the transferral of control of the nurse call system from one staff location to the next.

Dummy Plugs

Where hand held units are pulled out of the socket they shall immediately trigger a patient to staff call.

Fifty dummy plugs are to be provided free issue to the Board, when inserted within the socket removes this call trigger (when reset).

Crash Call

The crash call shall not form part of the nurse call system. Crash calls will be made via the phone system.

Software

Project Co. shall provide 2 N° copies of the software used on this project. Open protocol industry standard software must be used. All software shall be ‘backwards compatible’.

Modifications and Upgrades to the System

The system shall be specifically designed to easily accommodate upgrades and modifications to the system in line with changes in ward usage and nursing practice.

It shall be possible to carry out modifications to the system of operation, update location labels, and adjust tone output levels and flash patterns on-site.

Any future addition of new call and indicating units shall be accommodated by connecting equipment into the Nurse Call Network and running a Windows-based installation program. Upon completion of installation, the system shall automatically register the new devices and store their identity to assist with the future maintenance requirements of the system.

Equipment front-plates shall, in the main, be interchangeable and shall accommodate snap-in escutcheons accessible from the reverse of the plate.

Disability

The entire system must also be compliant with any additional requirements of BS 8300 (needs of disabled people).

W55 Nurse call systems

GENERAL

110 NURSE CALL SYSTEM General
System manufacturer: Board's choice.
Call initiation devices:
- Patient handsets: Refer to loaded drawings and Room Data Sheets.
- Patient pull cords: Refer to loaded drawings and Room Data Sheets.
- Nurse emergency pull-switches: Refer to loaded drawings and Room Data Sheets.

Visual signals:
- Ward entrance indicators: Required.
- Direction “Follow me” indicators: Required.
- Reassurance indicators: Integral within patient handsets.

Operating voltage to BS 7671: Extra low voltage.
Equipment interconnection: Wired.
Power supply units: Required.
Call indicator panels: Required.

120 CABLING AND CONTAINMENT Nurse call
Cable type: Submit design and cost proposals.
Containment: main routes on wire basket tray and rigid plastic conduit final run outs.
Rewireable installation: Required.
Concealed installation: Required.

SYSTEM PERFORMANCE

210 DESIGN
Design: Complete the design of the nurse call system in accordance with HTM 08-03.
Spare capacity: 25% of installed call initiation devices. Circuits, power supply units, nurse call panels shall have capacity for 25% growth.
Proposals: Submit drawings, technical information, calculations and manufacturers' literature.
Equipment electrical power: Provide electrical supplies to equipment requiring power.

220 MODE OF OPERATION
Patient to nurse:
- Sequence of lamps: Operates in a steady mode until cancelled at the associated reset unit.

Nurse emergency pull-switches:
- Sequence of lamps: Operates in a flashing mode until the emergency switch is returned to normal.
- Operation: Must not affect patient or emergency calls from other points on the system.

PRODUCTS

310 PRODUCTS GENERALLY
Products: In accordance with HTM 08-03.

320 PATIENT HANDSETS General
Manufacturer: Board's choice.
Product reference: Submit proposals.
Housing:
Material: High impact white plastics.
Ingress protection: To BS EN 60529, IP 67.
Permanently illuminated nurse call push: Coloured orange with tactile feel and marked with the nurse symbol.
Actuation: Electrical.
Reassurance lamp: Manufacturer's standard.
Reset: Refer to loaded drawings and Room Data Sheets.
Television control: Channel selection and volume control.
Programme controls: Submit proposals.
Bedlight control switch: On and off, marked with lamp symbol.
Attachment clip: Submit proposals.
Cable: White cord with strain relief.
Length: Submit proposals.
Plug: Able to disengage from the socket when strain is applied to the cable.
Mounting type: Submit proposals.
Monitored call circuit: Initiated by a break in the cable or withdrawal of the plug.
Parking bracket: Required.

330 PATIENT PULL CORDS General
Manufacturer: Board's choice.
Product reference: Submit proposals.
Cord colour: Orange.
Acorn: Orange coloured with nurse symbol.
Switch action: Momentary.
Accessories: Integral reassurance lamp with amber lens.

340 NURSE EMERGENCY PULL-SWITCHES General
Type: Pull-on/ push-off action.
Manufacturer: Board's choice.
Product reference: Submit proposals.
Colour: Red.
Labelling on switch: 'Emergency Pull'.
Mounting: Refer to loaded drawings and Room Data Sheets.

350 VISUAL SIGNALS General
Manufacturer: Board's choice.
Product reference: Submit proposals.
Lamp: Manufacturer's standard.
Colour: Red.
Labelling: Unique call device identification code.
Mounting plate material: Zinc plated steel.
Finish: Match electrical accessories.
Mounting type: Ceiling.
Accessories: Integral sounder.

370 POWER SUPPLY UNITS General
Standard: To BS EN 60950-1.
Manufacturer: System manufacturer.
Product reference: Submit proposals.
Output power supply: Stabilized and overload protected.
Integral standby power supply: Required.

380A CALL INDICATOR PANELS General
Manufacturer: System manufacturer.
Product reference: Submit proposals.
Display: LCD.
Lamps: LED.
Number: Refer to loaded drawings and Room Data Sheets.
Day/ night volume control switch: Required.
Patient to nurse call tone: Fixed frequency. 1 s on, 9 s off, until all calls are cancelled.
Nurse to nurse call tone: Manufacturer standard, shall not sound similar to any other alarm tones eg: fire alarms.
Mute switch: Required.
Call transfer: facility required to transfer calls from any indicator panel to any other indicator panel Speech facility: Not required.

EXECUTION

620 EXECUTION GENERALLY
Execution: In accordance with HTM 08-03.

630 INSTALLATION OF PATIENT HANDSETS
Attachment: Flexible lightweight cable, and plug.

640 INSTALLATION OF PATIENT PULL CORDS
Location: Ceiling mounted.
Position within room: Refer to loaded drawings and Room Data Sheets.

650 INSTALLATION OF NURSE EMERGENCY PULL-SWITCHES
Location: Refer to loaded drawings and Room Data Sheets.

660 INSTALLATION OF VISUAL SIGNALS
Location:
Refer to loaded drawings and Room Data Sheets
Kitchen;
Nurses' station;
Overdoor;
Sister's office;
Utility room; and
Submit proposals.
Position: Refer to loaded drawings and Room Data Sheets.

670 INSTALLATION OF POWER SUPPLY UNITS
Location: Centrally within the ward area.
Position: Electrical cupboard.

680 INSTALLATION OF CALL INDICATOR PANELS
Location: Refer to loaded drawings and Room Data Sheets.

COMPLETION

910 TESTING AND COMMISSIONING
Testing and commissioning: In accordance with HTM 08-03.
Controls: Verify operation.
Alarm signalling: Verify operation.
Audible signal sound level output: Measure.
Results: Submit.

920 DOCUMENTATION
Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system
Operation and maintenance instructions: Submit.
Record drawings: Submit.

930 SPARES AND CONSUMABLES
Supply the following spares:
Patient handsets: 2 of each type.
Patient pull cords: 2 of each type.
Lamps: 2 of each type.
Dummy call device plugs: 1 for every 10 patient beds.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Mechanical & Electrical**	Sheet	**WW AP.1.2.35 JB G1547**
Performance Specification Title	**Security Systems**	Date	**August 2014**
Prepared By	**PM**	Checked By	**JB**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	JB
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
SECURITY SYSTEMS

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

2.0 DESCRIPTION OF PROJECT

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central Energy Centre shall be provided to the South of the hospital housing heating, CHP, standby generation, fuel storage and utility incomers.

3.0 SCOPE

The scope of work covered by this Performance Specification shall include but not be limited to the following:-

Access Control System
Intruder Detection and Alarms System
Video door entry intercom
Intercom
Door interlocks
CCTV system
Panic Alarms

Final run outs of conduits
Conduits in or on walls
Interface with nurse call/panic alarms

4.0 PERFORMANCE SPECIFIED SYSTEMS

The Security System is a performance specified system and this specification outlines the requirements to be met by the system.

5.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this Performance Specification:-

Power wiring
Main cable containment (other than final run outs of conduits)
Programming of access control cards
Photographic equipment which the Board may require to process access control cards

6.0 INTERFACES AND DEMARCATIONS

The Security system shall be integrated with a host Internet Protocol network which will support communication, interaction, data transfer and data retrieval from and between the various engineering systems in the building. The Security system shall be connected to the host network via gateways. The Building Management System (BMS) will be provided with a Graphical User Interface which will permit the interrogation of the Security system down to component level. It is not intended that the BMS will control the Security system but rather will monitor component status and provide fault alarm indication at the Graphical User Interface.

The access control system shall be linked to the fire alarm system.

The CCTV system shall be linked to the intruder alarm and access control systems to provide specific viewing functions, such as presenting a picture on a monitor when an access card is presented to a reader, or when a movement detector activates.

Camera presets are required to respond to particular intruder alarms or access violation events, switching from low to high frame rate.

The external PA system shall be linked to cameras so the operator can ‘speak’ to persons in external spaces in an emergency or to reprimand/warn.

The design shall also take cognisance of the Board’s security requirements as detailed in the Board’s operational requirements.

Cabling

The main arterial runs of cable containment will be installed by the outside the scope of this Performance Specification.

Final run outs of cables from the main arterial containment shall be run protected in plastic LSOH conduit.

Cables shall be of the low smoke, zero halogen type (commonly referred to as LSOH, low smoke zero halogen).

In areas of non demountable ceilings, such as in Theatre suites, wiring shall be run in conduit arranged in a 'loop-in' basis to allow wiring without access to the ceiling void.

Power Supply

Final connection of system to power supplies:

7.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of current legislation, regulations, standards stated in the Materials & Workmanship clauses and Secured by Design.

8.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

Drawings

As part of the development of the design the Project Co. shall prepare general arrangement drawings of the Security System based on the base drawings and coordinated with other services and building elements.

Drawings shall include as a minimum:-

Cable containment
Power supplies
Monitors
Cameras
Camera controls
Image storage
Schematics
System integration
Control and indication equipment
Entry phones
Card readers
System interfaces
Door contacts
Magnetic locks
Intercom stations
Door access controllers
Central p.c.
Break glasses
Request to exit buttons
Door interlocks
Panic Alarms

9.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Building Control. Project Co. shall liaise, with and adhere to, the requirements of the Building Control Officer.

Any other member of the Project and Hospital teams concerned with the planning and administration of security systems and policies.

10.0 SYSTEMS

The final selection of all equipment and cabling shall be carried out by Specialist.

The design for all security systems shall be in line with the general principals of the approach recommended by Secured by Design.

Power Supplies and Control Units

Space is available in the Low Current section of the departmental electrical cupboards to accommodate power and control equipment. Such equipment shall not be installed in ceiling voids for reasons of fire risk mitigation.

Software

Project Co. shall provide 2 N° copies of the software used on this project. Open protocol industry standard software must be used. All software shall be 'backwards compatible'.

Low Current Systems action following mains failure/generator test conditions

The low current systems specified herein to be self-rebooting following mains failure and generator test conditions.

Low Current Systems with battery back-up

All battery systems shall be easy to test and change, it should be possible to replace the batteries without powering down or interrupting the operation of the system.

Warning shall be provided to the BMS when battery systems are failing and require maintenance replacement.

10.1 ACCESS CONTROL

General

Refer to security drawings for the locations of access controlled doors and video intercom units serving access controlled doors which represent the Boards requirements.

All entrance/exit doors will require door control systems with video entry systems and shall be operated internally by high level push to open buttons. Where video entry systems are being provided the position and quantity of cameras shall be such to enable the operator to view standing adults, children and persons in wheelchairs.

As a general rule of thumb, the following doors shall incorporate a controlled access system.

All external access doors
IT node room doors
Doors to wards
Main entrance doors to departments
FM & patient bed lifts
Additional restricted areas to be defined by NHS Lothian

The system shall be programmable to grant different patterns of access to staff and visitors.

Each ward, department and service area shall be capable of being locked down separately.

Proximity card readers shall be fitted to external personnel access doors into the Energy Centres.

The access control system should not inhibit emergency escape or access by the staff at any time.

The door access control system shall be integrated within the Nurse Call system, refer to PMI-069 and the Nurse Call performance specification WW AP.1.2.34 JB G1547.

Interfaces

The access control system shall also interface with the lifts and automatic doors.

Controlled doors along escape routes shall be capable of manual or automatic release in the event of the fire alarm system activating. Where escape runs from the public to the secure side of an access controlled door, the system shall operate such that the door is automatically released. Where escape runs from the secure to the public side of an access controlled door, the door shall be capable of manual release.

External Video Door Entry

The video door entry systems shall interface with the access control system and where indicated on the drawings, video door entry units shall be provided in order to communicate with personnel requesting entry. They also shall be provided with appropriate door release buttons.

The video camera shall be suitable for viewing of visitors in wheel chairs.

The external video door entry systems serving the main entrances shall be standalone systems and may utilise the external CCTV cameras if the location of the cameras is such to provide facial recognition of the persons, including wheel chair users, seeking entry to the security staff providing entry. The entry systems shall be provided with local control and facility to transfer to the main security room centre.

The external video door entry systems serving all other external entrance locations shall be standalone systems linked to the local staff base as indicated on the security layouts. The video door entry systems shall interface with the access control system and where indicated on the drawings, video door entry units shall be provided in order to communicate with personnel requesting entry.

They also shall be provided with appropriate door release buttons. The video camera shall be suitable for viewing of visitors in wheel chairs.

Internal Video Door Entry

The internal video door entry systems shall be standalone systems linked between the controlled door and the local staff base as identified on the security layouts.

The video door entry systems shall interface with the access control system and where indicated on the drawings, video door entry units shall be provided in order to communicate with personnel requesting entry. They also shall be provided with appropriate door release buttons.

The video camera shall be suitable for viewing of visitors in wheel chairs.

Proximity Cards

Proximity cards shall be incorporated within staff I.D. Badges with a facility to enable alterations to cards.

The access control system cards shall be compatible with the electric access control system in the RIE so that a single card can be used throughout.

Up to 15 templates shall be provided to allow the Board to programme and issue their access control card.

1No. PC and 1No. printer shall be provided to facilitate the above. No consumables to be provided.

Card Readers

These shall have anti-vandal fastenings and protective casings. External readers must be waterproofed to IP54 and a rain shield provided where the reader type requires further protection.

Break Glass Units

Break glass override units shall be provided on the secure side of all access control doors to locally interrupt the power circuit to the mag locks (for emergency use). This break glass unit shall be coloured green.

Request To Exit Units (RTEs)

RTEs shall generally be provided on the secure side of the access controlled door to allow normal egress from the secure area where indicated on drawings.

Door Locks

Magnetic locks shall be of the face-to-face type. Mag locks shall not be of the recessed Shearlock type.

10.2 INTRUDER DETECTION AND ALARM SYSTEMS

An Intruder Detection System shall be provided for out of hours security cover. PIR detectors shall be located in the following areas:-

Corridors

Ground floor rooms with windows

Internal rooms adjacent to any roof access points

Alarms shall link to the Security Control Centre. Local security systems alarm annunciation shall be provided with wards.

The details of the Intruder Alarms system shall be developed by the specialist.

Door Contacts

Door contacts shall be provided at each access controlled door to report to the access control system whether a door has been left ajar or a door has been forced open without the use of a RTE, card reader or fire alarm interface unit.

10.3 CCTV

The system shall adhere to the guidance given under Article 1 of Protocol 1 of the Human Rights Act 1998. Dynamic privacy control units shall be incorporated into the system whereby they can only be modified by means of an authorised password.

The systems shall present a secure and reassuring environment for staff, patients and visitors by providing appropriate security measures within the particular restraints imposed by clinical demand and personal freedom.

The CCTV system shall be installed, and provided with appropriate signage, in accordance with the requirements of the Data Protection Act and architect's details.

Video Signal Management

All cameras shall be linked back to the Control Centre with local supplementary monitors in accordance with the Clinical Requirements.

The main receptions & A&E receptions shall also incorporate a CCTV monitor position each with a flexible control facility to allow a combination of monitoring arrangements over two 20" flat LCD screens.

Local security systems alarm annunciation shall be provided within wards at the staff bases and at the central security room with facility for remote monitoring and control off site.

The scheduler shall be available for recording day, night and weekends so that different settings can be changed such as:-

Number of cameras to be recorded
Change record rates
Select activity on individual cameras (for example turn on camera during night periods only)
The stored video information shall be easily retrievable by entering the date and time.
The hard drives shall have the facility to be networked so that the system (live or stored data) may be viewed via a remote PC.
All cameras shall be provided with movement sensors so that movement detection can automatically set the CCTV cameras to a higher recording rate.
The system shall have the capability to increase camera record rates upon operation of intruder alarm detection or by operation of access controlled doors and/or external periphery doors

CCTV, Cameras, Servers and Image Storage

All CCTV cameras shall be IP-based. They shall be linked back to local hubs by fibre or Cat.6A cabling. Local data hubs shall be connected back to CCTV servers which shall in turn be linked to the main server room via a looped optical fibre network. CCTV cameras to be of the domed type.

CCTV cameras shall be programmed to 'tour' the viewable areas.

CCTV servers shall include input modules, processors and RAID storage providing 100% back-up. The system shall record at 25FPS per camera and provide 31 days storage; images shall be compressed, with the exception of a one hour period before and after alarm incidents, and be overwritten after 31 days of storage. Each CCTV server shall also be provided with an independent broadband connection to provide connectivity in the event of a network failure.

The system shall comprise a multi-channel digital recorder with a recording frame per second for each camera which is in accordance with a detailed engineering specification to be agreed with Lothian and Borders Police. The digital recorder shall also control playback of images onto a CCTV monitor.

The system shall be provided with a dedicated UPS of 30 minutes autonomy, in accordance with SHTM 06-01 recommendations, to protect against loss of data

Trigger Functions

The CCTV system shall be linked to the intruder alarm and access control systems to provide specific viewing functions, such as presenting a picture on a monitor when an access card is presented to a reader, or when a movement detector activates.

Internal CCTV

Project Co. shall provide a comprehensive colour CCTV system integrated within the BMS covering all corridors, reception, lift lobbies and other areas where members of the public gather or areas where access is to be restricted i.e. wards.

CCTV cameras shall be installed at the main entrances, waiting and circulation areas where the security and safety of hospital staff and patients is a concern but where free access for the visiting public is allowed. The CCTV systems are also to cover:-

All exits and entrances (including the Energy Centre entrance)
Ambulance parking
Vehicle bays
Fill points
Ward entrances
Children's play areas
Ambulance entry points
A&E departments
Car parks, estates yards, public spaces
Generator plant rooms
Main heating plant rooms
Corridors
Receptions
Lift lobbies
Other areas where members of the public gather or areas where access is to be restricted

All camera positions shall be provided with a local power supply unit with battery back-up provided to the server racks.

External CCTV

Project Co. shall provide a comprehensive colour CCTV system covering all external access points, car parking and external pedestrian/cycle circulation routes around the full site including FM, service yards, car parks, walkways, therapy gardens, boundary of/entrances to Site, boulevard, service tunnel etc, and the general road network.

External cameras shall be mounted on dedicated CCTV poles provided with a duct for power cabling and a second for comms cables.

External cameras to be capable of operating in reduced light conditions, cameras to be of the “low light” type.

External cameras shall be fully functional, set up with stops to avoid over viewing of adjacent properties.

External cameras covering the car parking areas shall be provided with number plate recognition capability.

The external CCTV system shall be testing using the Rotakin test in accordance with BS EN 50132-7. Human recognition (50% Rotakin) shall be provided in all areas.

10.4 INTERCOM SYSTEM

General

The intercom system fitted as part of the door entry system is described in the access control section.

This section relates to standalone intercom systems as indicated on the drawings.

The final positions of the Intercom Master Stations, Sub-Stations and Power Supplies shall be determined during the detailed design.

System Operation

The system shall be local standalone systems and shall provide total hands free open voice communication operation after the initiation of a call, with full duplex speech. The Master Station handset will allow communication privately or press-to-talk.

In the event of a user attempting to make a call to a station already in operation an engaged signal will be received.

10.5 PANIC ALARMS

General

The system shall satisfy the following requirements.

Panic alarms shall be integrated with the security system and BMS to allow:-

The unlocking of doors, initiated by the Fire Alarm system, along all escape routes to assist evacuation in an emergency.
Automatic locking of doors within the Accident & Emergency Departments if a panic button is pressed.
Activation of a security camera in a particular position when a door is opened to provide a picture of the person entering.

All panic alarms fixed and mobile shall be monitored centrally by the on-site Security Control Centre and shall provide a description of the alarm activation and the precise location of staff members in distress.

Fixed Panic Alarms

Locations as identified in the architects ADB drawings shall be fitted with panic alarms in the form of a discrete push button fixed to the underneath of the desks and hardwired to the security system.

At these locations a loud alarm shall be raised at the scene of the incident on activation of a panic alarm button.

Staff Mobile Panic Alarms/Personal Attack Alarms

Staff mobile panic alarms shall be provided for:

Emergency Department
Imaging Department
Emergency Decontamination
Out of Hours Service Areas

Staff mobile panic alarms shall be linked to reception desks of the relevant department.

An NHS Wi-Fi network shall be installed throughout the Hospital to facilitate the use of personal attack alarms.

The Wi-Fi/radio-frequency network infrastructure shall be compatible with the personal security device to provide lone-worker protection.

W40 Access control systems

GENERAL

110 ACCESS CONTROL SYSTEM GENERALLY
Standards: To BS EN 50133-1 and in accordance with BS EN 50133-7.
Manufacturer: Submit proposals.
Registration:
A member of BSIA;
A Gold member of NSI;
A Silver member of NSI; or
A member of SSAIB.
Operation in the event of mains failure: Access point remain secure.
Tokens: Proximity cards and Submit design and cost proposals.
Readers: Proximity readers.
Standby battery supply: 24 h (VRLA with 10 year life).
Locking mechanisms: Magnetic locks (face-to-face type) and strike plates. Magnetic locks shall not be of the recessed Shearlock type.
Controls: Board's choice.
Accessories:
Access control point status monitoring devices;
Card printer;
Digital camera;
Emergency break glass units; and
Request to exit buttons.

120 AUDIO INTERCOM SYSTEM
Entrance panel: Required.
Remote handsets: as drawings.
Manufacturer: Submit proposals.
Product reference: Submit design and cost proposals.
Audio communication: Two way.
Remote door opening via handset: Required.
Calling method: Push button.

130 VIDEO INTERCOM SYSTEM
Entrance panel: Required.
Remote handsets: as drawings.
Manufacturer: Submit proposals.
Product reference: Submit design and cost proposals.
Audio communication: Two way.
Video communication: One way.
Video image: Colour.
Camera type: Wide angle.
Remote door opening via handset: Required.
Calling method: Push button.
Mounting Height: 1200mm to centre of lens unless specified otherwise on architect's elevation drawings.

140 CABLING AND CONTAINMENT general
Cable type: Board's choice.
Containment: Cable basket as section Y63.
Rewireable installation: Required.
Concealed installation: Required.

SYSTEM PERFORMANCE

210 DESIGN
Design: Complete the design of the access control system.
Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

220 ACCESS CONTROL POINTS GENERALLY
Recognition classification to BS EN 50133-1: Class 2.
Access classification to BS EN 50133-1: Class B.
Environmental classification to BS EN 50133-1: Submit proposals.
Number of transactions (minimum): Submit proposals.

230 CONNECTION TO FIRE DETECTION AND ALARM SYSTEMS
Operation in the event of a fire signal: Access points open if escape needs to pass through secure area.

240 INTEGRATION WITH OTHER ALARM AND SECURITY SYSTEMS
Objectives: Fully integrated security system operating on engineering IT network via Internet Protocol. Refer to Particular Specification..
Systems to be integrated:
Closed circuit television systems as section W44;
Intruder detection and alarm systems as section W41;
Fire detection and alarm systems as section W50;
Central controls and building management systems as section Y40; and
Submit proposals.

PRODUCTS

310 MULTIPLE TECHNOLOGY CARDS
Type: Proximity card.

320 PROXIMITY CARDS
Standard: To BS ISO/IEC 10373-6.
Type: Non-contact 125 kHz proximity multi-chip and antenna without battery.
Physical characteristics: To BS ISO/IEC 14443-1.
Code: Unique, pre-programmed to BS 7227.
Unique, visible identification number: Required.
Manufacturer's guarantee against electronic failure (minimum): 25 years.
Accessories: Slot and neck strap.

360 PROXIMITY READERS
Manufacturer: Board's choice.
Product reference: Submit proposals.
Operating frequency: 125 kHz.
Proximity read range: Submit proposals.
Visual indication: LED displaying red when access point status secure, green when unlocked.
Audio status indication: Multiple tone sequences.
Tamper detection: Required.
Colour: Submit proposals.

390 INTERCOM ENTRANCE PANELS
Entrance panel call buttons: To suit.
Microphone: Integral.
Speaker: Integral.
Camera: Integral within video intercom entrance panels.
Finish: White.
Backlight: Required.
Audio tone when button pressed: Required.

400 ACCESS CONTROL CABLES
Standard: To BS 4737-3.30.
Conductor:
Nominal diameter: Board's choice.
Stranding: Board's choice.
Sheath: LSZH.
Cores (minimum): Board's choice.

420 MAGNETIC LOCKS AND STRIKE PLATES
General: Magnetic locks shall not be of the recessed Shearlock type.
Manufacturer: Board's choice.
Product reference: Submit proposals.
Operating voltage: Board's choice.
Operation: Fail unlocked.
Holding force (minimum): 8 kN.
Material and finish: Submit proposals.
Instant release circuit: Required.
LED status indication: Not required.

440 INTERCOM REMOTE HANDSETS/ WALL MOUNTED DEVICE
Buzzer: Integral – Activates when door open and shall have facility for user override.
Monitor: Integral within video remote handsets/ wall mounted device.
Door release button: Required.
Mounting: Wall.
Finish: White.

450 ACCESS CONTROL SYSTEM CONTROLLERS
Manufacturer: Board's choice.
Product reference: Submit proposals.
Type: Microprocessor based.
Administration access: Password protected.
Synchronise date and time: Once a day.
ODBC compatible database:
Users (minimum): 12000.
Information fields per user:
Access period.
Access points.
Department.
Email address.
First name.
Holiday schedule.
Last name.
Photograph.

Telephone.
Token expiry.
Token number.
Visitor status.
Spare information fields per user (minimum): Submit proposals.
Import and export of database in ASCII format: Required.
Monitor and record the following transactions and events:
Forced access.
Pass back attempt.
Tamper.
Transaction invalid.
Transaction timed out.
Transaction valid.
Events and transactions: Data and time stamp.
Customised event alarms: Display.
Control features:
Access point status monitoring.
Anti pass back control: Global.
Auto unlock at predefined times.
Configure access groups, grids and levels.
Configure access point unlock time.
Configure time grids, zones and slots.
Daylight time saving.
Display access point status on site and layout plans.
Reports: Provide searchable information.
Transaction and event reports:
By access point.
By area.
By department.
By time and date period.
By transaction type.
By user.
Other reports:
Occupancy reports.
Time and attendance reports.
Publishing: Export to pdf and Print.

455 DOOR CONTROLLERS
Number of doors per controller: Board's choice.
Door lock battery backup: Within system controller (VRLA with 10 year life).
Time between token presentation and door unlock (maximum): 0.3 s.
Enclosure:
Material: Steel.
Finish: Board's choice.
Tamper alarm: Required.

460 PERSONAL COMPUTERS
Manufacturer: Board's choice.
Product reference: Board's choice.
Processor: Board's choice.
Read only memory (RAM): Board's choice.
Hard disk:

Capacity: Submit proposals.
Speed: Submit proposals.
Video card: Submit proposals.
Sound card: Board's choice.
DVD/ CD rewriter: Required.
Network card: 10/100 base T Ethernet.
Modem: V.92 56 kbits/s data, fax and voice..
Monitor: 20 inch LCD
Keyboard and mouse: Wireless.
Operating system: Windows XP.

465 ACCESS CONTROL POINT STATUS MONITORING DEVICES
Type: Magnetic reed switch.
Material: Aluminium.
Mounting: Recessed.

470 CARD PRINTERS
Type: Dual sided.
Print:
Method: Colour dye sublimation.
Resolution: 300 dpi.
Operation: Double sided.
Speed (minimum): 90 cards/ h.
Laminate: Hologram.
Card feeder capacity: 200.

480 EMERGENCY BREAK GLASS UNITS: Generally
Manufacturer: Board's choice.
Product reference: Board's choice.
Frangible element: Non-resettable.
Colour: Green.
Labelling: "EMERGENCY DOOR RELEASE".
Mounting: Semi-recessed.

480 EMERGENCY BREAK GLASS UNITS: DCFP department
Type: Vandal resistant.
Manufacturer: Board's choice.
Product reference: Board's choice.
Frangible element: Non-resettable.
Colour: Green.
Labelling: "EMERGENCY DOOR RELEASE".
Mounting: Semi-recessed.

490 REQUEST TO EXIT BUTTONS
Manufacturer: Board's choice.
Product reference: Board's choice.
Material: Plastics.
Finish: White.
Engraving: "PUSH TO EXIT".
Operation: Momentary.
Illuminated button: Not required.

EXECUTION

620 INSTALLING ACCESS CONTROL SYSTEMS
Standard: To BS EN 50133-1 and in accordance with BS EN 50133-7.
Location of the access controller: Submit proposals.
Token reader: Install next to system controller.

630 INSTALLING CABLING Generally.
Standard: To BS 7671.
Route: Submit proposals.
Timing: Do not start internal cabling until building enclosure provides permanently dry conditions.
Cables: Install in one length.
Cable pulling: Submit proposals. Do not overstress. Prevent kinks and twisting of the cable.
Cables passing through walls: Sleeve with conduit or pipeduct. Bush at both ends.
Jointing: At equipment and terminal fittings only.

650 INSTALLING READERS generally
Mounting:
Type: Wall.
Height (finished floor level to underside of equipment): 900 mm.

690 INSTALLING INTERCOM SYSTEMS generally
Entrance panel:
Mounting: Recessed.
Location: Submit proposals.
Height (finished floor level to underside of equipment): 1300 mm.
Handset locations: as drawings.
Labelling: Identify call buttons.

COMPLETION

910 TESTING AND COMMISSIONING GENERALLY
Standard: To BS EN 50133-1.
System commissioning agent: Board's choice.
Notice before commencing tests (minimum): Board's choice.
System programming:
Configure user database and tokens.
Number of users: 12000.
Configure access permissions.
Configure time grids, zones and slots.
Cable testing:
Insulation resistance: Submit results.
Earth continuity: Submit results.
Access points: Verify the correct operation of reader and lock mechanism. Configure unlock times.
Standby supply: Verify operation in the event of a mains failure. Check capacity and submit results.
Charger: Verify operation.
Equipment tamper detection: Verify operation.

920 EQUIPMENT LABELLING AND SYSTEM DIAGRAMS
Access points and door controllers: Label with a unique identification code.
System diagram: Provide showing the location and identity of all system equipment.
Location: Next to the access system controller.

930 AUDIO INTERCOM SYSTEM TESTING AND COMMISSIONING
Call button: Verify the operation of call buttons.
Audio communication: Verify 2 way audio communication.
Remote release: Verify the operation of remote door release facilities.

940 VIDEO INTERCOM TESTING AND COMMISSIONING
Call button: Verify the operation of call buttons.
Audio communication: Verify 2 way audio communication.
Video image: Verify the operation of the video camera and remote display.
Remote release: Verify the operation of remote door release facilities.

950 DOCUMENTATION
Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system
Operation and maintenance instructions: Submit.
Record drawings: Submit.
Commissioning Certificate: Submit.
Test Certificate: Submit.

960 SPARES AND CONSUMABLES
Tokens to be supplied: none.

W41 Intruder detection and alarm systems

110 INTRUDER DETECTION AND ALARM SYSTEMGENERALLY
Standard: To BS EN 50131-1.
System manufacturer: Submit proposals.
Registration: Submit proposals.
Grade: Grade 2.
Power supply: Type A.
Environmental classification: Class I.
Areas to be protected: Refer to Particular.
Perimeter protection: Submit design and cost proposals.
Detectors: Submit proposals.
Equipment interconnectivity: Wired.
Cabling and containment:
Cable type: Submit design and cost proposals.
Containment: Rigid conduit, as section Y60.
Rewireable installation: Required.
Concealed installation: Required.
Warning devices:
Internal: Submit design and cost proposals.
External: Submit design and cost proposals.
Signalling method: Submit design and cost proposals.
Control and indicating equipment (CIE): Submit design and cost proposals.
Accessories: Submit design and cost proposals.
Completion: Submit design and cost proposals.

SYSTEM PERFORMANCE

210 DESIGN
Design: Complete the design of the intruder detection and alarm system.
Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

225 ZONING AND DEVICE IDENTIFICATION
Zoning: Divide the installation into separately controlled and identifiable zones.
Device identification: Individual address.

230 SPARE CAPACITY
Spare capacity (minimum): 25%.

235 CONNECTION TO FIRE DETECTION AND ALARM SYSTEMS
Fire and fault signal: Accept and relay to the alarm receiving centre.

246 INTEGRATION WITH CCTV SYSTEMS
Integration: In accordance with BS 8418.

250 DIGITAL COMMUNICATORS
Standards: To BS EN 50136-1-3 and BS EN 50136-2-3.

252 DIRECT LINE SIGNALLING
Standards: To BS EN 50136-1-2 and BS EN 50136-2-2.

255 PREVENTION OF SETTING FOR GRADE 2 SYSTEMS
Conditions preventing system setting: Submit proposals.

261 SUPPLEMENTARY PROCESSING OF SIGNALS FOR GRADE 2 SYSTEMS
System status, set:
Response to hold-up signal/ message: Submit proposals.
Response to fault signal/ message: Submit proposals.
ATS message type in response to tamper signal/ message: Submit proposals.
System status, unset:
Response to hold-up signal/ message: Submit proposals.
Response to tamper signal/ message: Submit proposals.
ATS message type in response to hold-up signal/ message: Submit proposals.
ATS message type in response to tamper signal/ message: Submit proposals.
ATS message type in response to fault signal/ message: Submit proposals.

265 SUPPLEMENTARY INDICATIONS FOR GRADE 1 AND 2 SYSTEMS
System set: Submit proposals.
During setting: Submit proposals.
During unsetting: Submit proposals.

272 NOTIFICATION REQUIREMENTS FOR GRADE 2 SYSTEMS
Means of notification: Submit proposals.

280 SUPPLEMENTARY TAMPER DETECTION FOR GRADE 2 SYSTEMS
Tamper detection of junction boxes: Submit proposals.
Additional forms of tamper detection: Submit proposals.

286 MONITORING SUBSTITUTION OF GRADE 1, 2 AND 3 SYSTEM COMPONENTS
Substitution of system components: Submit proposals.
Substitution of signals/ messages: Submit proposals.
Timing:
Substitution of system components: Submit proposals.
Substitution of signals/ messages: Submit proposals.

290 EVENT RECORDING FOR GRADE 2 SYSTEMS
Memory capacity (minimum): Submit proposals.
Endurance of memory after system power failure (minimum): 30 days.
Event recording functions: Submit proposals.

PRODUCTS

310 ACOUSTIC DETECTORSGENERALLY.
Standard: To BS 4737-3.6.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Mounting: Submit proposals.
Features: Submit proposals.

312 BEAM INTERRUPTION DEVICESGENERALLY.
Standard: To BS 4737-3.12.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Mounting: Submit proposals.
Features: Submit proposals.

314 CAPACITIVE PROXIMITY DETECTORSGENERALLY.
Standard: To BS 4737-3.13.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Mounting: Submit proposals.
Features: Submit proposals.

316 COMBINED PASSIVE INFRARED AND MICROWAVE DETECTORSGENERALLY.
Standard: To BS EN 50131-2-4.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Mounting: Submit proposals.
Features: Submit proposals.

317 COMBINED PASSIVE INFRARED AND ULTRASONIC DETECTORSGENERALLY
Standard: To BS EN 50131-2-5.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Mounting: Submit proposals.
Features: Submit proposals.

318 DELIBERATELY OPERATED DEVICESGENERALLY
Standard: To BS 4737-3.14.
Type: Submit proposals.
Manufacturer: Submit proposals.
Submit proposals: Submit proposals.
Operating mechanism: Submit proposals.
Key reset: Required.
Operating method: Submit proposals.
Sound level during operation: Submit proposals.

319 MICROWAVE DETECTORSGENERALLY
Standard: To BS EN 50131-2-3.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Mounting: Submit proposals.
Features: Submit proposals.

320 PASSIVE INFRARED DETECTORSGENERALLY.
Standard: To BS EN 50131-2-2.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Mounting: Submit proposals.
Features: Submit proposals.

322 PROTECTIVE SWITCHESGENERALLY.
Standard: To BS 4737-3.3.
Type: Magnetic reed switch.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Circuit configuration: Submit proposals.
Material: Submit proposals.
Mounting: Submit proposals.
Features: Submit proposals.

326 ULTRASONIC DETECTORSGENERALLY
Standard: To BS 4737-3.5.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Mounting: Submit proposals.
Features: Submit proposals.

328 VIBRATION DETECTORSGENERALLY
Standard: To BS 4737-3.10.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Mounting: Submit proposals.
Features: Submit proposals.

330 VOLUMETRIC CAPACITIVE DETECTORSGENERALLY.
Standard: To BS 4737-3.8.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Mounting: Submit proposals.
Features: Submit proposals.

340 ELECTRONIC SOUNDERS
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Colour: Submit proposals.

345 LED CLUSTERS
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Colour: submit proposals.

350 VIBRATING PAGERS
Manufacturer: Submit proposals.
Product reference: Submit proposals.

355 XENON BEACONS
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Colour: submit proposals.

360 EXTERNAL SOUNDERS
Type: Self activating bell, foam proof.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Stand by power supply: Integral.
Colour: Submit proposals.
Strobe: Integral.
Visual indication: LED.
Ingress protection to BS EN 60529: IP65.

400 CONTROL AND INDICATING EQUIPMENT (CIE)GENERALLY
Standard: To BS EN 50131-1.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Controller: Microprocessor based.
Features:
Event time recording.
Alarm and fault indication.

450 REMOTE KEYPADS
Backlight: Required.
Individual zone identification: Required.
Individual device identification: Required.
Deliberately operated button: Integral.

480 MULTI-CORE INTRUDER ALARM CABLES
Standard: To BS 4737-3.30.
Conductor: 0.22 m², 7 x 0.2 mm stranding.
Sheath: LSZH.
Cores (minimum): Submit proposals.

EXECUTION

620 INSTALLING INTRUDER ALARM CONTROL AND INDICATING EQUIPMENT
Standards: To BS 7671 and BS EN 50131-1.
Location: Submit proposals.
Main power supply: From an unswitched fused connection unit. Permanently wire with a dedicated circuit from the building's main low voltage switchboard.
Dummy external sounder: Required.
Location: Submit proposals.

630 INSTALLING CABLES
Route: Submit proposals.
Device wiring: Individual radial circuit from control panel.
Timing: Do not start internal cabling until building enclosure provides permanently dry conditions.
Cables: Install in one length.
Cable pulling: Submit proposals. Do not overstress. Prevent kinks and twisting of the cable.
Cables passing through walls: Sleeve with conduit or pipeduct. Bush at both ends.
Jointing: At equipment and terminal fittings only.

635 INSTALLING ACOUSTIC DETECTORS Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): 3000 mm.

640 INSTALLING BEAM INTERRUPTION DEVICES Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): Submit proposals.

645 INSTALLING CAPACITIVE PROXIMITY DEVICES Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): Submit proposals.

650 INSTALLING COMBINED PASSIVE INFRARED AND MICROWAVE DETECTORS Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): Submit proposals.

651 INSTALLING COMBINED PASSIVE INFRARED AND ULTRASONIC DETECTORS Generally
Mounting: Recessed.
Height (finished floor level to underside of equipment): Submit proposals.

655 INSTALLING DELIBERATELY OPERATED DEVICES Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): Submit proposals.

660 INSTALLING MICROWAVE DETECTORS Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): Submit proposals.

665 INSTALLING PASSIVE INFRARED DETECTORS Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): Submit proposals.

670 INSTALLING PROTECTIVE SWITCHES Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): Submit proposals.

675 INSTALLING ULTRASONIC DETECTORS Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): Submit proposals.

680 INSTALLING VIBRATION DETECTORS Generally.
Mounting: Surface mounted.
Height (finished floor level to underside of equipment): Submit proposals.

685 INSTALLING VOLUMETRIC CAPACITIVE DETECTORS Generally.
- Mounting: Recessed.

Height (finished floor level to underside of equipment): Submit proposals.

690 INSTALLING ELECTRONIC SOUNDERS Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): Submit proposals.

695 INSTALLING LED CLUSTERS Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): Submit proposals.

700 INSTALLING XENON BEACONS Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): Submit proposals.

710 INSTALLING REMOTE KEYPADS Generally.
Mounting: Recessed.
Height (finished floor level to underside of equipment): 1300 mm.

COMPLETION

905 TESTING AND COMMISSIONING GENERALLY
Standard: To BS EN 50131-1.
System commissioning agent: Submit proposals.
Notice before commencing tests (minimum): 2 weeks.
Cable testing
Insulation resistance: Submit results.
Earth continuity: Submit results.
Charger: Verify operation.
Detection devices: Verify the operation, and adjust to provide maximum coverage.
Device voltage: Submit details of the voltage at powered devices.
Local warning devices: Verify operation.
Remote signalling: Verify operation.
Standby supply: Verify operation in the event of a mains failure. Check capacity and submit results.
Tamper detection: Verify operation.
Timers: Set up and adjust entry and exit timers.
User codes: Set up and commission.

910 DEVICE IDENTIFICATION AND TESTING
Device list: Before commissioning submit proposals, including proposed device, zone and group names.
Zone diagram: Before commissioning submit proposals.
Device identification: Label devices with a unique address corresponding to that used by the CIE.
Device testing: Verify the operation of each device. Submit a schedule of devices, including the device test methods and results.

915 SYSTEM SOAK TESTING
Soak test: Undertake when construction works are complete, but before handover and before connection to a remote alarm receiving centre.
Period: 14 days.
Re-test after remedial works.

920 STANDBY BATTERY TESTING

Mains power supply: Isolate.

Quiescent mode: Measure current supplied by standby source when intruder detection and alarm system is operating in the quiescent mode. Submit results.

Alarm mode: Measure current supplied by standby source when intruder detection and alarm system is operating in the alarm mode. Submit results.

925 TESTING ACTUATION, INTEGRATION AND INTERFACING WITH ALARM AND SECURITY SYSTEMS

Connections with other systems and equipment: Verify and demonstrate operation of the systems and equipment under fire and fault conditions. Submit results.

935 DOCUMENTATION

Standard: To BS EN 50131-1.

Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system

Operation and maintenance manual: Submit.

Record drawings: Submit.

Commissioning Certificate: Submit.

Test Certificate: Submit.

940 LOG BOOK

Type: Hard back cover embossed "INTRUDER DETECTION AND ALARM SYSTEM LOG BOOK" with A4 lined paper, minimum 100 pages.

Number of copies: 3.

945 SPARES AND CONSUMABLES

Supply the following spares:

Deliberately operated devices: 2 of each type.

Detectors: 2 of each type.

Protective switches: 2 of each type

W44 Closed circuit television systems

GENERAL

110 CCTV SYSTEM Internal areas
System: In accordance with BS EN 50132-7 and Home Office Scientific Development Branch CCTV operational requirements manual.
Manufacturer: Board's choice.
Registration: Submit design and cost proposals.
Format: Consultative Committee for International Radio (CCIR) PAL colour, 1080 scan
lines/frame, 25 frames/second, 16:9 aspect ratio.
Purpose: To provide a secure and reassuring environment for staff, patients and visitors.
Type: Digital.
Surveillance equipment: Cameras.
Controller: Control matrix.
Telemetry transmitter and receivers: Submit design and cost proposals.
Number of monitors: Camera: monitor ratio (maximum)10:1.
Data collection: Submit design and cost proposals.
Accessories:
Camera brackets;
CCTV signage;
Internal camera housings; and
Submit design and cost proposals.

110A CCTV SYSTEM External areas
System: In accordance with BS EN 50132-7 and Home Office Scientific Development Branch CCTV operational requirements manual.
Manufacturer: Board's choice.
Registration: Submit design and cost proposals.
Format: Consultative Committee for International Radio (CCIR) PAL colour, 1080 scan lines/frame, 25 frames/second, 16:9 aspect ratio.
Purpose: To provide a secure and reassuring environment for staff, patients and visitors..
Type: Digital.
Surveillance equipment: Cameras.
Controller: Control matrix.
Telemetry transmitter and receivers: Submit design and cost proposals.
Number of monitors: Camera: monitor ratio (maximum)10:1.
Data collection: Submit design and cost proposals.
Accessories:
Camera brackets;
CCTV signage;
External camera housings;
Towers; and
Submit design and cost proposals.

120 CABLING AND CONTAINMENT Internal areas
Cable type: Board's choice.
Containment: Cable basket.
Rewireable installation: Required.
Concealed installation: Required.

120A CABLING AND CONTAINMENT External areas
Cable type: Board's choice.
Containment: Submit design and cost proposals.
Rewireable installation: Required.
Concealed installation: Required.

SYSTEM PERFORMANCE

210 DESIGN
Design: Complete the design of the CCTV system.
Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

240 DIGITAL STORAGE
Rate per camera (minimum) : 25 frames/s.
Compression of images : Yes, with the exception of a one hour period before and after an alarm incident.
Data over-writing period : 31 days.
Back-up storage: 100% back-up required.

250 INTEGRATION WITH OTHER ALARM AND SECURITY SYSTEMS
Objectives: To integrate CCTV system with other systems.
Systems to be integrated:
Intruder detection and alarm system
BMS
Access control
External PA system
Laboratory CCTV installation.

PRODUCTS

310 CAMERAS: INTERNAL
Camera Type: Domed.
Manufacturer: Board's choice.
Product reference: Submit proposals.
CCD sensor format: Submit proposals.
Resolution (minimum): 1080 lines/frame.
Power supply: Extra low voltage.
Camera synchronising: Submit proposals
Signal to noise ratio (minimum): Submit proposals.
Image strength with 75 ohm terminations: 1 V peak to peak.
Automatic gain control: Required.
White balance control: Automatic.
Backlight compensation: Required.
Present gamma settings: 1 and 0.45.
Iris: Automatic.
Shutter speed adjustment: Automatic.
Infrared sensitive: Not-required.
Colour to monochrome switching: Automatic at pre-determined threshold (25 lx)
Lens mounts: Submit proposals.
Lens:
Type: Variable focal length.
Filter: Submit proposals.

Mounting points: Submit proposals.
Accessories: Submit proposals.

310A CAMERAS: EXTERNAL

Camera Type: “Low Light”, domed.
Manufacturer: Board's choice.
Product reference: Submit proposals.
CCD sensor format: Submit proposals.
Resolution (minimum): 1080 lines/frame.
Power supply: Extra low voltage.
Camera synchronising: Submit proposals
Signal to noise ratio (minimum): Submit proposals.
Image strength with 75 ohm terminations: 1 V peak to peak.
Automatic gain control: Required.
White balance control: Automatic.
Backlight compensation: Required.
Present gamma settings: 1 and 0.45.
Iris: Automatic.
Shutter speed adjustment: Automatic.
Infrared sensitive: Not required, to be “low light” type.
Colour to monochrome switching: Automatic at pre-determined threshold (25 lx)
Lens mounts: Submit proposals.
Lens:
Type: Variable focal length.
Filter: Submit proposals.
Mounting points: Submit proposals.
Accessories: Submit proposals.

330 PAN AND TILT UNITS: Internal

Camera Type: Dome.
Manufacturer: Board's choice.
Product reference: Submit proposals.
Pan angle: 5°-350°.
Tilt angle: -20°-90°.
Speed control: Submit proposals.
Pan speed: Submit proposals.
Tilt speed: Submit proposals.

330A PAN AND TILT UNITS: External

Camera Type: “Low Light”, domed.
Manufacturer: Board's choice.
Product reference: Submit proposals.
Pan angle: 5°-350°.
Tilt angle: -20°-90°.
Speed control: Submit proposals.
Pan speed: Submit proposals.
Tilt speed: Submit proposals.

340 CONTROL MATRIX

Manufacturer: Board's choice.
Product reference: Submit proposals.
Video inputs: Submit proposals.
Video outputs: Submit proposals

Adjustable dwell time per camera image: Submit proposals
Interval: Submit proposals.
Video inputs:
Unused: Automatic skip.
Lost: Alarm displayed on monitor.
Spot monitor output: Submit proposals.
Control keyboard: Tactile push buttons with individual LED indication.
Manual selection of camera images: Submit proposals.
Screen mode: Sequential switching and split screen.
Titling: Time, date, and camera identification.
Video motion detection: Required.
Alarm outputs: Submit proposals.

350 TELEMETRY TRANSMITTERS
Manufacturer: Board's choice.
Product reference: Submit proposals.
Control functions:
Autopan;
Auxiliary latching function;
Auxiliary momentary action function;
Focus;
Iris;
Lamps;
Pan;
Power; and
Tilt.
Alarm inputs: Submit proposals.
Control keyboard: Tactile push buttons with individual LED indication.
Control via coaxial cabling: Synchronised frequency shift keyed (FSK) signalling.
Control over twisted pair cabling: 4-20 mA current loop.
Multiple camera control: Required.
Guard tour set up: Required.
Mounting: 19 inch rack.
System configuration: Password protection.

360 TELEMETRY RECEIVERS
Type: Submit proposals.
Control signal type: Submit proposals.
Inputs: Submit proposals.
Pre-set pan, tilt, zoom and focus positions: Submit proposals.
Movement control modes: Submit proposals.
Enclosure with integral power supply unit:
Material: Submit proposals.
Degree of ingress protection to BS EN 60529: IP65.
Colour: Submit proposals.

380 DIGITAL VIDEO RECORDERS
Manufacturer: Board's choice.
Product reference: System manufacturer.
Resolution:
Horizontal: 720 pixels.
Vertical: 576 pixels.
Storage media: Submit proposals.
Capacity: 31 recording days.

Inputs: Submit proposals.
Recording speed: 0.1-50 frames/s.
Event recording mode: Required.
Pre-event buffer: Submit proposals.
Camera inputs: Submit proposals.
Monitor outputs: Submit proposals.
IEEE 1394 connections:
Input: Submit proposals.
Output: Submit proposals.
Integral CD recorder: Required.
Video motion detection: Required.

390 MONITORSGENERALLY
Manufacturer: System manufacturer.
Product reference: System manufacturer.
Approval: BEAB.
Type: Liquid crystal display (LCD).
Size (nominal diagonal): 21 inch.
SVHS input: Submit proposals.
Audio input and output: Not required.
Mounting: Wall.

400 CAMERA BRACKETS general
Manufacturer: System manufacturer.
Product reference: System manufacturer.
Type: submit proposals.
Material: Submit proposals.
Finish: Submit proposals.
Camera mount adjustment: Single bolt release.
Pan: ±360°.
Tilt: ±70°.

410 CCTV SIGNAGE: To architects details
Manufacturer: System manufacturer.
Product reference: System manufacturer.
Format: Yellow background with black text and images.
Size: Submit proposals.
Content:
Warn individuals that they are entering premises or an area with CCTV surveillance.
CCTV camera symbol.
Describe the purpose of the CCTV system.
Identify the organisation responsible for operating the system.

420 EXTERNAL CAMERA HOUSINGSGENERALLY
Manufacturer: System manufacturer.
Product reference: System manufacturer.
Shape: Submit proposals.
Material: Submit proposals.
Finish: Board's choice.
Vandal resistant fasteners: Required.
Ingress protection to BS EN 60529: IP65.

Integral heater: Required.
Sun shield: Required.
Wiper and washer assembly: Required.

430 INTERNAL CAMERA HOUSINGSgeneral
Manufacturer: System manufacturer.
Product reference: System manufacturer.
Shape: Submit proposals.
Material: Submit proposals.
Finish: Board's choice.
Vandal resistant fasteners: Required.
Ingress protection to BS EN 60529: Submit proposals.

440 INFRARED ILLUMINATORS
Manufacturer: System manufacturer.
Product reference: System manufacturer.
Lamp type: Submit proposals.
Infrared wavelength: Submit proposals.
Effective infrared distance (minimum): Submit proposals.
Infrared cut off angle: Submit proposals.

450 TOWERS general
Manufacturer: System manufacturer.
Product reference: System manufacturer.
Type: Tubular section.
Height above ground level: Submit proposals.
Tilt over facility: Required.
Anti climb guards: Required.
Finish: Galvanized.

620 INSTALLING CLOSED CIRCUIT TELEVISION SYSTEMS
Standard: To BS EN 50132-7.
Site survey: Assess the site conditions and available artificial light.
Access: Locate system to provide safe access for maintenance and testing.
Camera connections: Conceal where practical, otherwise contain within PVC covered metal flexible conduit.
Mounting heights: Submit proposals.

630 INSTALLING CABLES
Route: Submit proposals.
Timing: Do not start internal cabling until building enclosure provides permanently dry conditions.
Cables: Install in one length.
Cable pulling: Submit proposals. Do not overstress. Prevent kinks and twisting of the cable.
Cables passing through walls: Sleeve with conduit or pipeduct. Bush at both ends.
Jointing: At equipment and terminal fittings only.

640 INSTALLING SIGNAGE
Location: Submit proposals.

910 CLOSED CIRCUIT TELEVISION SYSTEM TESTING AND COMMISSIONING
Standard: To BS EN 50132-7.
Evaluation of system performance: Rotakin test.
Commissioning video: Display image quality and camera coverage, using Rotakin test target.
Camera coverage: Adjust to obtain optimal performance.

920 DOCUMENTATION
Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system
Operation and maintenance instructions: Submit.
Record drawings: Submit.
Commissioning Certificate: Submit.
Test Certificate: Submit.

Specification Check / Revision Sheet

Project	**RHSC and DCN Edinburgh Hospitals**	Project Number	**G1547**
Service (s)	**Electrical**	Sheet	**WW AP.1.2.36 JB G1547**
Performance Specification Title	**Fire Detection and Alarms System & Gaseous Fire-Extinguishing System**	Date	**August 2014**
Prepared By	**JB**	Checked By	**BR**

Revision Ref.	Date of Revision	Page N$^{o(s).}$	Revision Details	Checked By
FT	December 2013	All	Final Tender	BR
FC	July 2014	All	Update for Financial Close	JB
FC	August 2014	All	Comments Incorporated	JB

RHSC and DCN EDINBURGH
FIRE DETECTION AND ALARMS SYSTEM & GASEOUS FIRE-EXTINGUISHING SYSTEM

CONTENTS

MATERIALS AND WORKMANSHIP CLAUSES

1.0 GENERAL INTRODUCTION

Purpose of Document

The manufacture, supply, installation, wiring, connecting, setting to work and commissioning of the works described in this document.

This specification relates to the Low Voltage Distribution system serving the RHSC-DCN Building and the associated Energy Centre.

This specification shall be read in conjunction with all other mechanical and electrical engineering services specifications and the Architectural drawings.

Description of Project

The new facility shall re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit.

The building is generally constructed from reinforced concrete.

The basement houses FM support facilities and the main building services heat distribution centres and electrical plant rooms.

Ventilation plantrooms are generally located at roof level and level 2.

A central energy centre to the South of the hospital houses heating, CHP, standby generation, fuel storage and utility incomers.

2.0 EXISTING SITE AND SERVICES

There will be a fire command centre in the control room.

During a fire incident control of ventilation and smoke will be from the command point and alternative repeater panels will be located at various positions around the building as shown on the fire alarm schematic.

The fire command centre shall provide command and control for the life safety systems including PC graphics for:

Fire Alarm Detection and annunciation;
Sprinklers (monitoring);
Ventilation system smoke dampers (monitoring and control at each fireman's entry/ main fire alarm panel location via BMS interface)
Fire fighting systems (monitoring and control);
Helipad systems (monitoring);
All other systems provided in accordance with the agreed fire strategy.

3.0 SCOPE

The scope of work covered by this Performance Specification shall include, but not be limited to the following:-

Fire detection and alarm system
Gaseous fire-extinguishing systems to the main core server room
Final run out conduits
Conduits in or on walls

4.0 PERFORMANCE SPECIFIED SYSTEMS

The Fire Detection and Alarm System is a performance specified system and this specification outlines the requirements to be met by the system.

5.0 SPECIFIC EXCLUSIONS

The following is specifically excluded from the scope of this element of the Performance Specification:-

Power wiring
Main cable containment (other than final run outs of conduits)
Sprinkler System

6.0 INTERFACES AND DEMARCATIONS

The fire detection and alarm system & gaseous fire-extinguishing system shall be integrated with a host Internet Protocol network. The fire detection and alarm system shall be connected to the host network via gateways. The System will be provided with a Graphical User Interface which will permit the interrogation of the fire detection and alarm system down to component level. It is not intended that the BMS will control the system but rather will monitor component status and provide fault alarm indication at the Graphical User Interface.

The system shall be integrated with the RIE as indicated on drawing WW-XX-XX-SC-572-001.

The new system shall be fully tested and bedded in prior to be connected through so that no false fire alarm signals are exchanged between the two facilities during system commissioning.

7.0 APPLICABLE STANDARDS

All elements of the works shall be designed in accordance with the requirements of current legislation, regulations and standards stated in the Materials & Workmanship clauses.

The fire detection and alarm system & gaseous fire-extinguishing system shall accord with all appropriate Scottish Hospital Technical Memoranda 81 and 82, HTM 05, Codes of Practice and relevant British & European Standards, the Scottish Non-Domestic Handbook, Fire, Annex 2b, Hospitals, 2006., BS 5839-1 and the agreed Fire Strategy.

8.0 DESIGN CRITERIA

Electricity Supply Characteristics

LV power characteristics: 400/230 V, 3-phase, 50 Hz, 230 V, 1-phase, 50 Hz.

Drawings

Project Co. shall prepare general arrangement drawings of the Fire Detection and Alarm System & Gaseous Fire-Extinguishing System.

9.0 LIAISON

Project Co. shall include for liaison with:-

Health and Safety Professionals. As well as the Health and Safety requirements of this specification, Project Co. shall include for close liaison with Health and Safety professionals including the Hospital's Health and Safety Advisors and the CDM Co-ordinator and shall comply with the CDM Regulations and all Health and Safety regulations.

Other Specialists Project Co. shall liaise with other specialists as necessary to ensure that all interfaces between the Fire Detection and Alarm System and other systems are allowed for. This shall include but not be limited to:-

NHS Lothian Fire Officer
City of Edinburgh Council
Scottish Fire & Rescue Service
Building Management System specialist
Lifts consultant
Security systems specialist
Sprinkler systems specialist
Smoke damper controls panel specialist
Pneumatic tube system specialist
Catering equipment specialist
Roof/Window specialists (with regards smoke relief)

Building Control. Project Co. shall liaise, with and adhere to, the requirements of the Building Control Officer.

Any other member of the and Board teams concerned with the planning and administration of fire precautions.

10.0 SYSTEMS

10.1 FIRE DETECTION AND ALARM SYSTEM

System Type

The Fire Detection and Alarm System shall be of the analogue addressable type providing category L1 coverage as defined by BS 5839:1:2013.

Cabling and Cable Containment

The Fire Detection and Alarm System wiring shall comply with the requirements of BS5839-1, SHTM 81 & 82 and Scottish Non-Domestic Handbook, Fire, Annex 2b, Hospitals, 2006.

Cables shall be the types as specified in BS5839 and be of red outer sheath and of the low smoke, zero halogen type (commonly referred to as LSF). All cables, including power cables and network cables, associated with the Fire Detection and Alarm System shall be of the enhanced type, meeting the PH120 classification when tested in accordance with BSEN 50200 and the 120 minute survival time when tested in accordance with BS 8434-2.

The main cabling routes shall be supported by wire basket cable trays. Runs of wiring comprising 1, 2 or 3 cables may be installed directly upon the soffit.

Methods of cable support shall be non combustible and shall withstand a similar temperature and duration to that of the cable whilst maintaining adequate support.

In areas of non demountable ceilings, such as in Theatre suites, wiring shall be run in conduit arranged in a ‘loop-in’ basis to allow wiring without access to the ceiling void.

Fire Alarm Zones

Project Co. shall determine fire alarm zone boundaries in accordance with the guidance in (S)HTM82 and BS5839. Reference shall be made to the fire strategy drawings for fire compartment boundaries.

In the event of fire The Works shall be capable of individual zone evacuation with all other zones receiving awareness signalling in accordance with the cause & effect matrix developed from the Fire Strategy.

Trigger Devices

The following trigger devices shall be provided:-

Multi sensor fire detectors shall be of the multi-criteria type operating via an algorithm to minimise unwanted fire signals as much as is practically possible
Manual call points (flush mounted in occupied spaces)
Heat detectors (temperature activation settings to be below that of sprinkler heads)
Smoke detectors in supply ductwork at all air handling units
Beam detectors
Canopy Extinguisant systems

Manual Call Points

Manual call points must be provided at every exit and staircase with no point in the building being more than 30m travel from a call device. (Any deviation for Clinical requirements shall be agreed with the Board).

Fire Alarm Evacuation facilities shall be provided at each main node, these shall require a double action e.g. break frangible lid and then activation of call point.

Ceiling Void Detection

The requirement for void detection will be risk assessed within each void in accordance with the Fire Strategy. The Fire Strategy provides an explanation for the methodology to be adopted for the risk assessment of the void content and an overview of the types of items considered to be acceptable.

The risk assessment, in matrix form, shall be agreed with the Board to identify where void detection is necessary.

Gaseous Extinguishing Systems

Gaseous Extinguishing Systems shall be provided in the following areas:

Main core server room

The room will be provided with gaseous extinguishing system which shall include a local control panel. The gaseous extinguishing system control panel shall be connected to smoke detectors within the server room and shall, in a preset sequence, shut down the room ventilation, close any air dampers, and ultimately trigger gas release.

The gaseous extinguishing system control panel shall be connected to the ‘house’ fire alarm system.

Refer to section S70 of this specification for Materials & Workmanship clauses pertinent to the gaseous extinguishing system.

Project Co. shall advise on any specific requirement relating to room construction, airtightness, pressure relief, gas extraction, interfaces with mechanical services/ power supplies/ fire alarm system.

Project Co. shall produce working drawings indicating locations of bottles, control panels, human interfaces, detection, pipework, nozzles, valves, power supplies, etc.

The design shall be co-ordinated with the cooling systems and IT equipment layouts.

The following matrix describes in general the actions required in the event of fire in the server room.

MAIN CORE SERVER ROOM FIRE DETECTION CAUSE AND EFFECT SCHEDULE

	'HOUSE' PANEL				COMPUTER ROOM						
	Flashing zone light	Text display	Zone sounders	Audible alert on panel	Shut down room ventilation	Close dampers	Trigger gas release	Flashing zone light	Text display	Sounders in server room	Audible alert on panel
Computer suite											
Gaseous Ext. Panel											
Smoke Detector 1	X	X	X	X	X			X	X	X	X
Smoke Detector 2	X	X	X	X	X	X	X	X	X	X	X

Omission of Detection

Detection need not be provided in:

Bathrooms
Shower rooms
Staff toilets
Cupboards of less than 1m²

Detection shall be provided in all other areas unless a risk assessment has been produced and agreed. .

Warning Devices

Fire alarm audibility levels shall be as required by HTM 05, SHTM82 and BS5839-1.

Audible alarm devices shall provide a constant tone when in "alarm" and be a light pulse & intermittent tone when in "alert".

Audible alarm devices shall generally be positioned to warn staff without undue disturbance to patients.

Noise sensitive areas exist within the Hospital within departments such as Theatres, Recovery, etc. the Board shall indicate which areas shall have a normal level of sound and which shall have a reduced level.

Voice evacuation announcements shall be provided in the atrium as required by the fire strategy with pre-programmed announcement text being agreed with the Board. These announcements shall be made via voice alarm sounders.

In areas where patients can escape unaided, and in non-patient areas, the audibility of the alarm shall be in accordance with BS 5839-1. Such areas would be:

Out patients
Public spaces
Main hospital streets

Fire alarm sounders shall be of the addressable type that are low power consumption and are wired directly upon the local fire alarm loop cable. Combined detector/sounder units are acceptable. All sounders must be provided with the facility to adjust sound levels.

Audio/Visual alarm devices shall be provided in:-

Plantrooms
UPS rooms
WCs in public areas
Noisy areas
Over each external door which gives access to fire alarm panels

In occupied spaces Audio/Visual alarm devices shall incorporate a sounder of 50dB(A) at 1m of similar sound to the main audible alarms.

Visual only alarms shall be provided in:

Operating theatres and post operative recovery
Intensive therapy units, critical care, and other similar high dependency units
Imaging rooms

The system shall be equipped with sufficient sounders to maintain sound outputs in different areas in accordance with SHTM 82, HTM 05, and incorporate visual strobe indicators for a fire condition in accordance with the requirements of the Disability Discrimination Act.

Control and Indicating Equipment

The Main Alarm Panel (MAP) shall be located in the Main Entrance. The MAP shall be wall mounted. The Fire Alarm PC Screen and HVAC screen shall be located in the Security Control room to provide the Fire Authorities with the facility to control the operation of the supply/exhaust air systems with assistance from FM personnel.

Local Fire Alarm Panels (FAP). FAPs shall be standalone local control and indication panels. On each floor, a local FAP shall be provided which shall enable each area to be separately and independently commissioned. The final quantity of local FAPs will depend upon the system supplier's technology. Every fire detection loop shall not be loaded to more than 80% of its capacity. The MAP shall be linked to all standalone local FAPs via a master bus network. Should this master bus network fail each local FAP shall be able to operate autonomously.

Graphic Repeat Panel (GRP). Adjacent to the MAP provide a GRP which shall clearly identify the location of a departmental area upon activation of a triggering device within that area.

Repeat Alarm Panels (RAP). RAPs shall identify the device and department in alarm via the LCD text display; the graphics shall assist the fire fighting team to clearly identify the location of the department in alarm. RAPs shall be located as indicated on the fire strategy drawings and in the Fire Control Room.

Framed coloured floor plans shall be provided at the MAP and RAP positions.

Local Repeat Indication Panels (LRIP) shall be provided at each staff base. LRIPs are to advise staff of where the location of the fire is so that they can plan their evacuation procedure whilst in the alert state. LRIPs shall have a minimum of a 40 character LCD display to identify to the nursing staff in the department in alarm and to evacuate as appropriate. These panels shall also have an audiovisual alarm unit so that upon activation of a fire signal the nursing staff will be immediately alerted.

The LRIPs at Staff Bases may be combined with local nurse call indicator panels (and Isolated Power Supply Unit annunciator panels where appropriate). Refer to the layout drawings for quantities and locations of Staff Bases.

Any other control panels which may be required due to the system proposed, shall be located in riser cupboards and/or plantrooms.

All fire alarm panels shall be capable of giving details of system status for fire, fault and alarm conditions including full text descriptions of location at all nodes and staff base positions. In addition, all panels shall be capable of data / event logging and report generation.

The control panels shall be fully networked with resilient connections to the site based PC front end with map facilities and remote graphics monitoring in Hillington via a dedicated link.

The control panels shall be sized to provide an additional 25% spare capacity for future growth within the Fire Detection & Alarm system.

Power Supply Units

A power supply unit shall be provided for each of the control panels. Each power supply unit shall be dedicated to the Fire Detection and Alarm System for the area it serves.

Power supply units shall be integral with batteries.

Power supply units shall be sized at 125% of its nominal use.

All batteries shall be, valve regulated lead acid (VRLA) with sufficient autonomy to drive the system (in quiescent mode) for 24 hours, followed by a 30-minute period where all alarm devices and communications are operated with the normal sound pressure level outputs. Batteries shall have a design life of 10 years.

Final connection of system to power supplies – schedule of responsibilities:-

Local means of electrical isolation (key operated fused connection unit) - by the Electrical Board installed outside the scope of this Performance Specification.
Power cable from local means of electrical isolation to power supply unit – by the Specialist Installer.
Termination of power cable at both ends- by the Specialist Installer.

Action following mains failure/generator test conditions

The fire alarm system specified herein to be self-rebooting following mains failure and generator test conditions.

Door Retaining Units

Door retaining units shall be of the electromagnetic type and shall operate as described in SHTM 82.

Doors shall be released upon fire alarm activation, their operation shall be as described in SHTM82. The system shall be fail safe door closed.

Door retaining units shall be configured to permit the doors to close at night.

Project Co. shall advise the Electrical Installer of local power supply requirements for door retaining units.

Door holder locations are indicated on the Architect's fire strategy drawings.

Smoke Damper Control

The details of the Smoke Damper control are to be finalised at a later stage.

Ancillary Devices

Interface units shall be provided to control/monitor security access control doors, mechanical plant, smoke damper control panels, sprinkler switches (including those in retail units), gaseous extinguishing systems, lift controllers, AGV controllers, atria smoke control, staircase smoke pressurisation/venting and basement smoke venting.

The extract hood in the kitchen will be fitted with 'fire trace' automatic extinguishing systems by the catering equipment specialist outside the scope of this contract.

The fire alarm system shall interface with the retail units' fire alarm panels.

An interface unit shall be installed at each BMS outstation.

Interface units shall be provided at each sprinkler flow detection valve to monitor valve position and flow.

Interface units shall be provided at each retail unit for sprinkler flow switches and pumps (monitoring).

Short circuit isolators shall be incorporated either within the base of each device or as standalone items. Should standalone devices be offered they shall be installed at intervals of no greater that 20 devices on a particular fire alarm loop and always between fire compartments.

Development and Management of Cause and Effect Schedule

The Cause and Effect Schedule shall encompass every fire alarm zone, every fire alarm control and indicating panel, interfaces with access control systems, door retaining units, gaseous extinguishing systems, paging system, audible and visual alarms, sprinklers, all mechanical services plant, smoke damper control panels, lift controllers etc.

The Cause and Effect Schedule shall form the basis of the demonstration and verification of correct system operation.

Progressive horizontal evacuation in patient areas is to be facilitated by each fire resisting sub-compartment being on a separate alarm zone, and by the use of two stage (evacuate/alert) alarms. Generally, upon detection of fire within a fire compartment it is anticipated that the following of events shall occur.

Fire Panel indicates an event.
Fire Alarm Control Panels and Repeat Panels indicate location of the fire event.
“fire” signal is sent to the Fire Command Centre.
Redcare connection to Alarm Receiving Centre (ARC)
“alarm” signal provided by audible and/or visual warning devices within the alarm zone.
“alert” signal provided by audible and/or visual warning devices within the adjacent sub-compartments (in horizontal plane).
“alert” signal provided by audible and/or visual warning devices within the adjacent sub-compartments immediately above and below (in vertical plane).
Recirculating ventilation systems serving areas in which the ‘alarm’ signal is given shall be set to discharge to the open air.

Ventilation plant serving the basement and atria shall shut down and be under the control of FM staff via the BMS interface adjacent to the main fire alarm panels and be under the direction of the fire brigade.
All other ventilation plant shall continue to operate and shall be under the control of FM staff via the BMS interface adjacent to the main fire alarm panels and be under the direction of the fire brigade.
Interface to extinguishing systems in kitchen extract hood.
Access controlled doors in “alarm” sub-compartment shall be automatically released to ‘free’ state.
Access controlled doors in adjacent sub-compartments shall be automatically released to ‘free’ state.
Doors detents in “alarm” sub-compartment shall be released.
Door detents in adjacent sub-compartments shall be released
Global release of all external final escape doors.
A signal shall be relayed to the local smoke damper control panel and the relevant dampers will be opened/closed as necessary.
Lifts serving the area in alarm shall receive an appropriate signal to operate as detailed within the Fire Strategy,
Interfaces with fixed gaseous extinguishing system.
Interfaces with fire shutters.
Interface is activated within retail units/ tenanted spaces.
The pneumatic tube transport system shall be shut down globally following the completion of any transaction in progress.

The sprinkler system operates in isolation of the Fire Detection & Alarm system and therefore does not form part of the cause & effect scenario.

Manual Operation of Sounders

A manual alert/evacuate control facility shall be provided for each alarm sounder zone. This shall be integrated within the main fire alarm control and indication panel. It shall provide the facility to manually activate any sounder zone in alert or evacuate mode, and to enable progressive evacuation of the Hospital under control of the Fire Brigade. The controls shall meet the requirements of SHTM 82.

Grace Times

The system shall be capable of accommodating the following strategy if required to reduce false alarms.

For any zone to cause an evacuation signal a double knock scenario must occur, i.e. two devices must detect fire within that zone. When the first device operates, a supervisory alert signal shall be sounded at the main fire panel. The signal must be acknowledged within a pre-defined period or the system shall go to fire mode. However, if the signal is acknowledged, a timer shall be initiated which shall allow inspection of the area, the duration of which is to be agreed with the Board and the local fire authority. Should a second device operate within the alerted area within this period, then the system shall go to fire and operate in accordance with the relevant matrix drawing.

However, in the event of the operation of any manual call point, a single knock scenario shall take place, which shall cause immediately an evacuation fire signal.

Should this strategy be adopted, this must be agreed with the Hospital and the local fire authority.

Testing & Commissioning

The complete system shall be fully tested and commissioned in accordance with BS5839.

A full audibility test shall be carried out in the presence of the Fire Officer and any other bodies who need to be present.

Following the testing and commissioning, Project Co. shall issue a Certificate of Installation and Commissioning which shall conform with BS5839-1.

Project Co. shall take into account the need for maintaining patient security during alarm testing i.e. the testing regime shall not allow for ordinarily secure doors to open as a result of routine testing.

Demonstration

Following testing and commissioning, Project Co. shall demonstrate the completed system.

Documentation

Project Co. shall provide necessary documentation to confirm that the system will have a documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing systems to current level of technology, and extend new field panels on a previously installed network.

Project Co. shall provide prior to completion a Log Book which shall conform with BS5839-1.

Software

Project Co. shall provide 2 N° copies of the software used on this project, following issue of the Certificate of Installation and Commissioning. Open protocol industry standard software must be used. All software shall be 'backwards compatible'.

Requirements Specific to the Energy Centre

The energy centre will house:-

Dual fuel (oil and gas) boilers. MV switchgear, diesel fuelled standby generator plant, CHP plant, fuel storage and associated pumps.

The fire alarm system shall include interfaces with gas shut off valves, interfaces with fusible links in boiler rooms, CHP room and generator rooms, interfaces with BMS.

In rooms where fuel is stored, pumped and utilised, the selected fire alarm equipment shall be suitable for the hazardous environment.

Audio/Visual alarms shall be provided throughout the energy centre selected to take account of the background noise.

W50 Fire detection and alarm systems

110 FIRE DETECTION AND ALARM SYSTEM
System manufacturer: Submit proposals.
Manufacturer approval: LPCB LPS 1014 certified.
Type: Automatic analogue addressable.
Category to BS 5839-1: L1.
Variations: None.
Detection devices:
Atmosphere: Normal.
Types:
Manual call points;
Optical beam smoke detectors ;
Point heat detectors ;
Point smoke detectors ; and
Submit design proposals.
Equipment interconnectivity: Enhanced fire resisting cabling.
Cable containment: Cable basket, as section Y63.
Rewireable installation: Required.
Concealed installation: Required.
Internal alarms:
Primary: Sounders.
Secondary: Visual alarm signal devices.
External alarms: Refer to Particular specification 'Existing site and services'.
Controls: Main control and indicating equipment.
Accessories:
Automatic door release mechanisms ;
Actuation of fire protection systems ;
Mimic panels ;
Remote indicators ;
Short circuit isolators ; and
Zone diagrams.

130 ASPIRATING DETECTION SYSTEMS refer to Particular specification.
System manufacturer: Submit proposals.
System type: Secondary sampling.
Equipment interconnectivity: Enhanced fire resisting cabling.
Cable containment: Cable basket, as section Y63.
Rewireable installation: Required.
Concealed installation: Required.

210A DESIGN OF FIRE DETECTION AND ALARM SYSTEMS
System designer: Board.
Design: Complete the design of the fire detection and alarm system in accordance with BS 5839-1, SHTM81 and 82, Scottish Non Domestic handbook, Fire, Annex 2b, Hospitals.
Proposals: Submit drawings, technical information, calculations and manufacturers' literature.
System design certificate: Submit with design proposals.
Design drawings to be co ordinated with architect's reflected ceiling grid
Submit cable containment and power supply requirements
Submit Cause and Effect matrix

215 DESIGN OF ASPIRATING DETECTION SYSTEMS
System designer: Board.
Design: Complete the design of the aspirating detection system in accordance with BFPSA Code of practice for category 1 aspirating detection systems.
Proposals: Submit drawings, technical information, calculations and manufacturers 'literature.
System design certificate: Submit with design proposals.

220 PERFORMANCE OF FIRE DETECTION AND ALARM SYSTEMS
Areas to be protected: Refer to the particular section of this specification for details of where protection may be omitted.
System objectives: To provide type L1 protection. To warn staff without undue disturbance to patients.
Spare system capacity: 10% loop loading.
Number of devices per zone (maximum): Board's choice.

225 PERFORMANCE OF ASPIRATING DETECTION SYSTEMS
Areas to be protected: Refer to Particular Specification.
System objectives:
In server rooms: To provide pre fire warning, interfaced with house fire alarm system, as described in the particular section of this specification. System will be used in area with high air flow.
In theatres and MRI - in lieu of ceiling mounted detectors.
Maximum transport time: 120s.
Sampling: Continuous.
System sensitivity: Very high.

250 DETECTION ZONES
Zoning: Submit proposals. Follow guidance given in BS5839-1 and SHTM 81 and SHTM 82. Refer to Architect's Fire Strategy Plans for compartments and sub compartments.

255 ALARM ZONES
Alarm zoning: Submit proposals.
Mode of operation: To warn staff without undue disturbance to patients. To facilitate progressive horizontal evacuation in accordance with SHTM 82. Refer to Particular section of this Specification.
All zone evacuate control: Not required.

260 ACTUATION OF FIRE PROTECTION SYSTEMS
Standard: To BS 7273-1.
Objectives: gaseous extinguishing systems in 2 no. server rooms to be actuated as described in the Particular section of this specification and clause S70.

265 INTEGRATION WITH OTHER ALARM AND SECURITY SYSTEMS
Objectives: Refer to particular.
Systems to be integrated: Refer to Particular.

266 INTERFACES TO EQUIPMENT
Interfaces to equipment not forming part of the fire detection and alarm system: Design system to interact with the equipment in the event of a fire or fault signal.
Equipment and mode of operation: Refer to Particular.

270 INTERFACE ISOLATION FOR TESTING PURPOSES
Isolation of systems and equipment: Design system so that the actuation, integration and interfacing can be isolated during fire alarm testing.
Means of isolation: Via CIE.

285 EXTERNAL ALARM SIGNALLING
Objective: External alarms required at each fire exit. External sounders to be silenced after 30minutes.

310 DETECTION DEVICES
Device address setup: Automatic via CIE.
Removal of devices: Must require a special tool. Must not affect the operation of alarm equipment.
Device bases: Maintain circuit continuity when device is removed.

320 PRODUCTS FOR USE IN EXPLOSIVE GAS OR VAPOUR ATMOSPHERES
Standard: To BS EN 60079-14.

330 PRODUCTS FOR USE IN EXPLOSIVE DUST ATMOSPHERES
Standards: To BS EN 61241-14 and BS EN 61241-17.

370 MANUAL CALL POINTS
Standard: To BS EN 54-11.
Manufacturer: Board's choice.
Product reference: Submit proposals.
Operation: Type A.
Frangible element: Non-resettable.
Integral red visual indicator: Required.
Environmental category: Indoors.
Mounting: Fully recessed.
Time delay between activation of manual call point and the alarm signal (maximum): 3 s.
Protective covers: Not required.

380 OPTICAL BEAM SMOKE DETECTORS
Standard: To BS EN 54-12.
Manufacturer: Board's choice.
Product reference: Submit proposals.
Thermal turbulence detection: Required.
Contamination compensation: Required.
Power supply: Internal.

400 POINT HEAT DETECTORS
Standard: To BS EN 54-5.
Manufacturer: Board's choice.
Product reference: Submit proposals.
Classification: A1.
Suffix: S.
Type: Point.
Temperature activation settings to be below that of sprinkler heads.

410 POINT SMOKE DETECTORS
Standard: To BS EN 54-7.
Manufacturer: Board's choice.
Product reference: Submit proposals.
Detection method: Multi criteria type.

420A ENHANCED FIRE RESISTING CABLING
All fire alarm system wiring, including loop wiring, power supplies and network cabling shall be of the enhanced type.
Type: In accordance with BS 5839-1.
Sheath and accessory colour: Red.
Refer to V32 clauses 420 & 420A to 420L.

430A STANDARD FIRE RESISTING CABLING
NOT TO BE USED

435 SOUNDERS
Standard: To BS EN 54-3.
Manufacturer: Board's choice.
Product reference: Submit proposals.
Type: Electronic sounder.
Sounder cut off time (maximum): 30 minutes.
Ingress protection standard: Type A.
Colour: Red.
Directional output at 1 m (minimum): Adjustable so as to alert staff only in patient areas.
Elsewhere to achieve noise level required by BS5839-1.
Integral beacon: Not required.
Mounting: Semi-recessed.
Power supply: From loop.

445 VIBRATING RADIO PAGERS
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Number to be supplied: 50.
Type of licence: Manual frequency co-ordinated licence.
Response time following alarm condition (maximum): 5 s.
Response to fire alarm condition:
Unique vibrating and audible output on alarm condition.
Duration: Continuous for 60 s or until acknowledged at the vibrating radio pager.
Priority over all other signals.
Response to loss of transmission: Identified at the pager within 5 m by a visual and tactile signal.
Power source: Battery.
Low battery warning: Indicated by visual and tactile signal.
Display:
80 character (minimum) LCD.
Backlight: Required.
Password protection: Required.

447 TRANSMITTERS FOR VIBRATING RADIO PAGERS
Manufacturer: As vibrating radio pager.
Product reference: Submit proposals.
Type of licence: As vibrating radio pager.
Power supply: Integral.
Standard: To BS EN 54-4.
Standby source: Rechargeable battery.
Indications:
Output fault signal;
Total loss of power supply; and
Battery supply failure.
Alarm outputs: Output to vibrating radio pagers and Output to fault warning equipment.

450A AUDIBLE / VISUAL ALARM SIGNAL DEVICES:
For use in plantrooms, service yards etc as detailed in Particular section of this specification
Manufacturer: Board's choice.
Product reference: Submit proposals.
Type: Xenon beacon, also to incorporate sounder to achieve sound levels required by BS5839-1.
Flash rate per minute:
Minimum: 30.
Maximum: 130.
Lens:
Material: Polycarbonate.
Colour: Red.
Enclosure ingress protection to BS EN 60529: IP44.

450B VISUAL ALARM SIGNAL DEVICES
For use in Operating theatres, ITU, audiology, Imaging and other areas of high dependency as detailed in the particular section of this specification
Manufacturer: Board's choice.
Product reference: Submit proposals.
Type: Xenon beacon.
Flash rate per minute:
Minimum: 30.
Maximum: 130.
Lens:
Material: Polycarbonate.
Colour: Red.
Enclosure ingress protection to BS EN 60529: IP44.

455 FULLY FUNCTIONAL REPEAT PANELS
Standard: To BS EN 54-2.
Features: Match CIE.

460 MAIN CONTROL AND INDICATING EQUIPMENT (CIE)
Standard: To BS EN 54-2.
Main display: 32 character alphanumeric colour display.

Zone indication to BS 5839-1: Individual LED status indicators.
Installed capacity: Board's choice.
Monitored sounder circuits (minimum): Board's choice.
Printer: Output to separate printer.
Indications:
Fault signals from points;
Total loss of power supply; and
Alarm counter.
Controls:
Coincidence detection;
Delays to the activation of outputs;
Disablement of addressable points; and
Test condition facilities.
Outputs:
Output to fire alarm devices;
Output to fire alarm routing equipment;
Output to fire protection equipment;
Output to fault warning equipment; and
Standardized input and output interface.
Input device: Alphanumeric keypad.
Enclosure: System manufacturer's standard.
Ingress protection to BS EN 60529: System manufacturer's standard.
Finish: Submit proposals
Mounting: Recessed.

465 POWER SUPPLY EQUIPMENT
Standard: To BS EN 54-4.
Standby source: Rechargeable battery (VRLA with 10 year life).
Time after which sufficient capacity remains to power the fire alarms for at least 30 minutes: 24 h. Note that although the system will be supported by standby generator it will not be permitted to reduce this duration accordingly.
Housing: Within the CIE.
Monitoring of power supplies: By the CIE.

470 AUTOMATIC DOOR RELEASE MECHANISMS
Standard: To BS 5839-3.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Control type: Electromagnetic.
Mounting type: wall mounted but at sufficient height to prevent damage by trolleys.
Operation: Automatic via CIE.
Power: Derived from sounder circuit.
Integral manual release button: Required.

475A MIMIC PANELS
Standard: To BS EN 54-2.
Manufacturer: System manufacturer.
Product reference: Submit proposals.
Type: Submit proposals.
Material: Submit proposals.
Enclosure ingress protection to BS EN 60529: IP44.
Mounting: Recessed.

480 REMOTE INDICATORS
Lamp: High intensity LED.
Colour: Red.
Lens:
Material: Polycarbonate.
Colour: Clear.
Enclosure ingress protection rating to BS EN 60529: IP 44.

550 SHORT CIRCUIT ISOLATORS
Manufacturer: Board's choice.
Product reference: Submit proposals.
Power supply: Loop powered.
Integral LED status indicator: Required.

565 ASPIRATING SMOKE DETECTION EQUIPMENT
Equipment: In accordance with section 11 of FIA Code of Practice for Design, Installation, Commissioning & Maintenance of Aspirating Smoke Detector (ASD) Systems.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Pipework: Submit proposals.
Size: Submit proposals.
Sampling points: Submit proposals.

650 INSTALLING MAIN CONTROL AND INDICATING EQUIPMENT (CIE)
Location: Submit proposals.
Power supply: Derive from a dedicated circuit from the main switchboard and connect to CIE via unswitched fused connection units.

660 INSTALLING CABLING
Standard: To BS 7671.
Cable route: Segregate from other cabling. Where installed in trunking, locate in a dedicated fire cabling compartment.
Type: Loop or radial circuits without spurs pr tees
Mechanical protection: in areas where physical damage or rodent attack could occur.
Fastening cables:
To building fabric: Metal P-clips with red plastic coating.
To cable supports: Metal bands with red plastic coating.
Cables passing through the building fabric: Sleeve.
Jointing: At equipment terminals.
Cable terminals: Use ceramic terminal blocks.
Maximum circuit resistance: Measure before concealment. Submit results.

670 INSTALLING POINT DETECTORS
Protective cage: Not required.

680 INSTALLING MANUAL CALL POINTS
Location: Prominent position.
Mounting height generally (above finished floor level): 1.2 m.
Test key: Locate to allow easy test operation.

Labelling: Identify the manual call point address.
Type: Face engraved rigid plastic laminate.
Background: White.
Lettering: Red.

700 INSTALLING SOUNDERS
Circuit wiring: Distribute and interleave multiple sounder circuits around the building.
Protective cage: Not required.

705 INSTALLING VISUAL ALARM SIGNAL DEVICES
Location: Submit proposals
Mounting height generally (above finished floor level): 2.1 m.
Protective cage: Not required.

710 INSTALLING SHORT CIRCUIT ISOLATORS
Location: Submit proposals.
Labelling: Identify the associated zones.

720 INSTALLING END OF LINE DEVICES
Location: Submit proposals.
Labelling: Identify the presence of an end of line device, and describe its function.

725A INSTALLING REMOTE INDICATORS
Concealed detection devices: Install individual LED indicators.
The provision of an individual indicator will generally not be necessary provided that the location of the detection device is clearly indicated at the CIE, exceptions: lift shafts, mechanical and electrical risers, electrical cupboards, electrical switchrooms and transformer rooms, lift motor rooms.

730 INSTALLING TRANSMITTERS FOR VIBRATING RADIO PAGERS
Location: Submit proposals.
Connection to equipment: Install interconnecting wiring between transmitter and: Submit proposals.
Power supply: Derive from a dedicated circuit from the main switchboard and connect via unswitched fused connection units.

740 INSTALLING INTERFACES TO OTHER EQUIPMENT AND SYSTEMS
Connection to equipment: Install interconnecting wiring between interface unit and equipment controlled.
Interface units: Label, describing their function.

750 INSTALLING ALL ZONE EVACUATION CONTROLS
Location: Integral within CIE.

760 INSTALLING ASPIRATING SMOKE DETECTION SYSTEMS
Pipework:
Joints: Solvent welded.
Bends: Long radius.
Labelling: Along the pipework and at each sampling point.
Connection to sampling point: Rigid extended sampling pipe.

910 TESTING AND COMMISSIONING GENERALLY
Commissioning: In accordance with BS 5839-1.
System commissioning agent: Board.
System verification agent: Board.
Notice before commencing tests (minimum): 2 weeks.

911 SYSTEM INFORMATION
Device list: Before commissioning submit proposals, including proposed device and zone names.
Zone diagram: Before commissioning submit proposals.

915 TESTING AND COMMISSIONING OF ASPIRATING SMOKE DETECTION SYSTEMS
Standard: In accordance with FIA Code of Practice for Design, Installation, Commissioning & Maintenance of Aspirating Smoke Detector (ASD) Systems.

920 DEVICE IDENTIFICATION AND TESTING
Device identification: Label devices with a unique address corresponding to that used by the CIE.
Device testing: Verify the operation of each device. Submit a schedule of devices, including the device test methods and results.

925 CABLE TESTING
Insulation resistance: Submit results.
Earth continuity: Submit results.

930 SYSTEM SOAK TESTING
Soak test: Undertake when construction works are complete, but before handover.
Period: 14 days per construction zone.
Re-test after remedial works.

935 STANDBY BATTERY TESTING
Mains power supply: Isolate.
Quiescent mode: Measure current supplied by standby source when fire detection and alarm system is operating in the quiescent mode. Submit results.
Alarm mode: Measure current supplied by standby source when fire detection and alarm system is operating in the alarm mode. Submit results.

940 TESTING ACTUATION, INTEGRATION AND INTERFACING WITH ALARM AND SECURITY SYSTEMS
Connections with other systems and equipment: Verify and demonstrate operation of the systems and equipment under fire and fault conditions.

945 MEASUREMENT OF SOUND PRESSURE LEVELS
Sound pressure levels: Measure throughout the building.
Test instrument:
Standard: To BS EN 61672-1.
Setting: Slow response, weighting A.

Doors: Close before measuring sound pressure levels.
Results: Submit.
Format: Electronic layout drawing showing location of measurements with results

960 CERTIFICATION
Format: In accordance with BS 5839-1 Annex G.
Number of copies: Match operation and maintenance manuals.
Design certificate: Submit.
Installation certificate: Submit.
Commissioning certificate: Submit.
Verification certificate: Submit.
Test certificate: Submit.
Fire Alarm Sound Record Sheets: Submit.

965 DOCUMENTATION
Operation and maintenance instructions, record drawings & test/commissioning certificates to be compatible with Zutec system.
Operation and maintenance manual: Submit.
Record drawings: Submit.
Fire evacuation plan: Submit.
Format: Electronic colour CAD layout.

970 LOG BOOKS
Format: To BS 5839-1 Annex F.
Number of copies: 1.

980 ACCEPTANCE CERTIFICATE
Acceptance certificate: Prepare and submit.

990 SPARES AND CONSUMABLES
Supply the following spares:
Frangible elements for manual call points: 10.
Detectors: 2 of each type
Printer ink and paper roll: Replace immediately before handover.

S70 Gaseous fire-extinguishing systems

GENERAL

120 HALOCARBON GAS TOTAL FLOODING FIRE-EXTINGUISHING SYSTEM
System manufacturer: Submit proposals.
Extinguishant type: Submit proposals.
Source: High pressure storage cylinders.
Pipelines: Submit design and cost proposals.
Pipeline ancillaries:
Container valve assemblies and their actuators;
Check valves and non-return valves; and
Submit design and cost proposals.
Outlets: Nozzles.
Operation: Electrical actuation.
Controls:
Control panel;
Electrical automatic control and delay devices;
Non-electrical automatic control and delay devices;
Manual triggering and stop devices;
Pneumatic alarm devices; and
Submit design and cost proposals.
Accessories: Submit design and cost proposals.
Completion:
Plant and equipment identification: Submit design and cost proposals.

SYSTEM PERFORMANCE

210 DESIGN
Design: Complete the design of the gaseous fire-extinguishing system.
Proposals: Submit drawings, technical information, calculations and manufacturers' literature.

230 HALOCARBON GAS FIRE-EXTINGUISHING SYSTEM
Standards:
CEA 410 (FC-3-1-10) extinguishant: To BS ISO 14520-4.
FE-13 (HFC 23) extinguishant: To BS EN 15004-6.
FE-36 (HFC 236fa) extinguishant: To BS ISO 14520-11.
FM-200 (HFC 227) extinguishant: To BS EN 15004-5.

PRODUCTS

310 HIGH PRESSURE STORAGE CYLINDERSFOR HALOCARBON GAS TOTAL FLOODING FIRE-EXTINGUISHING SYSTEM
Standards: To BS EN ISO 9809-1 and BS EN ISO 9809-3.
Type: submit proposals.
Manufacturer: System manufacturer.
Product reference: Submit proposals.
Number: Submit proposals.
Capacity: Submit proposals.

325 CONTAINER VALVE ASSEMBLIES AND THEIR ACTUATORS
Standard: To BS EN 12094-4.
Manufacturer: Submit proposals.
Product reference: Submit proposals.

326 HIGH AND LOW PRESSURE SELECTOR VALVES AND THEIR ACTUATORS
Standard: To BS EN 12094-5.
Manufacturer: Submit proposals.
Product reference: Submit proposals.

328 CHECK VALVES AND NON-RETURN VALVES
Standard: To BS EN 12094-13.
Manufacturer: Submit proposals.
Product reference: Submit proposals.

340A NOZZLES FOR HALOCARBON GAS FIRE-EXTINGUISHING SYSTEMS Server rooms x 2
Type: Overhead.
Manufacturer: Submit proposals.
Product reference: Submit proposals.

350 ELECTRICAL ACTUATIONFOR HALOCARBON GAS TOTAL FLOODING FIRE-EXTINGUISHING SYSTEM
Actuator: In accordance with BS 7273-1.
Type: Point smoke detector.
Manufacturer: Submit proposals.
Product reference: Submit proposals.

360 MECHANICAL ACTUATIONFOR HALOCARBON GAS TOTAL FLOODING FIRE-EXTINGUISHING SYSTEM
Actuator: In accordance with BS 7273-2.
Type: Manual release.
Manufacturer: Submit proposals.
Product reference: Submit proposals.

370 CONTROL PANELSFOR HALOCARBON GAS TOTAL FLOODING FIRE-EXTINGUISHING SYSTEM
Type: Submit proposals.
Manufacturer: Submit proposals.
Product reference: Submit proposals.
Components on panel fascia:
Alarm silence lamp;
Buzzer silence;
Fire-extinguishing system automatic mode - lamp;
Fire-extinguishing system manual mode - lamp;
Hold gas release - switch and lamp;
Isolate gas release circuit - switch and lamp;
Isolate remote signal - switch and lamp;
Key operated security switch;
Lamp test switch;
Manual/ automatic mode - push switch;
Manual release unit ;
Power on lamp;

Silence alarm switch;
System general fault - lamp and buzzer;
Test evacuate alarm switch; and
Submit proposals.

380 ELECTRICAL AUTOMATIC CONTROL AND DELAY DEVICES
Standard: To BS EN 12094-1.
Controls:
Abort switch ;
Automatic and manual/ manual only switch;
Discharge prevention device;
Hold switch ;
Manual release switch;
Time delay facility; and
Submit proposals.

390 NON-ELECTRICAL AUTOMATIC CONTROL AND DELAY DEVICES
Standard: To BS EN 12094-2.
Controls:
Abort switch ;
Automatic and manual/ manual only switch;
Discharge prevention device;
Hold switch ;
Manual release switch;
Time delay facility; and
Submit proposals.

400 MANUAL TRIGGERING AND STOP DEVICES
Standard: To BS EN 12094-3.
Manufacturer: Submit proposals.
Product reference: Submit proposals.

410 NON-ELECTRICAL DISABLE DEVICES
Standard: To BS EN 12094-6.
Manufacturer: Submit proposals.
Product reference: Submit proposals.

420 PNEUMATIC ALARM DEVICES
Standard: To BS EN 12094-12.
Manufacturer: Submit proposals.
Product reference: Submit proposals.

450 PRESSURE GAUGES AND PRESSURE SWITCHES
Standard: To BS EN 12094-10.
Manufacturer: Submit proposals.
Product reference: Submit proposals.

460 ODORIZING DEVICES
Standard: To BS EN 12094-16.
Manufacturer: Submit proposals.
Product reference: Submit proposals.

EXECUTION

620 INSTALLING STORAGE CYLINDERS
Location: Close to the hazards they protect.
Protection for severe climatic or mechanical exposure: Provide guards or enclosures.
Sunlight: Protect from direct sunlight.

630 INSTALLING NOZZLES
Location: Free of obstructions, air currents and draughts.
Position: Install perpendicular to the hazard centred over the area protected by the nozzle, or between 45° and 90° from the plane of the hazard surface.

640 INSTALLING CONTROL PANELS
Location: Exit to the protected space.
Mounting: Semi-recessed with collar.

COMPLETION

910 TESTING
Notice (minimum): 3 days.
Static pressure test:
Open ended pipelines: Pneumatically test in a closed circuit for 10 minutes at 3 bar (300 kPa). The pressure drop must not exceed 20% of the test pressure.
Closed sections of pipelines: Hydrostatically test to 190 bar (19000 kPa) for high pressure systems and 36 bar (3600 kPa) for low pressure systems, for a period of 2 minutes. After this period check that there is no leakage.
Purging: On completion of testing, purge the systems. Remove moisture.

920 SETTING TO WORK
Operation: Using nitrogen, or a suitable alternative, test that flow through pipelines and nozzles is unobstructed.
Thermal links: Check that control cable lines are free.
Pneumatic heat actuation: Test using manometer. Capillary lines must be leak free.

930 DOCUMENTATION
Operation and maintenance instructions: Submit.
Record drawings: Submit.

940 OPERATING TOOLS
Tools: Supply tools for operation and maintenance purposes.
Quantity: 2 sets.

Add value.
Inspire trust.

Edinburgh RHSC-DCN

Critical Care Department Briefing Review

April 2022

Mechanical, Electrical and Public Health Consulting Engineers
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Issue / Revision Record

Issue	Date	By	Checked	Comment
1	08.04.22	SMCK	BR	Initial Report

We aim to be the pre-eminent provider of quality building services solutions and the best to work with, in the view of our clients, partners and colleagues. We believe in a sustainability led approach to design for the benefit of our clients and the world we live in.

It is our ultimate goal to work closely with our fellow professionals and clients to minimise carbon emissions and to deliver a better environment for us all to live in.

Contents

1.0 Introduction

This Report examines the Client's briefing for the Critical Care Department at Edinburgh's RHSC-DCN Hospital, with particular regard to Ventilation and Pressurisation conditions. The documents being reviewed comprising the H&K Reference Design Briefing Environmental Matrix and accompanying Guidance notes.

These documents have been reviewed along with any referenced documentation and commentary provided against any additional Ventilation Performance guidance contained within.

2.0 Executive Summary

From our Review of all referenced documents, we have not found any guidance with regards to ventilation rates other than that provided for Neutropenic Patient Ward and Isolation Rooms the latter of which confirms the requirement for pressurised lobbies to +10 Pa and 10 A/C per hour.

We would also advise that the Client NHSL was given numerous opportunities to comment on the bedroom air change rates being provided within this Department and never advised that these should be treated any differently from sleeping accommodation throughout the Hospital at 4 A/C per hour mechanical Supply and notional balanced pressure with no defined or monitored value.

3.0 Briefing Information

3.1 Environmental Matrix Table

Within this Table the Client has briefed 4 A/C per hour Positive pressure but no defined value for PICU 4 Beds with the exception of Single Bed Isolation Cubicle, which is noted as HBN 04 Dependant, Neonatal HDU Single Bed Cubicle 4 A/C per hour.

Throughout this Table only Isolation Cubicles and associated Gowning Lobbies are quoted as HBN 04 dependant.

3.2 Guidance Notes

Within the Guidance Notes clauses Notes 1,15 and 21 make reference to HDU (High Dependency Unit) and PICU (Paediatric Intensive Care Unit) and advise as below:

Note 1. This workbook is prepared for the Reference Design Stage as an easier reference tool to replace ADB RDS M+E sheets for the Environmental Criteria elements as described on these sheets.

Note 15 (part) HDU Bed Areas - Design Criteria - HBN 57 gives specific guidance as well as SHTM 03-01 esp Appendix1 for air changes -10 A/C per hour Supply,18 to 25ºC control Range …….

Note 21 Note that Isolation Suite ventilation provisions for this project shall follow HBN 04 Supplement 1 Section 4 Item 4.8 Guidance ……..

4.0 Reference Documents

In carrying out this review we have examined the following referenced Documents, copies of which are attached within the Appendix:

- B1 Critical Care Clinical Output based Specification
- H&K Reference Design Briefing Environmental Matrix as per Contract briefing document with guidance notes
- HBN 04-02 Critical Care Units
- HBN 57 Critical Care (old doc))
- SHPN 04 Supplement Isolation suites
- HTM 2025 (old doc)
- SHTM 03-01 Appendix 1: Table A1
- HBN 04 Supplement 1
- Ward Layout Drawing
- HBN 23 Hospital Accommodation for children and young people (not referenced)

5.0 Commentary

We have noted our comments against each of the referenced Documents below.

Critical Care Clinical Output Specification SEPT 2014

This is the particular Client Department Specification within which the only reference to ventilation is on Page 14 of this document which refers to lobbied Single Bed Isolation Rooms and confirms positive pressure lobbies to be provided.

Reference Data is recorded in Section 1.9 and includes:

HBN 57 Facilities for Critical Care (See Below)
SHTM 2025 Ventilation (See Below)

H&K Reference Design Briefing Environmental Matrix as per Contract briefing document with guidance notes

As per the notes above only Isolation Suites Section 1.8 are refenced differently from other patient accommodation and on the notes we have extracted the references to various Guidance Documentation.

These are HBN 57 (see Below) SHTM 03-01 Table 1 (See Below) and HBN 04 Supplement 1 (see below).

HBN 04-02 Critical Care Units OCT 2014

Section 4 Page 7 Whole unit planning and Design considerations makes passing mention of ventilation but no defined standards.

Section 6 Clinical Spaces Notes 6.1 to 6.9 details Isolation Rooms and their ventilation. There does not appear to be any other reference to ventilation of patient areas with 4.4 repeating the 10 A/C per hour and +10 Pa guidance for the lobby. There does not appear to be any guidance on A/C per hour or pressure for other than the Isolation Rooms.

HBN 57 Critical Care (old doc) 2003

Section 8 Engineering Requirements includes for Ventilation sec 8.42 talks about a balanced Supply and Extract but also refers to each bedroom having a lobby which we would translate as Isolation Facilities see section 8.50.

SHPN 04 Supplement Isolation facilities in Acute Settings Sept 2008

Sec 2.5 defines two Isolation facilities.

Enhanced single room with en-suite facilities.
Enhanced single room with en -suite facilities and ventilated bed access lobby (isolation suite).

Neither of which are applicable as generally the rooms in Critical Care we are looking at don't have en-suite facilities. However, ignoring this,the document states that the Enhanced Single Room need only have extract ventilation.

Section 4 Page 15, describes Ventilation for an Isolation Suite.

HTM 2025 (old) 1994

Section 2 refers to Provision of Ventilation in Healthcare Buildings and gives a general description of various ventilation systems.

Section 6 Special Ventilation Systems does not appear to have specific guidance for Critical Care Areas.

SHTM 03-01 Table1

Refers to Critical Care Areas at 10A/C per hour with +10 Pa and has a specific note re Isolation Rooms. Where as Isolation Rooms also on the table are referred to HBN 04-01, see note above where HBN 04-01 refers specifically to Isolation Rooms with en-suites.

SHPN 04 Supplement 1 Isolation Facilities in Acute Settings Sept 2008

Again, this refers to rooms with en-suite facilities which isn't what we have, and A/C per hour and pressure are for lobbied Isolation Suites not Bedrooms.

Ward Layout Drawing

This drawing is provided for general guidance to the Department layout.

Health Building Note 23 Hospital Accommodation for Children and young people 2004

Whilst this document doesn't appear to be referenced in the H&K Reference Design Briefing Environmental Matrix and cross referencing notes we felt it appropriate to include within this review.

Section 5, page 51 refers to Engineering Services and cross references HBN 57 for Critical Care page 51 and 5.60 page 55 for Isolation rooms.

Again, no other reference appears to be given to bedrooms requiring 10 A/C per hour and +10 Pa pressure.

6.0 Conclusions

From our review of all of the referenced documents we can find no reference to providing 10 A/C per hour and +10 Pa positive pressure for any other area of patient accommodation other than those associated with Isolation Suites and Neutropenic Wards.

We would suggest that if higher Air Change Rates were a Client requirement they were never requested within the briefing documentation.

7.0 Appendices

- B1 Critical Care Clinical Output based Specification
- H&K Reference Design Briefing Environmental Matrix as per Contract briefing document with guidance notes
- HBN 04-02 Critical Care Units
- HBN 57 Critical Care (old doc))
- SHPN 04 Supplement Isolation suites
- HTM 2025 (old doc)
- SHTM 03-01 Appendix 1: Table A1
- HBN 04 Supplement 1
- Ward Layout Drawing
- HBN 23 Hospital Accommodation for children and young people (not referenced)

B1 Critical Care Clinical Output based Specification

H&K Reference Design Briefing Environmental Matrix as per Contract briefing document with guidance notes

HBN 04-02 Critical Care Units

HBN 57 Critical Care (old doc))

SHPN 04 Supplement Isolation suites

HTM 2025 (old doc)

SHTM 03-01 Appendix 1: Table A1

HBN 04 Supplement 1

Ward Layout Drawing

HBN 23 Hospital Accommodation for children and young people (not referenced)

Add value.
Inspire trust.

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Re-provision of RHSC and DCN at Little France

ITPD: Volume 3 **(Part 6 Section 3 Sub-Sections A to E of the Schedule to the Project Agreement)** **The Board's Construction Requirements**	**Doc No:** **Title** **Revision:** **Date:**	**Volume 3** **Board's Construction Requirements** **Rev A** **March 2013**
Author: NHS Lothian (The Board).		

SCHEDULE TO THE PROJECT AGREEMENT

PART 6

Section 3: The Board's Construction Requirements

Sub-Section A: Introduction

Part 6 Section 3 of the Project Agreement encompasses the construction requirements of the Board and is divided into the following Sub-Sections and Appendices:

Sub-Section A Introduction

Sub-Section B Definitions and Abbreviations

Sub-Section C General Requirements

This Sub-Section contains overall philosophy and standards for the design, construction and finish and associated infrastructure, both internal and external for the Works and/or the Facilities.

Sub-Section D Specific Clinical Requirements

This Sub-Section contains design philosophy and specific requirements for each of the Clinical Services to be provided from the Facilities.

Sub-Section E Specific Non-Clinical Requirements

This Sub-Section contains Soft FM summary interface specifications and other Non-Clinical specifications related to the Works and/or the Facilities.

Appendix A Interface with Campus Site and/or Campus Facilities

Part 1 – Interface Construction Matters and Interface Proposals

Part 2 – Interface Proposals Procedure

Part 3 – General Matters

Annex 1 – Form of Notice

Appendix B Interface Output Specification

Appendix C Environmental Matrix

Appendix D Not Used

Appendix E Initial Drainage Proposal

Appendix F Access Strategy

Appendix G Connection Proposal

Appendix H Construction Access Proposal

Appendix I Oversail Strategy

Appendix J Service Proposal

Appendix K Substation Proposal

Appendix L Supplemental Drainage Proposal

Appendix M TMS

SCHEDULE TO THE PROJECT AGREEMENT

PART 6

Section 3: The Board's Construction Requirements

Sub-Section B: Definitions & Abbreviations

A. Terms used in this Schedule Part 6 Section 3 where defined in the Project Agreement shall have the meanings ascribed to them in the Project Agreement or otherwise shall have the meanings given to them as follows:-.The following abbreviations have been used in this Schedule Part 6 Section 3:

24/7	Twenty four hours a day seven days a week
ACS	ACS Accreditation (formerly CORGI Regulations)
AEDET	Achieving Excellence – Design Evaluation Toolkit
AFD	Action for Disability
AHU	Air Handling Unit
AGSS	Anaesthetic Gas Scavenging System
BCR	Board's Construction Requirements
BEAM	Building Environment Assessment Methodology
BMS	Building Management System
BREEAM	BRE Environmental Assessment Method
BS	British Standard
BSRIA	Building Services Research & Information Association
CAA	Civil Aviation Authority
CAMHS	Child and Adolescent Mental Health Service
CCTV	Closed-circuit television
CDM	CDM Regulations
CEL	Scottish Government Health Directorates Circulars
CEN	European Committee for Standardisation
CHP	Combined Heat & Power
CIBSE	Chartered Institution of Building Services Engineers
COSHH	Control of Substances Hazardous to Health

CP	Code of Practice
CYPH	Children and young peoples hospital which may otherwise be known as RHSC (Royal Hospital for Sick Children)
DCN	Department of Clinical Neurosciences which forms part of the Facilities
DDI	Direct Dial In
DGH	District General Hospital
DHW	Domestic Hot Water
DoE	Department of the Environment
ED	Emergency Department
EMS	Environmental Management System
EN	Euronorm Standards
EPC	Energy Performance Certificate
EU ETS	European Union Emission Trading System
HBN	Health Building Notes
HDL	Health Department Letters
HDU	High Dependency Unit
HFN	Health Facilities Notes
HFS	Health Facilities Scotland
HGN	Health Guidance Notes
HIS	Healthcare Improvement Scotland
HSE	Health & Safety Executive
HSDU	Hospital Sterilisation and Disinfection Unit
HTM	Health Technical Memoranda
HVAC	Heating Ventilation & Air Conditioning
HWS	Hot Water Supply
ICAO	International Civil Aviation Organisation
ICT	Information & Communication Technology

IDS	Intruder Detection System
IES	Illuminating Engineering Society
IEE	Institution of Electrical Engineers
IHT	Institute of Highways & Transportation
IP	Interpenetration Protection rating
IPS	Isolated Power Supply
IT	Information Technology
ITPD	Invitation to Participate in Dialogue
JAA	Joint Aviation Authority
LAN	Local Area Network
LEV	Local Exhaust Ventilation
LPS	Loss Prevention Standard
MAOT	Mobile Air Operations Team
MCA	Maritime and Coastguard Agency
MEL	Management Executive Letter (now known as Health Department Letters – HDL)
MRI	Magnetic Resonance Imaging
MTBF	Mean Time Before Fail
MOD	Ministry of Defence
NBS	National Building Specifications
NEAT	NHS Environmental Assessment Tool
NHBC	National House Building Council
NHS	National Health Service
NHSIA	National Health Service Information Authority
NHSL	NHS Lothian
PA	Public Address system
PBX	Private Branch Exchange
PCIU	Percutaneous Cardiac Investigation Unit

PCP	Project Co's Proposals
PICU	Paediatric Intensive Care Unit
PIR	Passive Infra-red
PoE	Power-over-Ethernet
PPE	Personal Protective Equipment
PPG	Planning Policy Guidance
RBD	Reliability Block Diagram
RDD	Reviewable Design Data
RFFS	Rescue and Fire Fighting Services
RHSC	Children and young peoples' hospital (which may be known as CYPH and/or Royal Hospital for Sick Children) which forms part of the Facilities
SAR	Search and Rescue
SCIEH	Scottish Centre for Infection and Environmental Health
SCIM	Scottish Government Capital Investment Manual
SEHD	Scottish Executive Health Department
SEPA	Scottish Environment Protection Agency
SFPN	Scottish Fire Practice Notes
SFT	Scottish Futures Trust
SGHSCD	Scottish Government Health and Social Care Directorates
SHFN	Scottish Health Facilities Notes
SHGN	Scottish Health Guidance Notes
SHPN	Scottish Health Planning Notes and Scottish Hospital Planning Notes
SHS	Scottish Healthcare Supplies
SHTM	Scottish Health Technical Memoranda
SHTN	Scottish Hospital Technical Notes
SI	International System of Units
SUDS	Sustainable Urban Drainage System

TPO	Tree Preservation Order
UPS	Un-interruptible Power Supplies
VIE	Vacuum Insulated Evaporator
VDU	Visual Display Unit
VoIP	Voice over Internet Protocol (or Voice Over IP)
WC	Water Closet
WRAP	Waste & Resources Action Programme

B. The following additional definitions have been used in this Schedule Part 6 Section 3:

Adaptability Strategy	Means the Adaptability Strategy, provided by Project Co to define their strategy for ensuring appropriate provision for adaptability and flexibility of the Facilities
Appendix A	Means Appendix A (Interface with Campus Site and/or Campus Facilities) annexed to this Sub-Section C of Section 3 *(Board's Construction Requirements)* of Schedule Part 6 *(Construction Matters)* as varied, amended or supplemented from time to time in accordance with the Project Agreement;
Benefit Realisation Plan	A benefits realisation plan acts as an overview of the main milestones detailed in each benefit profile. It serves as a management tool to monitor, track and manage the collective set of benefits associated with a project. The key activities (e.g. measurements, evaluations etc), from each benefit should be drawn together to form the consolidated plan. This will provide a centralised resource to help keep track of what needs to be done, when and by whom, to manage the successful realisation of benefits.
Blue Light	Ambulance, police and fire services
Car Park B	The car park which ceases to be used as a car park and is the Site
Certified Wood	Timber certified by Forest Stewardship Council
Corporate Greencode	Corporate GREENCODE® is a suite of software, templates and support materials developed by the NHS for the NHS. It is maintained by Health Facilities Scotland (HFS) to: • guide you through the development and implementation of a corporate Environmental Management System (EMS) and

	• provide tools to help you run and maintain your corporate EMS.
Council	The City of Edinburgh Council
Design Champion	Person in the Board who promotes the importance of achieving quality in capital developments and in ongoing initiatives to improve both the patient environment and the working lives of staff
Encode	HTM 07-02: EnCO2de – Making energy work in healthcare
Environmental Matrix	Means the Environmental Matrix, which details the room environmental condition requirements of the Board required within each department / unit / space / area. The title is Reference Design Envisaged Solution – RHSC / DCN Environmental Matrix version third issue as set out in Appendix C of this Section 3 *(Board's Construction Requirements)* of Schedule Part 6 *(Construction Matters)* (as varied, amended or supplemented from time to time in accordance with the Project Agreement);
Existing CAMHS	Child and Adolescent Mental Health Services currently at the Royal Edinburgh Hospital and Forteviot at the Existing RHSC
Existing DCN	Department of Clinical Neurosciences, Western General Hospital, Edinburgh
Existing RHSC	Royal Hospital for Sick Children, 9 Sciennes Road, Edinburgh
Family Council	Works collaboratively with partners, such as the Board, RHSC reprovision team and other forums, to ensure that the family perspective is integrated into current service provision, including redesign, for Children & Young People (C&YP) services
Firecode	Firecode consists of a number of Health Technical Memoranda (HTM) which consider policy, technical guidance and specialist aspects of fire precautions. Full list of HTM obtained from http://www.dh.gov.uk/en/Publicationsandstatistics/Lettersandcirculars/Firecode/DH_609
Good Practice Guidance for selecting materials	The edition of the publication entitled "Good practice in the selection of construction materials" (British Council for Offices (BCO): 2011) or any amended or updated version as at Financial Close.
Green Travel Plan	Means the NHS Lothian Sustainable Development Strategy Green Travel Plan.

HAI SCRIBE	Healthcare Associated Infection System for Controlling Risk In the Built Environment
HEAT	Means Health Improvement Efficiency and Governance, Access to Service, and Treatment Appropriate to Individuals
Hot Core	Direct vertical patient circulations route from Helipad to Emergency Department and from Emergency Department to Operating Theatres.
Identikit	Means NHS Scotland Identity Guidelines
Major Incident	As defined by the Board's Major Incident Strategy Response Plan Strategic Plan Number reference HPT E023 03
NHS Requirements	Means the requirements defined in paragraph 2.3 of this Sub-Section C as the same may be amended from time to time
Nursery	Means former Acorns nursery 51 Little France Crescent Edinburgh EH16 4SA
Project Sponsor	Person who is responsible within the Board for the success of the project
Safety Action Notices	Safety Action Notices were standard priority safety warnings issued in Scotland from 1995 to 2009 when they were superseded by Medical Device Alerts (from the MHRA – Medicine and Healthcare Products Regulatory Agency) and Estates & Facilities Alerts.
Secured by Design	Is the official UK Police flagship initiative supporting the principles of 'designing out crime'
Touch Down Base	A workstation space where staff can access a PC, Telephone, Printer ,radiological examinations, patient monitoring systems, emergency nurse/patient call system and other administrative tools to assist the clinical practitioner in executing their job.
Vistamatic	Glazed secure vision panel

SCHEDULE TO THE PROJECT AGREEMENT

PART 6

Section 3: The Board's Construction Requirements

Sub-Section C: General Requirements

1 Introduction

This document sets out the key design criteria and the core requirement to create a modern facility to re-provide services from the Existing RHSC, Existing CAMHS and the Existing DCN in a single building adjoining the RIE Facilities at the Campus Site. The design shall be enduring and take account of the history, culture and physical requirements of these internationally renowned centres of excellence.

Part 6 Schedule 3 Sub-Section C forms the general construction requirements included in the Board's Construction Requirements. Project Co shall satisfy all the requirements under this Sub-Section C.

This (and subsequent) sections of Sub-Section C of the Board's Construction Requirements outlines the overall aims of the Board with regard to the design quality of the Facilities. This Sub-Section C shall be read in conjunction with, but not limited to the following documents:

The Board's Policies; and

Project Specific Requirements defined in Sub-Sections D and E, and Appendices to this Schedule Part 6 Section 3.

Sub-Section C is divided into the following paragraphs.

Contents

2 Project Wide Requirements

The Board's vision is to provide high-quality, patient-centred services from modern Facilities. The new hospital is a single building supported by the separate energy centre but Project Co may provide other buildings on the Site to house plant and services. Where the term "building" is used, this refers to the RHSC and DCN hospital building. The energy centre and Project Co's other buildings shall meet the relevant requirements of Part 6 Schedule 3 Sub-Section C of the Board's Construction Requirements. The physical design and access to the Facilities shall promote and enhance the delivery of that full range of services, all to the benefit of patients, visitors, public and staff alike. Additionally the design strategy shall respond to the needs and aspirations of a variety of service providers including the NHS, local authorities and other community based services. The wish of the Board is to create a centre of excellence that may be an inspiration to others and set a benchmark of quality of sustainable design.

Project Co shall ensure the design complies with the general ethos detailed here, whilst also addressing the detailed requirements listed in the following clauses. It shall be noted that the requirements detailed are not exhaustive, and it is recognised that specific clinical needs will determine the nature and design of Facilities in some areas.

The Board requires the following matters to be addressed as part of its requirements:

a) The need for Project Co to maintain leadership throughout to the agreed final design stage and;

b) The Board's management team will be actively involved and will support both the project team and the clinicians.

Project Co shall support the Board's vision as stated above and develop a partnership with the Board to ensure that these aspirations are met and that Project Co co-operate fully in the evaluation of these criteria with the Board at key stages of the process.

Project Co shall ensure that the design of the Facilities draws upon and endeavours to further develop, improve and exceed current best practice (and Good Industry Practice) standards achieved in other similar schemes, and meets the requirements of the prospective patient groups, staff and the public. This philosophy of design and sustainability shall be extended across all parts of the Facilities including landscaped and external areas as well as the essential patient areas and these endeavours should extend to benefit the wider population of the community.

The Board is keen to actively participate in the design process. To facilitate this, Project Co shall engage the Board in the design and in particular the Reviewable Design Data.

2.1 Approach to Design

The Scottish Parliament has articulated the desire that Scotland becomes ***"the best small country in the world"*** and has further asserted that the quality of our built environment is a key factor in achieving this. The Scottish Government Health and Social Care Directorates (SGHSCD) believe that improving the quality of our caring environments is crucial to delivering the confident, compassionate Scotland that is aspired to.

The new building will follow the design aspirations and guidance laid out in the Policy on Design Quality for NHS Scotland (2010) to which the Board subscribes and implements through its Design Champion. The DCN will meet the objectives of the DCN stakeholders. Specifically for children and young people it will deliver the quality objectives laid down by the Family Council and other stakeholders in the project. The quality objectives of the children and young people's Family Council are:

a) The new hospital will be a beautiful place with Children and Young People at the centre of a nurturing, engaged and safe community.

b) The new hospital will provide systems and spaces that recognise the healing capacity of sustaining everyday lives and provide parallel pathways of care for patients, carers and families.

The DCN part of the Facilities will have a physical link with the existing RIE Facilities specifically with the critical care unit. Project Co should generally design and also satisfy themselves that the Facilities are capable of being so designed so that the construction and operation of the Facilities will all be within the Site subject to the rights granted to Project Co on the RIE Site and/or Bioquarter Site, as applicable, as detailed in Clause 9 (Nature of Land Interests) of the Project Agreement and subject to Appendix A. If any access or other rights are required for the construction and operation of Facilities outwith the Site and on any part of the Retained Site and/or Retained Estate and/or Bioquarter Site then Project Co will be required to notify the Board and seek agreement of the Board for the exercise of any such rights. If Project Co requires any access or other rights outwith the Campus Site and/or Bioquarter Site then Project Co recognises that consent to such rights will be required from the owner and/or operator and/or occupier of the affected property and Project Co will be responsible for obtaining any such consents.

The design will be evaluated against BREEAM 2011 New Construction (SD5073) (with BREEAM ENE1 target of 6 credits (excellent) in accordance with the BREEAM Scheme Document for New Construction (SD5073) Section 6.ENE1).

The design needs to realise the aspirations of the Benefit Realisation Plan.

The Design Champion for the project is the NHS Lothian's Project Sponsor, supported by the Director of Capital Planning and Projects, and the design process is managed by the reprovision project team.

Project Co shall take cognisance of all the architectural and building services implications of the requirements described in the Board's Construction Requirements in this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements).

2.2 General Requirements of the Board

Architectural and General Design

Project Co shall ensure the Facilities comply with the following general requirements of the Board:

a) Application of the principles contained within "A Policy on Architecture for Scotland, 2001"and "A Policy on Architecture for Scotland, Public Consultation, Review of Policy" 2006 both published by the Scottish Government;

b) Adherence to the requirements set out in CEL 19 (2010) “A Policy for Design Quality for NHSScotland, 2010 Revision published by the Scottish Government;

c) Application of the principles contained in “Improving Standards of Design in the Procurement of Public Buildings”, 2002 published by the Office of Government Commerce;

d) Application of the principles within the Scottish Government Health and Social Care Directorate's "A Policy on Sustainable Development for NHSScotland 2012". All NHS Scotland bodies engaged in the procurement of new healthcare buildings must carry out independent sustainability accreditation for projects;

e) Application of the principles contained in “Healthier Places” – Architecture & Design Scotland; and

f) Application of the principles contained in “A Vision of Health NHSScotland’s agenda for realising value in the developing healthcare estate” – Architecture & Design Scotland

Clinical Design Issues

a) In-patients and out-patients shall have an appropriate level of privacy and allow an adequate level of observation by staff;

b) The Facilities shall be designed to handle the projected workload;

c) The design shall provide and promote a calm, safe working environment and shall contribute to the development of this requirement through the choice of colours, soft furnishings and the visual integration of all safety and security systems;

d) Entrances and waiting areas shall have a light, spacious and welcoming atmosphere and the main entrances shall be immediately apparent;

General Design Issues

a) Whilst maintaining an integrated approach to the design of the Facilities, Project Co shall ensure that individual departmental design is age-appropriate and that patient orientation and recognition of location is achieved. Project Co shall consult the Board with respect to the interior design proposals and the Board’s preferences and opinions shall be taken into account in the final choices;

b) The Facilities shall incorporate the recommendations of "Effective Wayfinding and Signing Systems - Guidance for Healthcare Facilities" 2nd Edition 2005, NHSScotland Signage Guidelines, NHSScotland Identity Guidelines and BS8501:2002. “Graphic symbols and signs – Public information symbols” and have a co-ordinated décor and sign-posting scheme to create a safe and readily-understood patient environment;

c) The Facilities shall incorporate appropriate standards of security, and minimise the potential for exposure to crime and vandalism. Recognising that particularly vulnerable groups will use the Facilities, security will be designed to meet the needs of all patients, visitors and staff. Vulnerable individuals include, but are not exclusive to, young children, mental health patients, and the frail and elderly. The Facilities shall meet the requirements of Secured by Design. In this respect, as part of the planning process, discussions with the Lothian and Borders Police Architectural Liaison team and Special Branch shall take place, and any comments made reflected in the Facilities as appropriate (see paragraph 3.7 of this Sub-Section C for further guidance). The security arrangements shall require to have regard to, and be compatible with the security arrangements in place for the RIE Site; and

d) The Facilities shall be designed such that all maintenance and life cycle component replacement procedures can be carried out practically, efficiently and effectively and with minimal disruption to Clinical Services.

All standards, guidance, codes of practice and all other titled requirements that Project Co shall comply with are to be the current version of the requirement or its replacement requirement without the need for a Change. Refer also to paragraph 2.5 below.

2.3 NHS Requirements

In addition to the standards listed in paragraph 2.4 of this Sub-Section C, unless the Board has expressed elsewhere in the Board's Construction Requirements, a specific and different requirement, the Facilities shall comply with but not be limited to the provisions of the NHS Requirements as the same may be amended from time to time:

a) The themes, issues and recommendations in “Better by Design: Pursuit of Excellence in Healthcare Buildings” by the Department of Health;

b) New Policy on Design Quality for NHS Scotland published by SGHSCD;

c) Firecode;

d) HAI SCRIBE;

e) HBN;

f) HFN and SHFN;

g) HGN and SHGN;

h) HTM and SHTM;

i) SHTN;

j) SFPN;

k) HDL;

l) SHPN;

m) NHS publication 'Performance requirements for building elements used in healthcare facilities’;

n) NHS Scotland & NHS Policies;

o) Board Policies as scheduled and available in the Disclosed Data as such schedule and Board Policies may be amended from time to time;

p) Health Department Letters (or Management Executive Letters) as appropriate published by SEHD and SGHSCD;

q) Safety Action Notices published by NHS Scotland;

r) Healthcare Improvement Scotland (HIS);

s) NHS Model Engineering Specifications;

t) Department of Health publication “Better by Design”;

u) Corporate Greencode;

v) NHS Scotland Fire Safety Management, incorporating NHS Scotland Firecode;

w) Hazard Notices issued by NHS Scotland; and

x) HSC 1999/123;

i. Firecode

Project Co shall ensure the Facilities comply with the NHS Scotland Fire Safety Management - a suite of documents which explains the policy and technical guidance in fire precautions in hospitals and other healthcare premises, comprising the Health Facilities Scotland Fire Safety Policy, the Scottish Health Technical Memoranda (SHTM) and Scottish Fire Practice Notes (SFPN) which all comprise NHS Scotland Firecode, the Fire Safety Documentation Reference Guide and A Model Management Structure for Fire Safety.

Project Co shall prepare proposals in accordance with NHS Scotland Firecode to be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement prior to the submission of the proposals for approval by the Relevant Authority including without limitation building control department.

In the event of a conflict between the requirements of the local building control officers and NHS Scotland Firecode the more onerous requirements shall take precedence. Project Co shall notify the Board as soon as such conflict is known or suspected and shall further advise the Board of Project Co's proposed relevant design solution as early as possible before formal submission for review by the Board. When the more onerous requirement is to be used the Board will have the right to decide what constitutes the more onerous requirement.

Any fire strategy which affects the Site will also have to have regard to, be compatible with and operate in conjunction with the fire strategy and procedures for the RIE Facilities and/or Retained Estate, as applicable.

ii. Health Building Notes (HBN)

Project Co shall take fully into account the guidance and advice included within HBN. Project Co shall ensure the Facilities comply with the requirements of HBN and shall adopt as mandatory any recommendations.

iii. Health Facilities Notes & Scottish Health Facilities Notes (HFN & SHFN)

Project Co shall, in relation to all SHFN and all HFN (except HFN where an SHFN exists with the same number and covering the same subject matter): take fully into account the guidance and advice included within such SHFN and HFN; ensure that the Facilities comply with the requirements of such SHFN and HFN; and adopt as mandatory all recommendations and preferred solutions contained in such SHFN and HFN.

iv. Health Guidance Notes & Scottish Health Guidance Notes (HGN & SHGN)

Project Co shall, in relation to all SHGN and all HGN (except HGN where an SHGN exists with the same number and covering the same subject matter): take fully into account the guidance and advice included within SHGN and HGN. Project Co shall ensure the Facilities comply with the requirements of SHGN and HGN and shall adopt as mandatory any recommendations.

v. Health Technical Memoranda & Scottish Health Technical Memoranda (HTM & SHTM)

Project Co shall, in relation to all SHTM and all HTM (except HTM where an SHTM exists with the same number and covering the same subject matter): take fully into account the guidance and advice included within such SHTM and HTM; ensure that the Facilities comply with the requirements of such SHTM and HTM; and adopt as mandatory all recommendations and preferred solutions contained in such SHTM and HTM.

vi. Scottish Hospital Technical Notes (SHTN)

Project Co shall, in relation to all SHTN take fully into account the guidance and advice included within such SHTN; ensure that the Facilities comply with the requirements of such SHTN; and adopt as mandatory all recommendations and preferred solutions contained in such SHTN.

vii. Scottish Fire Practice Notes (SFPN)

Project Co shall, in relation to all SFPN take fully into account the guidance and advice included within SFPN. Project Co shall ensure the Facilities comply with the requirements of SFPN and shall adopt as mandatory any recommendations.

viii. Scottish Government Health Directorates Circulars (CEL and HDL)

Project Co shall, in relation to all CEL and HDL take fully into account the guidance and advice included within CEL and HDL. Project Co shall ensure the Facilities comply with the requirements of CEL and HDL and shall adopt as mandatory any recommendations.

ix. Scottish Health Planning Notes and Scottish Hospital Planning Notes (SHPN)

Project Co shall take fully into account the guidance and advice included within SHPN. Project Co shall ensure the Facilities comply with the requirements of SHPN and shall adopt as mandatory any recommendations.

x. Sustainability

Project Co shall comply with the requirements set out in "A Policy on Sustainable Development for NHSScotland 2012". This policy supersedes and incorporates NHS HDL (2006)21 "An Environmental Management Policy for NHSScotland".

Project Co shall comply with the requirements set out in HTM 07-02 EnCO2de – making energy work in healthcare.

Project Co's proposals shall facilitate the achievement of an effective Environment Management System; the exemplar tool is Corporate Greencode's objectives.

Project Co's proposals shall allow the Facilities to achieve as a minimum "very good" rating when subjected to a BREEAM 2011 New Construction (SD5073) and BREEAM ENE1 target of 6 credits (excellent) in accordance with the BREEAM Scheme Document for New Construction (SD5073) Section 6.ENE1

assessment.

Council requirements and NHS Policies including CEL 2 (2012), A Policy on Sustainable Development for NHSScotland 2012 to be read in conjunction with "A Sustainable Development Strategy for NHSScotland 2012", "Sustainable Development in the NHS", 2001 and, "NHS Estates, Sustainable Development: Environmental Strategy for the National Health Service," 2005.

xi. General

Project Co shall take fully into account all health building briefings and planning guidance relevant to the briefing, design and construction of an acute general hospital, particularly but not limited to the material published by SEHD and NHS Estates guidance formally promulgated for use in Scotland.

Project Co shall also take fully into account the guidance and advice included within the following publications as the same are amended from time to time:

a) Enhancing privacy and dignity-achieving single sex accommodation;
b) National standards of cleanliness for the NHS Scotland;
c) Quality Guidelines: Access for People with Disabilities (April 2000);
d) Infection Control in the Built Environment (SHFN 30 & HAI-SCRIBE);
e) National Standards of cleanliness for the NHS Implementation Guidance Toolkit;
f) Standards for Environmental Cleanliness in Hospitals; and
g) Scottish Infection Manual – "Managing the Risk of HAI in NHS Scotland".

Project Co shall ensure the design of the Facilities incorporates the following requirements;

a) Minimisation of the need for staff to be with patients in secluded or isolated parts of the building;
b) The layout of the inpatient units shall discourage patients from leaving the units except when authorised to do so. Project Co shall give due consideration to channelled exit routes that require the negotiation of staffed areas; and
c) Ease of patient observation by staff.

2.4 Minimum Design & Construction Standards

Project Co shall also ensure that the Facilities comply with Good Industry Practice, NHS Scotland requirements, relevant statutory requirements (including highways) and required consents including, but not limited to, the following as the same may be amended from time to time:

a) Construction (Design and Management) Regulations 2007;
b) Management and Safety at Work Regulations 1999;
c) Health & Safety legislation, including all UK and Scottish Statutory Instruments;
d) Recommendations of the Health and Safety Executive;

e) Control of Substances Hazardous to Health (COSHH) Regulations 2002 and amendments;

f) Manual Handling Operations Regulations 1992;

g) Health and Safety (Display Screen Equipment) Regulations 1992;

h) Workplace (Health, Safety and Welfare) Regulations 1992;

i) BS OHSAS 18000:2007~~;~~

j) Quality Assurance System to BS EN ISO 9000 and 9001~~;~~

k) The Equality Act 2010;

l) The Climate Change (Scotland) Act 2009;

m) “Better Public Building” by Department of Trade & Industry;

n) The Building (Scotland) Act 2003 and its most recent amendments;

o) The Fire (Scotland) Act 2005 and its most recent amendments;

p) The Fire Safety (Scotland) Regulations 2006;

q) The Building (Scotland) Regulations 2004 and its amendments;

r) The Non-Domestic Technical Handbook 2011 to The Building (Scotland) Regulations 2004 and its amendments

s) Scottish Fire and Rescue Service and NHS Lothian Fire Officer’s requirements and fire safety requirements, including, but not limited to the Board’s Fire Strategy, Fire Safety for NHS Scotland 2011, CEL 11(2011), Practical Fire Safety Guide for Healthcare Premises by Scottish Government and NHS Scotland Firecode series;

t) Minimum requirements of the relevant utilities companies, and the Board;

u) Requirements of The City of Edinburgh Council’s Building Control Officer, Fire Officer and Environmental Health Officer;

v) Relevant British Standards, Codes of Practice, or equivalent European industry recognised standards;

w) Eurocodes;

x) Building Research Establishment Digest Recommendations;

y) Local Bye-Law and Regulations;

z) Scottish Centre for Infection and Environmental Health guidance / recommendations;

aa) Treasury Taskforce Private Finance Technical Note No. 7: How to Achieve Design Quality in PFI Projects;

bb) The requirements of the National Radiological Protection Board;

cc) Radiological Protection Act 1970;

dd) Radioactive Substances Act 1993;

ee) The Ionising Radiation Regulations 1999;

ff) The Ionising Radiation (Medical Exposure) Regulations 2000;

gg) All other bodies and authorities having jurisdiction;

Project Co shall as a minimum achieve the standards detailed in the Patient Rights (Scotland) Act 2011; and

For the avoidance of doubt, Project Co shall provide all fixed fire fighting equipment to comply with statutory requirements and the requirements and recommendations of NHS Scotland Firecode.

2.5 Hierarchy of Standards

If there is any inconsistency within the terms of this Section 3 of Schedule Part 6 *(Construction Matters)* and the Appendices then the provisions of Appendix A, Appendix B (Interface Output Specification), Appendix E (Initial Drainage Proposal), Appendix F (Access Strategy), Appendix G (Connection Proposal), Appendix H (Construction Access Proposal), Appendix I (Oversail Strategy), Appendix J (Service Proposal), Appendix K (Substation Proposal), Appendix L (Supplemental Drainage Proposal) and Appendix M (TMS) shall prevail.

Where contradictory standards / advice are apparent within the terms of this Section 3 of Schedule Part 6 *(Construction Matters)* and the Appendices then subject to the foregoing paragraph then (1) the most onerous standard / advice shall take precedence and (2) the most recent standard / advice shall take precedence. When the more onerous requirement is to be used the Board will have the right to decide what constitutes the more onerous requirement.

Where there is a conflict of interest resulting from the use of the standards / advice Project Co shall involve the Board in the decision making process. The Board shall be entitled to make the final decision regarding the standards / advice to be used for the Facilities including any contradictions that may arise between items (1) and (2) above.

NHS Scotland standards shall take precedence over equivalent NHS England and Wales's standards.

In certain instances, NHS publications include a number of options or alternative solutions. Where the Board has defined their preference specifically, Project Co shall adopt these preferences as a mandatory requirement. Where no Board preference is stated, Project Co shall engage the Board in the design development process to seek and incorporate the Board's preference within the Facilities.

While the Board has placed a clear obligation on Project Co in relation to NHS publications, it also wishes to acknowledge that in certain cases the subject matter, guidance and advice included therein may have been further developed and improved since the date of publication. In this regard, the Board does not wish to limit the use of current best practice or innovation in relation to the adoption of design standards.

For the avoidance of doubt, the Board considers NHS publications reflect minimum standards and any alternatives proposed by Project Co shall provide a similar or enhanced level of service and quality.

2.6 Information Technology & Record Information

Computer aided design shall be applied but not limited to the following:

a) Calculations and principal energy flow analysis for plant simulation;

b) All drawn information layouts, schematics, etc.;

c) “As fitted” and record documentation and drawings;

d) Electrical, mechanical and communication services;

e) Landscaping and site planning and;

f) Traffic modelling and;

g) All other design or design information which Project Co is obliged to provide the Board in accordance with paragraph 4.5.17 (Completion Requirements) and/or Clause 17.18 and/or 18 of the Project Agreement.

The systems used for computer aided design, including Building Information Modelling, shall be available for use by the Board from the point of commencement of the design for the Facilities and all of the information listed above shall be made available on such systems and maintained fully up to date throughout the Works and as applicable during the Operational Term and made available at all times to the Board. This is required in order to assist with the transfer and integration of new and existing information between the Board and Project Co.

3 General Design Requirements

Project Co shall design the Facilities to address the following issues:

3.1 Character & Innovation

3.1.1 Vision

Cognisance shall be taken of the long and illustrious histories of the Royal Hospital for Sick Children and Department of Clinical Neurosciences in Edinburgh. The new building will effortlessly and efficiently support service delivery, both now and in the future, and the human needs of the people within the building; those on whom the service depends - the staff – and all those it is intended to serve. The design should be valued by the patients, staff, visitors, other users and the local community. It shall have an enduring quality that will outlive transient trends or architectural fashion and will provide a memorable landmark building of which future generations will be proud.

The design shall reinforce a strong positive image of the NHS and be identifiable with its function of care. It shall therefore represent the standards of excellence that the teams of staff at all levels are working to achieve.

The building design shall avoid being a purely utilitarian environment, neither bland nor monotonous and certainly not an “off the shelf shoe box”. Each part shall have a discrete visual identity. All vistas and focal points such as entrances should be instantly recognisable with distinctive visual interest.

It shall recognise the following human and healing aspects enshrined in NHSScotland’s vision for the healthcare estate:

a) Uplifting – a building that people of the local area are proud of; that is a symbol of the NHS service ethos and the staff: that conveys respect to the patients and which encourages respectful behaviour in return; which offers an “architecture of hope”.

b) Local – that one size does not fit all: that both the service configuration and the architectural expression should grow from, and support, the community needs and the unique characteristics of the place.

c) Natural – the importance of daylight and contact with the natural environment; of knowing the time of day and weather; of being able to escape into a garden; of being sustainable and using resources efficiently.

3.1.2 Excellence for Patients

The design of buildings, external and internal appearance as well as the design of the external works, and landscape can have a positive or a negative effect upon patient care, staff experience at the work place and the way NHS healthcare buildings are perceived. Project Co shall develop design solutions which by the use of materials, lighting, shape, scale, mass and form of the building elements make a positive contribution to engendering the well-being of patients, staff and visitors.

3.1.3 Healthcare Excellence

Project Co shall develop building design solutions that:

a) Reinforces the dependability and reassurance that the NHS means to the local community;

b) Respects their local environment and at the same time make a positive contribution to the urban context that they are in;

c) Clearly expresses their function in external and internal appearance;

d) Allow patient diagnostic and treatment areas to be differentiated in design concept and detail from inpatient areas; and

e) Reflect that design considerations such as the distribution, size and proportion of windows and the use of materials can reflect the clinical function.

These elements shall be expressed in the scale and mass of the buildings, as well as the disposition of functions, whilst sustaining its effectiveness and efficiency of its use.

3.1.4 Architectural Vision

Project Co shall develop building design solutions, which create an ordered composition of building elements in a stimulating form that successfully combines good standards of space, height, form, scale and use of materials and colours / images with associated functional requirements and the surroundings.

3.1.5 Stimulating Design

Project Co shall develop building design solutions which create a high quality, good working environment, both externally and internally, which shall provide a reassuring, enjoyable, convenient and safe hospital for all patients, their families, visitors and staff. This objective shall not be in conflict with the desire to produce a stimulating design. Project Co shall meet this objective and shall develop a design which will not date and which shall be adaptable in a way that does not destroy the original design vision / concept, whilst sustaining its effectiveness and efficiency of its use.

3.1.6 Design Innovation

The design shall reflect current and developing innovations in healthcare delivery and translate these into an innovative buildings solution including the incorporation of art integral to the architecture.

Innovation in design can range from whole concepts of hospital planning, distribution of functions etc to detail design of components, materials, spaces, use of technology etc.

3.1.7 Recognisable Quality

The Board expects high quality design to match the best national standards of healthcare provision it intends to implement.

Materials shall be substantive and of high quality. They shall be carefully detailed and constructed such that the quality is appreciated throughout the life of the Facilities. They shall retain their appearance within a compatible maintenance regime. For example, detailing of external materials shall be resistant to and shall not cause unsightly staining.

The life cycle plan and design detailing shall allow for replacement of elements of the buildings in a way that does not impair the design quality or adversely affect the service provision.

3.2 Internal Environment

3.2.1 Quality Environment

"You can't just heal a person with medicine; the environment has to work too."
Young People's Advisory Group

The design of the Facilities shall create a sustainable, high quality, good working environment, both externally and internally which will provide a reassuring, relaxing, convenient and safe hospital for all patients, their families, visitors and staff.

The Board anticipate that an interior designer will be included in the Project Co's design team to secure a clear co-ordination of the interior materials and wayfinding within the Facilities, matching the furniture, furnishings and equipment being procured by the Board.

Communal patient areas, which include spaces such as playrooms and quiet rooms, shall be domestic in design and ambience (whilst ensuring that measures to reduce the risk of transmission of infection and increase safety are not compromised). Public areas such as waiting and reception areas shall be restful, open and be well lit with natural light as far as is

practicable. They shall, as a rule, have views out to landscaped spaces that add quality and orientation.

The design shall allow for an open and friendly environment, but shall ensure privacy and dignity for patients, family members and visitors when required. To achieve this, the following features shall be incorporated:

a) The ability for patients to see staff working within each section;

b) The ability for staff to observe patients easily from the Touch Down Base;

c) Where appropriate, glazed panels to have privacy control;

d) Doors to all rooms inpatient single rooms shall have large viewing panels with privacy control;

e) Wards and Units shall function as dedicated patient care areas and must not be designed for use nor used as thoroughfares for access;

f) Facilities shall be sensitive to the cultural, religious and spiritual needs of patients, family members, visitors and staff;

g) All non-clinical areas shall be designed to limit incursion into the clinical areas; this may be achieved by separate service entrances;

h) Reception areas shall be easily accessible to visitors upon entry to the ward, department or unit;

i) Reception areas shall facilitate dialogue with visitors of varying heights e.g. children, wheelchair users, adults, whilst maintaining staff security and privacy across the reception desk;

Wards shall be designed to maximise the efficiency of working arrangements, ensuring minimal travelling distance whilst treatment is being carried out at bedside and in clinical treatment areas within the ward environment.

Washing and toilet facilities shall be located within bed areas, and sited to allow maximum visibility into the rooms. Visual and acoustic privacy must be positively addressed in the case of shared facilities within bed bays. All washing and shower areas shall be designed to minimise the spread of infection, and meet accessibility codes, for example large doors which open outwards.

A suitable and appropriate, continuous machine cleanable floor surface is required. Refer to paragraph 5.13.2 for flooring.

The use of curtains shall be minimized wherever possible to control infection by utilising screens/blinds within glass which can be operated without touching the blind.

The location of patient entertainment systems shall not be obtrusive.

It is anticipated that ward layouts will maximise views, particularly from bedrooms. Sight lines shall be optimised for all users to enable outward visibility with consideration being given to sill heights. Windows on the ground floor will require special attention in relation to privacy and security. Account shall be taken of external environmental conditions, such as stronger winds at higher levels and window designs shall manage and control these environmental effects. The Board welcomes innovative designs and diverse approaches such as wheelchair and baby-buggy height windows which are inherently safe. Window design and specification must meet the requirements of The Building (Scotland) Regulations 2004 and its amendments and adhere to all relevant minimum NHS Requirements.

Project Co shall provide covered areas, which can be used year-round, as amenity and play space. Project Co shall provide seating and furniture in these areas.

Parents/relatives/carers normally need to take time off work to be with their child/family member in hospital. Access for them to resume normal activities, while remaining close to their child/family member, must be demonstrated within the design, e.g. internet access in quiet internal and external areas for carers.

The internal finishes must be effectively and expertly designed and co-ordinated, and furnishings, furniture and equipment must be of high standard. User representatives, via the Board's Representative must be consulted at appropriate points throughout the design, construction and operational phases to ensure that the processes and solutions are responsive to specific needs, both operationally and aesthetically, as well as maintaining corporate requirements all in liaison with the Board's Project Team.

3.2.2 Light, Colour & Texture

Colour, decoration, works of art and motifs shall be used to facilitate identity of the Facilities; and its designated areas / zones and in addition improve wayfinding. It also shall be used to create an immediate and distinct 'image' of the Facilities to visitors, which is interesting and stimulating. The use of colour shall be co-ordinated with the lighting and be appropriate for the activities in each area; toned down in certain areas e.g., recovery, rehabilitation and quiet areas; but bright and stimulating in others, such as waiting and corridor areas.

Project Co shall propose the colour scheme and any choices available, details of which shall be submitted to the Board for review by the Board in accordance with paragraph 1.2.3 of Schedule Part 8 (Review Procedure), Table of Finishes and clause 12.6 of the Project Agreement.

The design shall provide quiet, comfortable areas with pleasing outlooks easily accessible from clinical areas where patients and their families / visitors can "escape" from the clinical environment. Such areas may facilitate informal discussions with health professionals in the future, and be equipped for play / recreation.

The effective use of light is an essential component of the hospital design. Light should be used both creatively within the building and also externally to light the building and create a sense of presence and beauty. The external lighting is to be designed to illuminate main entrances to the building, for wayfinding in the dark and to promote external design features. The use of external lighting to enhance security arrangements is essential.

The use of both natural daylight and artificial light should contribute towards a high quality environment and also be energy efficient. It shall be possible to adjust lighting for reading, close and clinical work, to suit mood and condition of patient, time of day etc. Emergency lighting is required throughout the Facilities.

Natural light should be provided in public spaces and in occupied private and staff spaces within the building as far as is practicable. Natural and artificial light sources shall be designed to avoid glare and thermal gain. Changes in level shall be well lit and abrupt changes in illumination should be avoided, unless specified as a clinical requirement. Glare on reception desks, signs and notice boards must be avoided. Artificial lighting layouts particularly, but not exclusively, along areas of circulation, shall be designed to avoid the creation of a stroboscopic lighting effect.

Deep plan spaces may prove necessary in certain circumstances. In such cases, the layout must be relieved by the penetration of daylight and sunlight from adjacent courtyards or roof and light shafts.

3.2.3 Internal Spaces

All internal spaces shall be planned in accordance with the requirements of the Specific Clinical Requirements at Sub-Section D with the appropriate adjacencies and layouts.

Some spaces shall be designed to encourage social interaction for patients, visitors and staff.

Public spaces shall be used to integrate the various parts of the building, and shall be designed to avoid being a space joined by long, narrow corridors.

3.2.4 Internal Wayfinding

Design solutions shall incorporate an integrated, comprehensive wayfinding strategy that enables patients, visitors and staff to self-navigate with ease and lack of stress throughout the buildings.

The integration of works of art into the wayfinding strategy is encouraged by the Board.

The wayfinding strategy shall be designed to meet the needs of staff, patients and visitors. Routes shall be clearly defined to ensure that parts of the buildings that are restricted to staff are not used as short cuts by patients and visitors. The use of enclosed internal courtyards as an integral part of a route shall be considered.

Internal signage shall be easily understood and consistent throughout the journey from the entrance to the department reception and on to rooms. It shall not create a clutter and the use of pictograms and graphic art is encouraged.

Proposals should be developed which acknowledge the multi-sensory process used in wayfinding and which address the needs of people with impairment in touch, smell, sight or sound.

The wayfinding strategy shall embrace the Identikit toolkit guidelines published by NHS Scotland and be able to interface with what is in use within the Campus Site and Bioquarter Site.

3.3 Urban & Social Integration

3.3.1 Sense of Place

The Facilities shall be designed to complement and enhance the quality of the design in the locality in which it is sited. It shall create a welcoming, inclusive and vibrant environment, and shall enable easy access by the communities and groups who will use it.

The Facilities shall be organised to establish a continuity of building frontage and a clear definition of public and private spaces. When approaching the building the viewing of service areas or more “industrial” looking parts of the Facilities shall be avoided.

3.3.2 Neighbourhood & Community

Project Co shall ensure they are considered a responsible 'good neighbour' throughout design, construction and operation periods. The Facilities shall add value to the neighbourhood and wider community, and not detract nor be a nuisance or a burden to the environment.

The design shall reflect the importance of the Project in healthcare terms and it shall be seen as a leading edge community resource reflecting the objectives of a modern NHS.

Project Co shall provide Facilities whose overall visual impact contributes to improving civic design, and is sensitive to their relationship with the surroundings.

Careful consideration shall be given to the height of the buildings in relation to adjacent developments.

3.3.3 Site Fit

New buildings, parking areas, other infrastructure and services shall be located with regard to the existing landscape and topography. Amenity space shall be planned around the buildings at appropriate places.

The design of the Facilities shall identify areas of the Site as possible expansion zones.

3.3.4 Hard & Soft Landscaping including Garden Spaces

Project Co shall design, as an integral part of the Facilities, a hard and soft landscaping scheme that will enhance the environment of the Facilities.

The landscaping scheme shall be of a high quality and shall assist in knitting the Facilities into their surroundings. It must also provide an interlinked network of attractive public spaces for amenity and circulation for use by patients, staff and visitors.

These will form an essential clinical part of the external environment, and must be integrated with the other aspects of the external environment, building entrance areas; car parking; access roads; pavements / footpaths; and service / delivery areas. The landscape design should support and enhance the separation of pathways of pedestrians, public vehicles and delivery vehicles.

The soft landscape design and choice of plants should assist in providing a therapeutic environment and be sympathetic to the character of the existing landscape.

External hard and soft landscaping (including courtyards) shall be designed for therapeutic use and provide patient's, staff and visitors access. The landscape scheme shall facilitate security of pedestrians and avoid 'No-Go' areas. A comprehensive and integrated landscape strategy shall be developed for appropriate formal and informal treatment of public and private areas.

Project Co shall provide all the external equipment required for the external areas. Details of the extent, type and location of such equipment shall be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement. Notwithstanding the foregoing, the Board reserves the right to fund specific equipment from Charitable Funds and

depending on the type of specific equipment thus funded such equipment shall be governed by Schedule Part 11 (Equipment Schedule).

3.4 Citizen Satisfaction

3.4.1 Design Concept

The visual forms shall enhance the sense of place and shall exploit to best advantage the environmental qualities of the Facilities and the Retained Site and the Retained Estate.

3.4.2 Scale & Proportion

Appropriate scale and proportions shall reflect the human scale, suitable for child and adult users of the hospital, adjoining urban surroundings and the existing buildings / structures at the Campus Site. Plant rooms, lift, stair towers and the helipad shall express form and function, but they shall not be perceived as dominating and oppressive.

3.4.3 Composition

The composition of the buildings shall be complete, cohesive and well balanced in massing. The visual form shall enhance the Site and sense of place.

The overall form of the buildings shall be designed to demonstrate the individual functional needs of each part of the Facilities. These parts shall harmonise with each other and the overall site, and the concept of facilities for different age and patient groups with distinct identities shall be fully explored by Project Co.

3.4.4 Aesthetics

The overall visual form of the buildings shall combine good standards of space, height, form and scale. The form of the building shall appeal to the aesthetic senses of patients, visitors and staff as follows:

a) The lines of the design shall clearly define forms and surfaces of the buildings;

b) The skyline shall reflect the mass of the buildings but not be out of scale and dominating;

c) The sky line shall not be monotonous.

d) The solid forms shall be in scale and have harmonious shapes; and

e) The interplay of light and shade shall add to the definition of the building form and the balance between solid and glazed elements needs to be incorporated into the design.

3.4.5 The Arts

The Board will be entitled to approve the whole art content in the Project and Project Co shall submit any artwork to the Board as Reviewable Design Data for review by the Board in

accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement before any art work is commissioned.

Project Co is required to demonstrate how art is an inherent element of the design and how it has been integrated into the building fabric such that there is differentiation between the identities of the RHSC, CAMHS and DCN areas.

The incorporation of art, its use for way finding and the enhancement of the overall therapeutic environment must be an essential requirement of the design. Work has been initiated by the Board to develop an arts strategy to support the design of a hospital, and its environs, that will promote health and wellbeing. In consultation with the Board, Project Co shall carefully consider the outputs from the 2010-2014 charitably funded Artists in Residence Programme within the RHSC and CAMHS. Documents relating to the Board's arts requirements are set out in the Disclosed Data. Project Co shall provide and install the art.

Project Co shall give careful consideration to the co-ordination and siting of artwork, so that it is multi-age appropriate, child-safe and interactive. Project Co shall ensure that all artwork conforms to the infection control standards appropriate to its location. Integration of artwork within the interior design should enhance identity at all levels – Facilities wide, departmental, main public spaces and circulation routes. To facilitate the utilisation of walls and other surfaces as art or for art, the design and positioning of engineering outlets, controls and sensors requires particular consideration. The internal wall construction and surface finishes within the Facilities shall allow for the flexible display of Artwork. Project Co's lighting design shall include for the use of illumination and spotlighting of the artwork features, or as art itself.

Project Co's design shall provide space for:

- Live arts performance and associated forms of presentation;
- The display of artwork created by children in RHSC and for the display of art competition work
- Health promotional events; and
- Public events, appeals and merchandising for fundraising / charity promotions.
- Artworks to be displayed on a rotational basis.
- Project Co shall ensure that the Facilities, where appropriate, incorporate innovative design and artworks as an integral part of the Facilities. Project Co shall:
    a) Create and designate spaces within the Facilities (both internal and external) which will be appropriate for the integration of artwork into the designs, and ensure that these locations incorporate suitable building services and the relevant parts of the Facilities are suitably designed and constructed in all respects for the provision for placing or fixing such items such that they are displayed to their best advantage;
    b) Liaise with the Board (or nominated representative) as ideas for arts are developed in conjunction with service users and staff, and, in conjunction with the Board, identify a shortlist of suitable artists that works may be commissioned through; and

c) Commission such artists whose artwork has been submitted to the Board as Reviewable Design Data and approved by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement, and take full responsibility for ensuring their works are integrated into the Facilities, also ensuring that the contractor and designers involved are integrated into this process from the outset such that the creative opportunities are maximised and that functional, cost and arts programme issues are anticipated and resolved.

Project Co shall take an active and supportive role in implementing an arts and environment programme for the Facilities.

Project Co's design shall integrate such artwork features as are being transferred from the Existing RHSC and Existing DCN into the overall design philosophy for the Facilities. A schedule of the large and heavy items to be transferred, including those items to be built into the new building fabric, is detailed in the Disclosed Data. A schedule detailing the more portable items to be transferred is included in Schedule Part 11 (Equipment Schedule).

The artworks proposals shall embrace (where applicable) the Identikit toolkit identity guidelines published by NHS Scotland.

3.5 Uses

3.5.1 Service Philosophy

The service philosophy is contained in Sub-Sections D and E of Section 3 of this Schedule Part 6.

The design shall deliver a solution, which fully reflects the special needs for each patient group whether they be attending hospital on a planned or on an unplanned basis. Clinical activity is considered further under these headings:

a) Unscheduled Care;

b) Scheduled Inpatient care;

c) Out-patient and Medical Day Care;

d) Critical Care Services;

e) Theatre and Day Surgery;

f) Clinical Support Services;

g) Child and Adolescent Mental Health Service.

These are detailed in the Board's Construction Requirements in this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements).

The Project shall promote integrated ways of working and delivering services for both primary and secondary care, and for the NHS, local authorities and other community based services.

3.5.2 Clinical & Non Clinical Functionality

The Facilities shall be designed to accommodate the Clinical, Non-Clinical and other functions ascribed to them in terms of space, environment and the efficient and safe operation of equipment, as defined in the Board's Construction Requirements in this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements).

The design of the Facilities shall:

a) Function efficiently, effectively and economically to achieve the optimum balance between capital cost of the Facilities and the Board's operating costs and to meet and satisfy all of the requirements and obligations set out in these Board's Construction Requirements to ensure that the Facilities are sustainable well into the future and as a minimum for the whole of the Operational Term or to meet the Handback Requirements, which ever is the longer period;

b) Demonstrate that the design fully reflects the special needs for each patient group in terms of access, functional relationships and planning;

c) Interface easily with other service providers in particular the wider services provided by the Board;

d) Foster the provision of patient-focussed acute services; and

e) Permit and encourage service integration across the care spectrum/community.

The design shall be able to do this in terms of environment, scale, comfort privacy, reassurance, style and security.

3.5.3 Design for Therapy

The Board places a high priority on how the design of the Facilities impacts, both mentally and physically, on the treatment experience for patients, families, visitors and staff. It is therefore essential that Project Co develops a clear strategy which is interpreted through the design of the Facilities and focuses on providing an environment that takes every opportunity to enhance the experience of every person who comes in to contact with it.

This paragraph 3 shall be read in conjunction with the requirements for infection control. Whilst it is expected that there is a balance to be drawn between design for therapy and infection control requirements, the requirements of one over the other shall not preclude the use of well thought out design and good quality solutions.

3.5.4 Patient Privacy and Dignity

To achieve appropriate levels of privacy, Project Co shall provide Facilities which allow adequate space around patients. This may include space for families, and other visitors to sit with patients, adequate space between chairs, and seating in rest bays along corridors to provide rest places along the route of the patient / visitor journey. The privacy afforded to patients, staff, families and visitors shall not be compromised by inappropriate or inadequate sound reduction measures in the design or in the build standard.

Sill heights for windows shall enable outward visibility, in particular for children, patients in wheelchairs and in beds. Special consideration shall be given to the needs of those with impaired mobility and those with poor sight. Some doors and internal glazed screens shall

require vision panels or other glazing systems, which may be obscured or controlled for privacy. The ability to use vision panels which allow objects / small children on the other side to be viewed are required in those areas as defined in the Room Data Sheets.

3.5.5 Age Appropriate Care

The age range of children routinely attending the RHSC paediatric facility will be 0 – 16 years, and a number of young people aged from 17 to 18 years of age also will attend. CAMHS patients routinely attend until they are 18 sometimes older therefore the building, particularly within the Inpatient areas, will offer a variety of facilities to meet the needs of infants, pre-school age, 5-10 year olds, 10-13 year olds and 13-16/18 year olds. Adolescents in RHSC have access to a social space designed specially for this age group, CAMHS inpatient areas are to accommodate 12-18 years olds. The DCN facility provides services to adults.

Age specific facilities will be provided within the appropriate areas.

3.5.6 Single Room Accommodation

DCN and CAMHS will have 100% of inpatient spaces in single rooms, and in the RHSC approximately 59% of inpatient spaces will be in single rooms, which will facilitate the management of the privacy and dignity of patients and families, and infection control.

Challenges for the design of single room accommodation, particularly within longer term inpatient facilities, includes many adolescents preferring to be in a single room for privacy, however consideration is to be given to provide additional space for social, educational and IT facilities.

3.5.7 Functional Relationships

The design shall offer all users of the Facilities the highest level of efficiency in their operations by way of relationships and adjacencies between functional units.

The general inter-relationship of wards and departments is fundamental to good design, ensuring patients and families can receive effective care and that staff can go about their business efficiently.

The grouping and disposition of departments shall take into account the importance of enabling easy flow of the three main groups of traffic:

a) Patient, family, visitor and staff traffic arriving at the hospital;
b) Patients' and staff traffic between clinical departments (in and out patient areas) and central diagnostic departments, particularly theatres and radiology.
c) Service traffic – good design will ensure that distances for service traffic are kept to a minimum with innovative use of vertical routes e.g. service lift;

3.5.8 Work Flows & Logistics

Workflows within and between departments shall be direct and the routes for patients and staff as short as possible. Internal traffic cross-flows which could be inefficient or conducive to the transmission of micro-organisms either through airborne or other means shall be minimised.

The movement of people and the distribution of supplies and waste shall be carefully considered. Circulation routes shall be clear and appropriately sized.

Patterns of movement within the hospital shall be clear, unambiguous and logical for patients, families, visitors and staff. The adjacency patterns will minimise travel time and distances for patients, families, visitors and staff, with clear and coherent signposting to support a natural flow of pedestrian traffic.

Use shall be made of art in creating focal points, and supporting wayfinding both for internal and external areas.

The route for patients to be taken to the RIE Facilities and RHSC Emergency Departments from the helipad is through the Hot Core. There is to be a controlled link to the RIE Facilities from the ground and first floors of the Facilities building.

All signposting and instructions must be readily accessible and capable of being understood by the community that the hospital serves.

Provision is to be made for deliveries being accommodated at a loading area / bay. These will arrive in a range of different vehicle types, and the deliveries will be off-loaded into an adjacent Goods Receipt Area. Provision is also to be made for mail to be delivered directly into a Mail Room, catering supplies delivered directly into a Catering Store, and linen will be delivered straight into a linen store.

3.5.9 Manual Handling

Project Co shall ensure that the working environment of staff shall be designed in such a way that where they are required to manually handle inanimate objects / patients and / or transport patients, due consideration shall be given to the obligations within the Manual Handling Operations Regulations 1992 (as amended). This shall extend to the provision of mechanical devices including fixed (i.e. ceiling mounted tracking hoist systems) or mobile hoists including appropriate allocation of space and structural capacity.

3.5.10 Adaptability & Expansion

Project Co shall ensure that the physical arrangement of the buildings allows for growth and change of Clinical Services in the future, as far as is practical. The provision for such are detailed in the Adaptability Strategy.

The design shall consider the means for departments to be used flexibly, adapted or expanded. National policy, clinical advancements and technological changes will impact on the way services are provided in the future, and the Facilities need to be sufficiently flexible to handle these advances. The design shall demonstrate that potential change or expansion has been considered by the provision of adequate space either at the external perimeter and / or between functions and departments.

The structural grid, construction technique, structure, service penetrations and engineering services strategy shall demonstrate that the design proposals for expansion, adaptation and flexibility are co-ordinated.

The provision of engineering, telecommunications and building services shall be appropriate for the provision of anticipated changes in medical equipment.

The architectural flexibility shall reflect the overall Adaptability Strategy.

Project Co shall ensure that the design of the internal enclosing walls, screens and ceilings and their relationship to the environmental servicing strategy present a co-ordinated and consistent approach throughout, capable of accepting change at a later date with the minimum of disruption to the building structure and main mechanical and electrical plant installations and associated services.

Project Co shall ensure that the Facilities' structure and envelope, services, partitioning, ceiling, and flooring systems are consistent with a co-ordinated methodology which facilitates future flexibility for re-planning and change in the layout of departments, rooms, services outlets and equipment.

The internal divisions and environmental servicing strategy shall provide a co-ordinated and consistent approach throughout and shall readily accept change with the minimum disruption to the building structure and main mechanical and electrical and plant installations. In particular, it shall be possible to install or relocate fittings, fixtures, equipment and service outlets with minimum disruption to the use of the Facilities.

Building structures shall be designed by Project Co to facilitate ease of alteration to the internal layout of the buildings, or to its plant, services or equipment, during the lifetime of the buildings. This shall be achieved by:

a) Selecting structural forms in which future builderworks holes for building services distribution, both vertically and horizontally (including ductwork), or equipment, may be cut simply and economically and maintaining the fire safety integrity without significant additional work;

b) Providing knock out panels to permit the formation of holes not exceeding 150x150mm through suspended floors, adjacent to 50% of the internal columns on all floors. These knock out panels shall be positioned close to columns distributed across all areas of each floor;

c) Designing the floors for imposed loadings that will permit the reallocation of space within the Facilities, so that each area of floor is structurally capable of supporting the imposed loads of offices, wards, corridors, general storage areas or waiting areas, together with their appropriate partition walls, finishes, ceilings, services and medical equipment;

d) Providing removable access panels within the structure, where these are required for the installation, maintenance, repair and removal of plant, services or equipment;

e) Constructing internal room walls such that they can be readily removed or altered i.e. the structure is not reliant on the walls for structural stability; and

f) Designing plant space and riser space so that future change can be accommodated.

Project Co shall ensure that the Facilities do not have perimeter upstand beams and all perimeter beams shall be designed to allow a clear 300mm services zone above the ceilings and below the perimeter beams, unless otherwise agreed with the Board.

3.6 Spaces

3.6.1 Floor Layouts

The design of departmental and unit layouts shall reflect the demand for space defined by occupancy and usage as described in the Board's Construction Requirements Part 6 Section 3 Sub-Section D (Specific Clinical Requirements), Sub-Section E (Specific Non Clinical Requirements). Where areas and shape of rooms results in undesirable spaces, Project Co shall discuss with the Board alternative solutions, which may or may not result in shared space providing a more appropriate environment as well as optimising the available use of space. These may include locker rooms, sitting areas, seminar rooms etc

3.6.2 Equipment Requirements

Project Co shall identify and provide all necessary connections and infrastructure (including supply, extraction and removal of waste) for all items of equipment identified in Schedule Part 11 (Equipment Schedule). For the avoidance of doubt, this obligation specifically includes specialist service requirements, including for example 3-phase electrical supply, surge protection, special water supply requirements and separation of contaminated waste.

Project Co shall provide a suitable environment for each item of equipment; this shall take into account lighting, temperature and ventilation requirements. Project Co shall design the Facilities to allow for the provision and safe use of the Group 1, Group 2A, Group 2B and Group 3 Equipment.

For reasons relating to standardisation, compatibility, staff familiarity and product quality the Board shall be entitled to choose items of equipment which shall be proposed and submitted by Project Co to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

Irrespective of the party responsible for the supply, installation, maintenance and replacement of each item of equipment (as detailed in the Schedule Part 11 (Equipment Schedule)), Project Co shall provide Facilities that satisfy the following criteria:

Allow equipment and associated systems to be installed, commissioned, operated, maintained and replaced in accordance with;

a) Good Industry Practice;
b) Manufacturer's instructions;
c) The Board's specific supplementary requirements; and
d) The Board's, and statutory health and safety requirements;

In order to:

a) Allow equipment and associated systems to operate efficiently, effectively and in accordance with their intended function for the whole of its design life;
b) Take due account of the impact on the environmental conditions within the Facilities. For the avoidance of doubt, this obligation includes (but is not limited to) impact of heat gain and loss, and ventilation; and
c) Take due account of the potential impact of future equipment changes through either updating or replacement. In particular, allowance for equipment of different sizes, weights, service requirements or environmental impacts.

d) Allow the Board to provide their Clinical Services and Non Clinical Services with a minimum of disruption during installation, commissioning, operation, maintenance and replacement.

A number of specialist engineering systems will be required within the Facilities and each shall be fully integrated within the design proposals. Specialist systems shall be incorporated where appropriate to enhance the operation of the equipment and the Facilities.

The construction, structure, plant and services shall be designed to meet the Board's Construction Requirements and the specific requirements for special equipment and associated services. The design of the Facilities shall meet these requirements with regard to wall, ceiling and floor loads, structural movement and deflections, the need for special floors, wall and ceiling supports, ceiling grids and other such measures to allow for the installation of special equipment and associated services.

3.6.3 Room Data Sheets

Project Co shall provide Facilities that, as a minimum, meet all the requirements specified in the Room Data Sheets included in this Schedule Part 6 Section 6. Room Data Sheets not included in Schedule Part 6 Section 6 shall be provided through RDD.

Project Co shall provide fully developed Room Data Sheets submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

As part of the commissioning process, Project Co shall be responsible for demonstrating compliance with the requirements included within the Room Data Sheets.

For the avoidance of doubt, Project Co shall provide mechanical ventilation, comfort cooling and air conditioning to suit the functional requirements of each of the rooms in the Facilities. Irrespective of the ventilation requirements in Room Data Sheets, where rooms are clearly intended to be occupied and / or become internal spaces during design development and natural ventilation is not possible, mechanical ventilation and / or extract ventilation shall be provided as appropriate to suit the function of the space.

3.6.4 Interior Design

Project Co shall develop an interior design strategy to cover all areas of the Facilities and shall present this to the Board for its consideration. The integration of works of art is considered by the Board to be an essential element of any such interior design strategy.

Proposals shall be presented by Project Co in room-by-room schedules with samples of finishes, colours, lighting fittings, materials as appropriate, and signage, supplemented by colour sketches or coloured computer images submitted to the Board for review in accordance with paragraph 1.2.3 of Schedule Part 8 (Review Procedure), Table of Finishes and clause 12.6 of the Project Agreement. Project Co shall agree with the Board a programme for submission of this information allowing sufficient time for consultation with the users, and for incorporating feedback into the final scheme.

Where Project Co includes internal planting displays, these must comply with the Board's infection control requirements, and associated irrigation and atmospheric controls shall be provided.

3.6.5 Space Standards

"Many factors can contribute to engendering a sense of ease, for instance:- the degree of natural light, brightness and airiness, colour and texture, an easily understood layout with clearly defined focal points, uncluttered signage and a clear distinction between the realms of public and private space, maintaining patient dignity".

SEHD 2006

Project Co shall provide designs which are efficient, economical and flexible for immediate and future use, and which can be managed efficiently to cope with seasonal and strategic variations in activity.

The internal and external space provision shall be equal to or greater than that prescribed in codes of practice, regulations and guidance related to hospital buildings.

Appropriate space provision shall be made for circulation, waiting and sub-waiting space and for the movement of patients, pedestrians and the storage and transportation of goods.

Individual departments shall be designed to allow formal and informal discussion, therapy and interaction within each clinical environment - such as in consultation rooms, therapy and rehabilitation rooms, waiting areas and receptions. The design shall also support the creation of a learning environment for informal and formal teaching of staff, students, patients and their families.

Project Co shall provide space to allow informal discussion, therapy and interaction within open and reception areas in the clinical environment, such as areas of rehabilitation, consultation and main waiting / reception areas. Consideration shall also be given to making use of open areas such as courtyards and corridor recesses within clinical areas and main circulation routes for 'break-away' space.

Project Co shall recognise that the perception patients' and staff of the spaces created may assist with their feeling of belonging and of not being intimidated, and may help with their orientation, mobility, confidence, privacy and their ability to socialise.

3.6.6 Ward Configuration

Where required, wards shall be configured to meet the requirements of single sex wards providing privacy and dignity to patients.

The layout of the wards shall facilitate the separation and zoning of patients into clinical groups to respond to seasonal variations in activity, case mix, and practice and to deal with infectious conditions.

Space around beds shall comply with Department for Health Adult in-patient accommodation: Planning and design manual: Version 2.5: England and HBN 23 Hospital Accommodation for Children and Young People (2005) providing adequate space for health care professionals, teaching requirements, visitors and multi-pieces of equipment to be located near to the patient within the bed area. Additional space shall be allowed for engineering and building services zones. There shall be a minimum of 3.6m between bed centres.

The Touch Down Bases are sited throughout the clinical ward area to ensure optimum observation of patients and equipment in single and four bedded wards. The ratio of Touch Down Base should be 1:4 beds depending on design of ward.

3.7 Security & Control

Security of patient, staff, families and other visitors is of utmost priority. The design of the Facilities shall ensure maximum protection and minimise exposure to crime in internal and external areas.

Special care shall be given by the Project Co to the control and monitoring of access points used by the public and staff from public circulation spaces particularly those which may be quiet and sparsely populated during out-of-hours services.

Particular attention shall be given to the security of routes used during the hours of darkness by staff between pedestrian access points to the Site, car-parking areas and entrances to the Facilities.

Access control systems shall be provided to restrict access to certain areas of the hospital to relevant staff members, patients and visitors as appropriate in paragraph 9.19. Access controls shall be based around the following requirements:

a) Provision of high resolution CCTV or appropriate technology at all entry and exit points, reception areas, main entrance and such other areas as are defined in paragraph 9.19;

b) Systems to provide of out-of-hours security infrastructure to accommodate varying working hours, particularly evening and night-time working;

c) Security systems that are consistent with other Board facilities and policies, including main door or departmental access systems linked to staff identity badges;

Points of entry and reception points shall be minimised and allow for natural supervision and/or monitoring of movement and entry.

There shall be minimal isolated vistas and dead-end spaces to design out the potential for crime. The provision of security lighting must be effective and efficient but not overbearingly bright.

Design of roadways, paths and parking areas shall take into account the safety of staff, patients and the public. Landscaping will soften the hospital site, be attractive and calming but be designed with security and safety in mind.

External areas and courtyards must be safe, secure and capable of being used in varying weather conditions.

All external access routes and entrances to the Facilities shall prevent the risk of wind funnels.

3.7.1 Secured by Design

Project Co shall meet the requirements of “Secured by Design”, and in particular the recommendations of the Secured by Design - Hospitals guide.

Project Co shall endeavour to ensure that their approach to security and control of the Facilities will be structured in a way which will allow the Board the flexibility to seek compliance with the requirements of the Secured by Design initiative at a later date.

3.7.2 Safer Parking Scheme

Project Co shall where possible adhere to the principles of the British Parking Association's Safer Parking Scheme Documents and Guidelines.

Project Co shall endeavour to ensure that their approach to security and control of the parking facilities will be structured in a way which will allow the Board the flexibility to seek compliance with the requirements of the Safer Parking Scheme initiative at a later date, and achieve the "Park Mark Safer Parking Award". Safe routes for pedestrians should be incorporated.

3.8 Site Access & Circulation

A traffic assessment has been undertaken on behalf of the Board to ascertain and evaluate the impact of the development on transport patterns. Project Co shall validate the recommendations of this report and secure agreement with The City of Edinburgh Council for its proposals.

The Board requires to see, as far as reasonably practical, the clear separation of access for services, supplies, and waste removal vehicles from patients' and visitors' access points and entry points for the Facilities. In addition as RIE is an operating hospital adequate access to the RIE must be maintained at all times during construction and operation of the Facilities.

In the planning and design of the Facilities and of the Site layout, Project Co shall endeavour to ensure as far as is reasonably practical that routes used by pedestrians are segregated from routes used by moving road vehicles and any tug trains or similar deployed in the operation and maintenance of the Facilities. Project Co through the location of suitable external seating shall provide "rest areas" in safe positions along the main pedestrian routes.

External wayfinding shall be consistent with the principles currently adopted on the RIE Site, and Bioquarter Site or as modified at some future date, and be appropriate for the different age range of patients involved.

For the RHSC Paediatric facility there will be separate entrances required for the following departments:-

a) For the Emergency Department (ED);

b) Main hospital entrance for patients, staff and visitors;

c) Child and Adolescent Mental Health Service (CAMHS);

Clinical Neurosciences

a) Route for emergency patient transfers via RIE Facilities Emergency Department;

b) Main hospital entrance for patients, staff and visitors;

The defined routes for construction plant and construction access roadways shall comply with the provisions of paragraph 4 and Appendix A.

Project Co shall undertake all necessary works associated with the following specific requirements:

3.8.1 Design for Disability

The design shall comply with the requirements of the Equality Act 2010, and take full consideration of HBN 00-02 “Sanitary Spaces”, SHFN14 "Disability access", SHFN20 "Access audits for primary healthcare facilities", HFN 21 “Car Parking” and Standards of Care for Dementia in Scotland: Action to support the change programme, Scotland’s National Dementia Strategy. Further guidance is provided in BS 8300:2009 Design of buildings and their approaches to meet the needs of disabled people - Code of practice.

Doors and lifts are required to be of a width and length to allow wheelchair access (often with additional attached equipment) and patients being transferred on trolleys and beds with attached clinical equipment, and this is also essential for children being transported in prams and buggies. Automatic doors along patient pathways are essential to ensure that staff pushing patients and /or equipment on trolleys, wheelchair users and parents/carers with children in prams/buggies can move rapidly and smoothly. Automatic doors will improve access for wheelchair users, those with reduced mobility, impaired vision and other disabilities. Automatic doors will minimise damage caused to doors and walls by trolleys and cages.

Entrances to the Facilities shall be clearly identified to promote ease of wayfinding and distinctive ‘landmarks’ shall be incorporated into the design particularly for the main entrances.

The Facilities’ environment, both externally and internally, shall be designed to be accessible to everyone. The journey on to the Site, from pedestrian / vehicle routes, through the main receptions, into the Facilities and to the desired locations shall follow a safe, logical and clear system.

Attention shall be paid in the design to all aspects of the physical environment relating to the accessibility of the Facilities as follows:

a) Access to buildings, such as level or ramped entry;

b) Emergency evacuation arrangements, in particular for the visually impaired, the disabled and the frail, such as fire refuges or alternative escape routes for people with mobility impairments;

c) The accessibility of external paths and landscaping and the location of “rest areas” on all external routes;

d) Circulation within buildings, including their interior layout;

e) Effective lighting and signage and colour or tone contrast on doors to aid orientation;

f) Desks, laboratory benches, work surfaces and reception desks with varying or flexible heights;

g) Appropriate seating;

h) Accessible toilets; and

i) Convenient but controlled ‘free’ proximity parking.

Project Co shall ensure that the Project design draws upon and endeavours to further develop improve and exceed current best practice and standards achieved in other similar

projects, and incorporates full accessibility for the prospective patient groups, staff and public. This shall include aspects of both physical environment and visual and audio aids to enable full and unrestricted use of the Facilities for all groups. This philosophy of design shall be extended across all parts of the Facilities including access to the landscaped and external areas as well as the essential patient treatment and residential areas.

Project Co shall ensure the design complies with the general accessibility ethos detailed above, whilst also addressing the detailed requirements listed elsewhere. It shall be noted that the requirements detailed are not exhaustive, and it is also recognised that specific clinical needs will determine the nature and design of Facilities in some areas.

In particular it is highlighted that the Facilities will be used by a high proportion of wheelchair users. Project Co shall ensure that the fire strategy and design of the Facilities take full account of this.

In meeting the overarching obligations with respect to accessibility, Project Co shall comply with the following non-exhaustive list of standards:

a) BS8300:2009 Design of buildings and their approaches to meet the needs of disabled people – Code of practice;

b) SHFN 14 Disability Access;

c) SHFN 20 Access audits for primary healthcare Facilities; and

d) HFN 21 Car parking.

BS8300:2009 “Design of buildings and their approaches to meet the needs of disabled people – Code of practice”; is also the document most widely referred to by consultants advising on general building design in relation to the Equality Act 2010. Project Co shall therefore refer to this document and give full regard to its standards. It will, however, be necessary to match the standards of BS8300:2009 “Design of buildings and their approaches to meet the needs of disabled people – Code of practice” with others laid down in NHS guidance notes.

For the avoidance of doubt, specific accessibility requirements listed in this Schedule Part 6 Section 3 shall take precedence over the standards laid down in BS8300:2009 “Design of buildings and their approaches to meet the needs of disabled people – Code of practice”.

3.8.2 Vehicular Access

Road widths, turning circles, waiting bays and lay-bys shall be designed so that they are suitable for hospital and emergency traffic including service vehicles and are designed for the convenience of staff and the public. These routes shall link the main access points on Old Dalkeith Road/ Little France Crescent to the principal vehicle routes and entrance points to the Facilities. It shall be noted that some of these routes may be required to connect seamlessly into and be compatible with roads, turning circles, bays and lay-bys which are outside the Site boundary.

3.8.3 Pedestrian Access

Project Co shall provide routes to the Facilities and to adjacent parts of the Campus Site from Old Dalkeith Road and Little France Crescent which are safe and convenient for pedestrians and cyclists to use. These routes shall link the main access points on Old Dalkeith Road / Little France Crescent to the principal patient, visitor and staff entrance points to the Facilities. It shall be noted that some of these routes may be required to connect

seamlessly into and be compatible with and reflect pedestrian desire lines and pathways which are outside the Site, subject to the requirements of paragraph 4, Appendix A and Clause 9 (Nature of Land Interests) of the Project Agreement.

Pedestrian routes to the building shall be as direct as possible to reduce the temptation to use or create unauthorised entrances and exits. Project Co through the location of suitable external seating shall provide “rest areas” along the main pedestrian routes.

Pedestrian emergency exits from the buildings shall be used for that purpose only and appropriate measures shall be taken by the Project Co to ensure that they cannot be used for accessing the buildings.

3.8.4 Cycle Routes

Special attention shall be given to the maintenance and extension of existing safe cycle routes. Project Co shall carry out works to form a cycle path and reconfigure the landscaped areas within the Yellow Area (Cycle Path Works) subject to providing a method statement for these works which method statement will form part of the relevant Interface Proposal, and complying with the requirements of Section 2 (Operational Construction Issues) and paragraphs 1 to 4 and 8 of Section 5 (Access Areas, Drainage and Substation) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A and the Access Strategy and/or where applicable any Access Strategy agreed and/or determined pursuant to Section 2 (Access Areas and Amended Drainage Proposal) of Part 2 (Interface Proposals Procedure) of Appendix A.

The reconfigured cycle path shall terminate at Little France Crescent and to the access to the Site from Old Dalkeith Road Project Co shall provide appropriately located bicycle security and staff changing facilities. It shall be noted that some of these routes may be required to connect seamlessly into and be compatible with existing cycle routes which are outside the Site boundary but within the Campus Site.

3.8.5 Emergency Vehicle Access

Project Co shall provide clear and well defined routes for emergency vehicles such as ambulance, fire and police. The Emergency Department access will require 2 distinct entrances: one for emergency patients and one for ambulant patients.

Ambulances will most frequently use the Emergency Department entrance and the entrance to DCN. Waiting and queuing of ambulances at these locations will require to be considered by Project Co.

The design of the Facilities by Project Co shall take into account the unimpeded continued routing of “blue-light” emergency ambulance traffic into the ED in the Facilities and the RIE Facilities and around the Campus Site. Special provision shall be made for manoeuvring, unloading and waiting of ambulances and other emergency vehicles at the Emergency Department for the Facilities and the RIE Facilities.

3.8.6 Service Vehicle Access

Service traffic shall be separately routed to the loading bay area(s). Project Co shall provide a holding facility for three of the longest lorries to wait for access to the service ramp to the basement of the building. Access to the holding area, VIE compound, energy centre and basement of the building will be controlled as defined in paragraph 7.5 of this Sub-section C.

In such areas safe segregated routes for pedestrians will be clearly identifiable and these will not be in conflict with vehicular movements.

3.8.7 Road Markings & Signage

Project Co shall undertake all necessary road, footpath and car parking markings and signage works within the Site boundary.

3.9 Car Parking & Drop-off / Pick-up

3.9.1 Car Parking

Car parking to replace the car parking spaces in Car Park B have been provided elsewhere at the Campus Site. Car Park F will provide additional car parking to meet the essential needs of the Campus Facilities.

Project Co shall provide a strategy for parking which demonstrates control of access to onsite and close proximity parking.

From the Actual Completion Date, Patients and Visitors to the Facilities will have access to Car Park E.

3.9.2 Emergency Department Parking

Project Co shall provide as a minimum 24 free spaces for emergency visitors to the ED for the Facilities and the RIE Facilities. Of these spaces:

a) 50% must be of a size for disabled or parent and child parking, and marked as appropriate.

b) 50% must be non-disabled spaces for short term parking for emergency visitors to the ED facilities.

These will be provided in a way that is clear to users that they are for short term stay and they will be located so as not to cause access issues elsewhere.

Access controls will be provided as detailed in paragraph 7.5 of this Sub-section C.

3.9.3 Disabled and Parent and Child Parking

The design of the Facilities shall recognise the importance of providing sufficient disabled parking spaces and drop-off points as close to the entrances as possible.

In addition to the disabled and parent and child parking provision at the ED, Project Co shall provide as a minimum:

a) 40 free disabled parking spaces for RHSC indicating that they are for Disabled and Parent and Child Parking; and.,

b) 20 free disabled parking spaces for DCN marked accordingly.

Access controls will be provided as detailed in paragraph 7.5 of this Sub-section C.

The design of the Facilities shall recognise the importance of providing sufficient disabled parking spaces and drop-off points as close to the entrances as possible.

3.9.4 Drop-off / Pick-up Arrangements

Project Co shall provide designated, covered “drop-off / pick-up” area(s) directly adjacent to the principal entrances to the Facilities including the ED entrance. This shall allow direct access to the Facilities, for a wide range of vehicles including private cars, taxis, ambulances and patient transport vehicles. The design should discourage any other use other than drop-off in this area.

4 Site Specific Requirements

4.1 Site Boundary

The Site is currently in the ownership of the Scottish Ministers and is part of the Campus Site.

Refer to other site boundary issues detailed in other parts of this paragraph 4 and paragraph 7 of this Sub-Section C (in particular paragraph 7.3).

4.2 Travel Plan

In line with the Board’s obligations under Policy Statement 3 of SEHD’s “Environmental Management Policy for NHS Scotland”, the Board will prepare a Green Travel Plan for the Facilities, which aims to reduce the impact on the environment of travel by staff, patients and visitors to and from the Facilities, and travel by staff during work at the Facilities.

The scope of this Green Travel Plan is in line with the Integrated Transport White Paper ‘Travel Choices for Scotland’ and ‘Scotland’s Transport: Delivering Improvements’.

Project Co shall assist the Board in developing the integrated Green Travel Plan to take account of the impact of the Facilities.

Project Co shall ensure that the proposals for Site access and circulation, pathways and car / cycle parking are discussed and agreed with the Board in the context of the Green Travel Plan.

Guidance is available within the SEHD document, ’Travel Plans: An Overview, September 2002’.

For the avoidance of doubt, the Board is responsible for the development of the Green Travel Plan.

4.3 Existing Services

4.3.1 RIE Enabling Works

The Board has identified the following enabling works (the “RIE Enabling Works”) which will be required to be carried out on the Campus Site to meet planning requirements. These key

enabling works will be carried out by or on behalf of the Board by or on behalf of Consort. These works do not form part of the Project and it is intended they are completed or substantially completed prior to any part of the Project commencing on Site. The key enabling works are described here for information purposes only and form part of Disclosed Data so that Project Co is aware of them and takes them into account in planning for the Project.

a) Flood Protection Works: which means the enhancement of existing flood protection measures at the Campus Site;

b) Road Infrastructure Works: which means changes to the road and transport infrastructure at the Campus Site, including but not limited to the creation of a public transport terminus to the east of RIE Facilities, new bus stances and revision of existing car parking;

c) VIE Relocation Works: which means relocation of the existing VIE plant and gas governor serving the RIE Facilities to another location on the RIE Site. Separate VIE plant is required for the Facilities;

d) Link Building Works: which means the building which is to be part of the RIE Facilities to which the new Facilities will be connected at ground and first floor levels;

e) Service Diversion Works: which means the disconnection of certain services such as electricity, water, gas, that serve the RIE Facilities and are currently located on under or over the Site and such services which are disconnected will be relocated in positions outwith the Site to new positions within the RIE Site. However Project Co should note that not all redundant services are being removed and grubbing up of any disconnected and redundant services will be the responsibility of Project Co, as part of the Works. Project Co should have regard to the following services which are expected to continue to be present at the Site namely the County sewer (which it is believed runs from south to north in the western area of the Site) the storm water system (which serves Car Park B), the utilities services for the Nursery including water, gas, power, telecommunication and drainage, the Sewers referred to in paragraph 6.1.1 and gas pipe referred to in paragraph 6.1.2; further the following services are expected to be present and possibly connected namely bases for medical gases, equipment, apparatus, pipes, conduits and the like relating to disconnected, non functioning and/or redundant services under the Site, manholes and slabs for parking equipment. Project Co shall carry out any protection and diversion works associated with any further existing services located within the Site but this list is not exhaustive and Project Co must satisfy itself as to the conditions of the Site. This may include (but not be restricted to) electric cables; telecommunications cables and equipment; gas mains and apparatus; sewerage mains / drainage pipes; and water mains;

f) Sewer Diversion Works: which means the diversion of trunk sewers currently located in the Site to positions outwith the Site to new positions within the RIE Site save for a section of Sewer referred to in paragraph 6.1.1 which will continue to run under the Site; and

g) Clinical Facilities: Reconfiguration/alteration of a number of clinical facilities within RIE Facilities;

4.3.2 Flood Works

a) Off-Site Flood Protection Works – It is proposed to construct flood defence walls (approximately 1000mm high) to both sides of the Niddrie Burn in the Nether Craigour area upstream of the Old Dalkeith Road bridge to provide improved flood protection to dwellings at Little France Mills and to the Campus Site and Campus Facilities. These works will be procured under a separate contract and do not form part of the Project and are expected to be carried out in the areas shown on the indicative plan RHSC-DCN-FP-001 which forms part of the Disclosed Data.

4.4 Demolition and Site Clearance Requirements

Notwithstanding paragraph 4.3 above, Project Co shall be responsible for the all demolition and site clearance of the Site including without limitation all structures such as the Nursery, services and removal of disconnected services. The work that Project Co shall carry out will include but is not limited to the following:

a) The identification and removal of all structures, including the Nursery, hardstandings and the like occupying the Site.

b) The identification and protection of live (and/or used) services in, under, on, over the Yellow Area, the Orange Area, the Service Strip, the Foul Service Strip, the Substation Site, Substation Access Area and the Substation Cable Route.

c) The identification, decommissioning, removal and / or protection / relocation of live (and used), live (and redundant) or redundant (and disconnected) services in, under, on, over, crossing the Site; and

d) The identification and removal of underground services, old foundations, drainage runs, basement structures and other below ground obstructions present following demolition of previous structures occupying the Site.

The Board has provided Disclosed Data. Whilst the Board believes that the information presented here is representative of the position on Site, Project Co is required to draw its own conclusions with respect to overall allowances required and the accuracy of the Disclosed Data. Other obstructions, contamination and services not yet identified may be present at the Site.

Where in connection with the Project, Project Co requires to carry out any demolition, Project Co shall carry out all demolition in accordance with BS 6187:2000 “Code of Practice for Demolition” and the following:

a) Issue a method statement identifying the scope and methodology for undertaking the demolition works in Project Co's Proposals and to be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement;

b) Break up and remove off-site all structures, foundations, temporary accommodation, and other below ground and surface obstructions in accordance with, but not limited to, BS5228, 2009 “Code of practice for noise and vibration control on construction and open sites.”;

c) Decommission and / or break up and remove all redundant underground structures, chambers and redundant surface water and foul water drains, telecommunications, electric cables, gas mains, water mains and ducts within the Site. For the avoidance of doubt, this obligations includes for making safe all redundant works left in-situ, and sealing of voids, where left, against vermin;

d) Protect remaining live services against damage or disruption; and

e) Minimise vibration and noise produced by the demolition works, and agree appropriate limits for such with the Board to be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

Project Co shall allow the Board to carry out independent monitoring that shall include but not be limited to air pollution, noise, and vibration.

4.5 Construction Phase Requirements

4.5.1 General

The permanent and temporary Works and all construction operations for the Project should, save where expressly provided otherwise, generally be designed and constructed so that they can be carried out and where appropriate replaced, repaired, renewed and maintained on and from within the Site.

The Site is part of the Campus Site and Project Co has to be aware of and plan and programme the Works and Operations having regard to the other activities and operations ongoing at the Retained Site and Retained Estate.

At some points it may be necessary temporarily for Project Co to enter or have access across other parts of the Retained Site and/or Retained Estate for construction activities in accordance with and subject to the requirements detailed in this Sub-Section 3 and Appendix A Appendix B (Interface Output Specification) and Appendix E (Initial Drainage Proposal) and the Interface Proposals and in accordance with Clause 9 (Nature of Land Interests) of the Project Agreement. Project Co shall be responsible for identifying and implementing all necessary working practices to satisfy statutory requirements in relation to their construction activities. The construction of the Facilities shall be registered with the Considerate Constructors Scheme. The Contractor shall be registered with the Considerate Constructors Scheme.

Project Co shall undertake the role of Client and appoint a Principal Contractor and CDM Co-ordinator under the Construction (Design & Management) Regulations 2007 and appropriate amendments for the duration of the Works.

Project Co shall also comply with the obligations of the “Contractor” as laid down in the Board’s “NHS Lothian Estates Operation Policy For Control of Contractors”.

Project Co shall at all times work within the hours permitted by The City of Edinburgh Council in granting planning permission for the Facilities.

Precautions shall be taken to avoid infestation of the Works by rats, mice and other vermin. When drains are being laid, precautions shall be taken to avoid the entry of rodents, including providing temporary stoppers to pipe ends and setting manhole covers in position

as the work proceeds. Pipes and cables passing through the foundation walls shall be properly built in.

Project Co shall take all necessary precautions to prevent the outbreak and spread of fire. Project Co shall provide and maintain suitable and adequate fire fighting equipment at points within and adjacent to the Works. Project Co shall comply with the requirements of the Fire Prevention on Construction Sites: The Joint Code of Practice on the Protection from Fire of Construction Sites and Buildings Undergoing Renovation. Bonfires on the Sites will not be permitted.

Project Co. shall not use the Site during the Works for any purpose other than carrying out the Works.

There are helicopter operations to and from the existing helipad facility currently operating from RIE Site. Project Co shall comply with CAA requirements on construction sites close to a helipad. In particular Project Co's tower cranes will require to have aviation lights to indicate the cranes location to the helicopters using the existing helipad.

Project Co shall provide, for the duration of the construction phase, Personal Protective Equipment for visiting Board staff (and other approved visitors), and use of Project Co facilities for meetings etc.

Project Co shall provide the Board with temporary site accommodation for Board staff and advisors for the duration of the Construction Phase.

Project Co shall provide, remove and pay for all associated consumption of the temporary utilities required to construct the Works.

4.5.1A Clean Roads and Footpaths

Project Co shall adequately maintain approaches to the Site and/or any other roads and/or footpaths within the Campus Site which it is using or accessing and keep such free from mud and debris or materials to the Board's satisfaction. All vehicles must be cleaned, with any mud or loose debris removed, prior to the vehicles leaving the Site. Project Co shall provide facilities for washing down vehicles before leaving the Site and/or the Campus Site, to avoid contamination of the surrounding roads. Any contamination of surrounding roads, pavements, cycle paths etc. by site traffic shall be removed.

4.5.2 Site Access

Construction Access over the Yellow Area

If Project Co requires to carry out works to form a construction access to the Site over the Yellow Area Project Co shall provide a method statement for these works which method statement will form part of the relevant Interface Proposal and shall construct the works and comply with the requirements of Paragraph 1 of Section 1 (Construction Access) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A and the Construction Access Proposal.

Works and Access during the Operational Term

Project Co shall maintain, repair, replace and renew the Facilities. Where in connection with the carrying out of works of maintenance, repair, replacement and renewal to the Facilities

Project Co needs to access the RIE Site and/or RIE Facilities any such works and access shall be carried out in accordance with Section 2 (Operational Construction Issues) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A, and the Interface Proposals and where applicable Paragraph 1 (Access Strategy) of Section 2 (Access Areas, Amended Drainage Proposal and Amended Substation Proposal) of Part 2 (Interface Proposals Procedure) of Appendix A. This is without prejudice to any other more onerous requirements detailed in the Board's Construction Requirements which may apply to other works being carried out in the RIE Site including without limitation:-

Where:-

a) the works are to repair, maintain, replace and renew service media serving the Facilities located within the Service Strip or the Foul Service Strip Project Co shall also comply with the provisions of Section 6 (Service Strip and Foul Service Strip) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A and the Service Proposal and where applicable any Amended Service Proposal agreed or determined pursuant to Section 3 (Amended Service Proposal) of Part 2 (Interface Proposals Procedure) of Appendix A; and/or

b) the works are to repair, maintain, replace and renew interface links between the fire alarm and security systems, PTS and ICT and the Joint, Project Co shall also comply with the provisions of Section 7 (Link Building) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A, the Interface Output Specification and the Connection Proposal; and

c) the works are to repair, maintain and (where necessary) replace and renew the electricity cable on the Substation Cable Route Project Co shall comply with the provisions of paragraph 3 of Section 2 (Operational Construction Issues) and paragraph 7 of Section 5 (Access Areas, Drainage and Substation) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A and the Substation Proposal; and/or

d) otherwise comply with any other requirements in relation to Access Areas otherwise referred to in this Section 3 *(Board's Construction Requirements).*

4.5.3 Board Major Incident Support

Project Co shall support the Board in dealing with a Major Incident. Project Co's support will be as required by but not limited to the Board's Major Incident Strategy Response Plan Strategic Plan Number reference HPT E023 03.

4.5.4 Restrictions and Requirements for Storage of Waste on Site

Project Co is required to demonstrate a waste management programme for the Works to minimise all site waste disposal to landfill, and to maximise reuse/recycling of timber, metal, plastic, paper and other waste arising. Project Co will liaise with all suppliers to ensure the minimum of packaging is used for deliveries of goods and materials to site. Any unavoidable packaging waste is to be recycled through an authorised waste recycler. When surplus excavated material and building spoil and rubbish cannot be recycled Project Co is to dispose of it to a licensed tip and be transported by an approved waste transportation company, and shall fully comply with all Law governing the controlled disposal of waste material. No materials shall be disposed of on Site by any other means. All spoil and waste materials that arise from the construction of the Works shall only be stored on Site until disposed off site. Project Co shall take cognisance of the location of the air intakes for the Retained Estate when assessing the locations for spoil and waste material stockpiles and

comply with the requirements of paragraph 4.5.12 in selecting the location for spoil and waste material stockpiles. No burning of any materials is permitted on or near the Site.

Project Co shall meet all statutory waste management regulations and local byelaws in relation to the storage of waste on site including but not limited to the Environmental Protection Act, Environmental Protection (Duty of Care) Regulations 1991, Hazardous Waste Regulations 2005 and WEE Directive.

The storage of waste during construction works shall cause no harm to neighbours and/or other building users at the Retained Site and particular attention is required to the location of waste storage areas in relation to windows and ventilation air intakes in the surrounding buildings.

Waste storage areas must be secure and shall be constructed such that they limit the possibility of leakages and contamination.

4.5.5 Site boundary treatment requirements

Project Co shall provide a site boundary that is secure and prevents unauthorised access to the Site at all times.

Around the perimeter of the Site Project Co shall provide a solid painted hoarding which extends from ground level to a minimum of 2.4m and shall provide visual screening of the Site. Corporate signage shall be restricted to the entrances and exits of the Site and in every case there shall be an NHS Lothian sign located next to each of the contractor's corporate signs. There shall be no other advertising on the hoarding or on tower cranes / construction equipment. Artwork created by or on behalf of the Board may be displayed on such crane and/or construction equipment as appropriate as proposed by the Board to Project Co. and approved by Project Co such approval not to be unreasonably delayed or withheld. All NHS Lothian signage shall comply with the recommendations of "Effective Wayfinding and Signing Systems - Guidance for Healthcare Facilities" 2nd Edition 2005, NHS Scotland Signage Guidelines and NHSScotland Identity Guidelines.

Project Co shall provide two waterproof public information project boards for external display. Project Co shall discuss and propose to the Board the content, size and location of these signs for approval by the Board such approval not to be unreasonably delayed or withheld. .

4.5.6 Site signage restrictions and requirements

Project Co shall obtain approval of the content and layout of the main site signboard/s from the Board such approval of the Board not to be unreasonably delayed or withheld subject to complying with the aftermentioned requirements. That part of the signage which refers to the Board shall follow the recommendations of "Effective Wayfinding and Signing Systems - Guidance for Healthcare Facilities" 2nd Edition 2005, NHS Scotland Signage Guidelines and NHS Scotland Identity Guidelines. The signboard/s shall contain the project title, the names of the Board, Project Co and the Principal Contractor. No additional advertising will be permitted on these signs beyond the standard consultant signboards.

4.5.7 Signage outside the Site

Project Co shall provide signage, but not in the Yellow Area, to the Emergency Department of the Royal Infirmary of Edinburgh that requires to be clearly visible from Old Dalkeith Road. Project Co shall ensure that existing RIE Facilities signage is replicated or reinforced if

temporarily obscured by the construction of the Facilities. Project Co shall replicate or reinforce existing RIE Facilities signage that is obscured by the Works.

4.5.8 Site Accommodation and Compound

Project Co will be entitled to use Car Park E for a site compound during the Construction Phase for the Works, subject to complying with the provisions of Section 3 (Site Compound/Car Park E) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A.

Project Co shall provide a site compound that is secure and prevents unauthorised access at all times. The existing services that run under, on and over Car Park E are to be located by Project Co. A record drawing of the existing services shall be provided to the Board prior to the commencement of construction of the Works. Project Co shall provide and obtain all necessary consents for temporary services to the site accommodation and compound and pay for their use.

Project Co shall be permitted to erect a sign stating their name and the project title at the entrance to the compound. No additional advertising will be permitted.

4.5.9 Restrictions and requirements on vehicles accessing the Campus Site road network

Project Co shall comply with paragraph 4.5.2. Notwithstanding the foregoing and any other requirements applying to any works, where any works and/or activities are or require to be carried out in any part or parts of the Access Areas, Project Co shall comply with paragraphs 2 to 4 of Section 5 (Access Areas, Drainage and Substation) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A and the Access Strategy and where applicable any Access Strategy agreed or determined pursuant to Section 2 (Access Areas, Amended Drainage proposal and Amended Substation Proposal) of Part 2 (Interface Proposals Procedure) of Appendix A and also in accordance with Clause 9 (Nature of Land Interests of the Project Agreement.

Project Co shall ensure that all contractors attending the Site are made aware of the heightened level of care and consideration required when carrying out work in an operational hospital in order to mitigate any detrimental effect on patient care, Board staff and the general public.

Project Co shall propose, discuss and agree with the Board a strategy for providing unimpeded Blue Light access to the RIE Emergency Department and other appropriate departments / units during construction of the Works. Project Co shall ensure that at all times during the construction and commissioning of the Works that free and unimpeded access is maintained for Blue Light emergency traffic through the Orange Area to the adult Emergency Department of RIE and through the Orange Area to the Percutaneous Cardiac Investigation Unit (PCIU) within the RIE. This includes the ambulance access which will encroach upon the Site, the stretcher drop off entrance and the ambulant entrance at the adult Emergency Department of the RIE. Provisions will also have are also to be made on the Site and Campus Site as required, to provide a minimum of five ambulance drop off parking spaces. The spaces are to be such that a stretchered patient can be taken directly into the adult Emergency Department of the RIE from an ambulance parked at any of these five spaces. Ambulances must also be able to pull out from any of the five spaces without hindrance to any other parked ambulance. Project Co shall plan construction and commissioning of the Works so as to accommodate these requirements including without limitation the TMS and/or Access Strategy and/or the requirements of Section 2 (Access

Areas, Amended Drainage Proposal and Amended Substation Proposal) of Part 2 (Interface Proposals Procedure) of Appendix A.

Project Co shall agree with the Board revisions to the Blue Light traffic access/egress routes during the construction period.

Where construction traffic is required to access the Orange Area and any other part of the Campus Site road network, Project Co shall be responsible for ensuring that drivers observe the 15mph speed limit, that all vehicles have a valid MOT (if required), have the appropriate comprehensive insurance and that all drivers hold a valid UK driving licence.

A vehicle “Civil Penalty Notice Scheme” operates on the Campus Site.

4.5.10 Construction works further information

A. Construction works on the Site but connecting to other parts of the RIE Facilities

Fire connection and the Joint

As set out in paragraph 4.5.1 the new Facilities shall be delivered as a standalone new build. However, the Facilities will be physically linked to the RIE Facilities at ground and first floor levels. The part of the RIE Facilities to which the Facilities will be linked is called the Link Building.

The Link Building is part of the RIE Facilities. Project Co will be responsible for designing and constructing the Facilities to physically link to the RIE Facilities at the Link Building interface point as more particularly detailed in the Interface Output Specification. Project Co shall carry out the works to connect the Facilities to the Link Building subject to and in accordance with:

a) Section 7 (Link Building) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A;

b) Interface Output Specification; and

c) the Connection Proposal.

Project Co shall design and construct the fire alarm in accordance with the provisions detailed in paragraph 3.7.

Project Co shall construct the Joint. The Joint shall form part of the Facilities.

B. Construction works outside the Site – Off Site Works

(a) Works outside the Site but within the Campus Site, and maintained by Project Co

There shall be building services links between the Facilities and the RIE Facilities in respect of building services and other connections in terms of: -

a) infrastructure associated with ICT;

b) a pneumatic tube system (PTS);

c) foul drainage connections.

The above matters form part of the RIE Works

a) Access road for the Substation Works in the Substation Access Area

(i) Project Co will design and build a new PTS system which will run from the Facilities to the pharmacy and laboratories within the RIE Facilities. Project Co will design and build an ICT Data Network system which will run from the Facilities to link to the Board's ICT equipment/systems within the RIE Facilities. The Board will advise Project Co of the route for the PTS and ICT within the RIE Facilities. Project Co will be responsible for replacing, repairing, renewing and maintaining the PTS and ICT. Project Co shall provide design, construction and other information which information will form part of Project Co's applicable Interface Proposal for approval by the Board and shall design build, construct, replace, renew and maintain in accordance with:

- Section 7 (Link Building) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A
- The Interface Output Specification; and
- The Connection Proposal.

(ii) Service Strip

There may also be connections into some existing infrastructure for foul water drainage. If Project Co requires to connect the foul water drainage systems for the Facilities into the existing foul water drainage systems for the RIE Site and/or RIE Facilities then foul water drainage systems must be designed and constructed by Project Co such that they may be connected to foul water drainage systems only at the agreed connection points in the Initial Drainage Proposal and/or within the Foul Service Strip. Project Co will be responsible for replacing, repairing, renewing and maintaining the foul water drainage systems serving the Facilities and the connections. Project Co shall provide design, construction and other information which shall be part of Project Co's applicable Interface Proposals to the Board for approval, about the foul water drainage systems serving the Facilities. Project Co shall comply with the requirements for installing, maintaining, repairing, renewing and replacing foul water drainage systems subject to and in accordance with:-

- Section 2 (Operational Construction Issues) and Section 6 (Service Strip and Foul Service Strip) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A; and
- The Access Strategy; and
- The Service Proposal; and
- The Supplemental Drainage Proposal; and where applicable
- any Access Strategy and/or Amended Drainage Proposal and/or Amended Service Proposal as applicable agreed or determined pursuant to Section 2 (Access Areas and Amended Drainage Proposal) and Section 3 (Amended Service Proposal) of Part 2 (Interface Proposals Procedure) of this Section 3 *(Board's Construction Requirements)* of Schedule Part 6 *(Construction Matters)* (as varied, amended or supplemented from time to time in accordance with the Project Agreement).

As regards design and construction, maintenance, repair, replacement, and renewal of any electrical, gas and water connections these must all be independent services serving the Facilities and shall not connect into any such services serving the Retained Site and/or Retained Estate. However wherever any such services have to be installed and cannot be installed on the Site they may be installed on the RIE Site, the locations for such services are however restricted to certain areas of the RIE Site namely the Service Strip. Project Co will be responsible for design and construction and replacing, repairing, renewing and maintaining such services serving the Facilities. Project Co shall provide such design,

construction and other information which shall be part of Project Co's applicable Interface Proposals for approval by the Board and Consort about the services and shall comply with:-

- Section 2 (Operational Construction Issues) and Section 6 (Service Strip and Foul Service Strip) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A; and
- The Access Strategy; and
- The Service Proposal; and where applicable
- any Access Strategy and/or Amended Service Proposal agreed or determined pursuant to Section 2 (Access Areas and Amended Drainage Proposal) and Section 3 (Amended Service Proposal) of Part 2 (Interface Proposals Procedure) of this Section 3 *(Board's Construction Requirements)* of Schedule Part 6 *(Construction Matters)* (as varied, amended or supplemented from time to time in accordance with the Project Agreement).

(iii) Access road for Substation Works in the Substation Access Area: if Project Co chooses to construct a substation on the land outlined in blue on Plan 4 in accordance with Paragraph D below then Project Co shall design and construct and thereafter maintain, repair, replace and renew the access road an access road thereto in the Substation Access Area and shall comply with the requirements for the access road detailed in paragraph D below.

C. Construction works outside the Site but within the Campus Site but not maintained by Project Co – the Retained Estate Handback Infrastructure which comprise Hospital Square Works, Cycle Path Works and Surface Drainage Works

The Board has identified the following works which will be required to be carried out outwith the Site on the RIE Site. These works comprise Hospital Square Works, Cycle Path Works and Drainage Works. These works will be carried out by Project Co and upon completion will not be maintained by Project Co but once completed will form part of the Retained Estate Handback Infrastructure. These works include:

Hospital Square Works:

(a) The design and construction of new roadway, hard and soft landscaping works to the area between the Chancellor's Building, RIE Facilities and the redline boundary to the north and east of the Site;

(b) Emergency Departments: The design and construction of new roadways, hardstandings and parking areas at the new entrance to the RIE Facilities and the Facilities' emergency departments including without limitation.

- Roundabout at the termination of the road north of the link to the RIE Facilities.
- RIE Day Surgery/PCIU ambulance drop off that will have access to the roundabout referred to in item a) above.
- Taxi rank and drop off set back from the road outside Ann Rowling Clinic
- Drop off set back from the road opposite the taxi rank and drop off referred to in item c) above.

- Roundabout at the RIE Facilities entrance for access to the DCN proximity parking and RIE Facilities Day Surgery/PCIU ambulance drop-off.

- The ambulance drop-off for the RHSC ED from Old Dalkeith Road. This shall have a minimum of 5 ambulance drop off spaces for the Adult and Paediatric Ambulance ED. The layout shall prevent Project Co's Operational Term vehicles from stopping ambulances from having access to the ED ambulance drop off spaces for the ED within the Facilities and RIE ED. For the avoidance of doubt there may also be element of these works carried out on the Site in which case any such elements are part of the Facilities and not Retained Estate Handback Infrastructure.

- Emergency visitor parking for the RHSC ED from Old Dalkeith Road. For the avoidance of doubt there may also be element of these works carried out on the Site in which case any such elements are part of the Facilities and not Retained Estate Handback Infrastructure.

- Link to the existing Adult Ambulant Entrance to the RIE ED and its 6 ambulance drop off spaces.

(c) Project Co shall create an access to the basement of the Facilities, the VIE Compound and energy centre at the Site from Old Dalkeith Road.

Drainage Works:

There may also be connections into some existing surface water drainage. If Project Co requires to connect the surface water drainage systems for the Facilities into the existing surface water drainage systems on the RIE Site then surface water drainage systems must be designed and constructed by Project Co such that they may be connected to surface water drainage systems at the agreed connection points in the Initial Drainage Proposal. Project Co shall provide design, construction and other information which shall be part of Project Co's applicable Interface Proposals to and for approval by the Board about the surface water drainage systems serving the Facilities and Project Co shall comply with Section 5 (Access Areas, Drainage and Substation) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A, the Initial Drainage Proposal, the Supplemental Drainage Proposal, the Access Strategy and where applicable any Access Strategy and/or Amended Drainage Proposal agreed or determined pursuant to Section 2 (Access Areas and Amended Drainage Proposal) of Part 2 (Interface Proposals Procedure) of Appendix A,

Cycle Path Works:

For details of the cycle works see paragraph 3.8.4 of this Sub-Section C.

D. Construction works outside the Campus Site and maintained by Project Co

Substation Works – Project Co shall be responsible for getting a dedicated HV power source for the Project via a dedicated Scottish Power substation. The Board has identified the Substation Site as the possible location for a dedicated substation for the Project.

If Project Co chooses to locate the substation on the Substation Site then Project Co shall provide design, construction and other information which shall be part of Project Co's applicable Interface Proposals to and for approval by the Board about the substation and access thereto which access may be formed only on the Substation Site and Project Co shall comply with the provisions regarding the Substation Access and cables in paragraphs 6 to 8

of Section 5 (Access Areas, Drainage and Substation) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A and the Substation Proposal.

If a substation is constructed on the Substation Site then in order to get power from the substation to the Site the Board has identified a route for the HV power cable, the Substation Cable Route, on the Bioquarter Site. The cable route to the Facilities may enter the Site via the Service Strip (shown shaded yellow and hatched in black on Plan 2) and the cable route may not cross the Retained Site at any other point. In constructing the cable on the Substation Cable Route, Project Co shall be responsible for all design, construction, maintenance, repair, replacement and renewal and shall comply with paragraphs 2 and 4 of Section 2 (Operational Construction Issues) and paragraphs 1 to 3 and 6 to 8 of Section 5 (Access Areas, Drainage and Substation) and Section 6 (Service Strip and Foul Service Strip) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A and the Access Strategy and Substation Proposal and the Service Proposal and where applicable any Access Strategy and/or Amended Service Proposal agreed or determined pursuant to Section 2 (Access Areas and Amended Drainage Proposal) and/or Section 3 (Amended Service Proposal) of Part 2 (Interface Proposals Procedure) of Appendix A.

4.5.11 Workmanship, Construction Accuracy & Tolerances

Project Co shall ensure that general workmanship conforms to current revisions of BS 8000: Series “Workmanship on Building Sites”, which covers typical building construction activities. Where specialist design proposals require construction activities outside the scope of this document, Project Co shall propose specific quality procedures relating to these activities based on Good Industry Practice current at the time, as a minimum.

Project Co shall ensure that workmanship for all construction and component assemblies is to the highest standards in every respect. Work is to be true to detail with sharp profiles, straight and free from defects, marks, waves or flaws of any nature impairing strength, performance or appearance.

The buildings and the external works shall be designed and set out by Project Co in accordance with BS 5606:1990 “Guide to Accuracy in Building”.

In some situations the tolerances identified in BS 5606 may not be appropriate for the particular elements or combination of elements in the Facilities. Where special levels of accuracy are required in relation to Project Co’s proposals these shall be stated by Project Co. Project Co shall consider the recommended procedure set out in Figure 8, Section 3, Appendix B, of BS 5606.

Project Co shall identify critical dimensions and setting out points on all its drawn information.

4.5.12 Control of Noise, Vibration and Dust

Project Co will ensure that unacceptable dust and pollution as a result of construction works or any other activities undertaken on the Site is not created at locations where patients, staff, visitors of members of the public might be exposed to pollutants and areas adjacent to ventilation intakes on the Campus Site (in particular intake vents at the existing operating theatres at the RIE Facilities and at the University Facilities). The ambient air quality standards to be met are as outlined in the table below:

Ambient air quality standards

Pollutant	Averaging Period	Air Quality Objective	
		Concentration (µg/m^3)	Allowance
Nitrogen Dioxide (NO_2)	1-hour	200	18 per calendar year
	Annual	40	-
Particulates (PM_{10})	24-hour	50	35 per calendar year
	Annual	40	-
	Annual	18	-
Particulates ($PM_{2.5}$)	Annual	12	-
		25	-
		15% reduction	-

Project Co shall comply as a minimum with the mitigations detailed in the Planning in Principle – Environmental Statement dated July 2011 and Addendums dated August 2011 and October 2011. Project Co shall comply with BS 5228-1:2009 Code of practice for noise and vibration control on construction and open sites Part 1: Noise and BS 5228-2:2009 Code of practice for noise and vibration control on construction and open sites Part 21: Vibration. Project Co shall comply with Control of Noise (Code of Practice for Construction and Open Sites) (Scotland) Order 2002. Project Co shall comply with the noise controls set in HAI-SCRIBE 2 review.

Project Co shall ensure that the design and installation of any plant, machinery or equipment shall be such that any associated noise complies with N25 when measured within any nearby living apartment, and no structure borne vibration is perceptible within any nearby living apartment.

The attention of Project Co is drawn to the provisions of Sections 60 and 61 of the Control of Pollution Act 1974, with reference to the control of noise in relation to any demolition or construction works. Where such works are adjacent to occupied property, Project Co shall ascertain from the Site neighbours what requirements or restrictions, if any, shall apply, particularly in relation to Aspergillus. The restrictions may relate to the type of construction plant to be used, siting of construction plant, methods of working to be adopted, the hours of work permissible and may, in addition, impose a maximum noise level that must not be exceeded.

With regard to piling operations, the Board considers it essential that steps are taken by Project Co to limit the effects of noise and vibration. Project Co is required therefore to demonstrate through the selection of the method of piling that full consideration has been given to this requirement.

Project Co shall at all times ensure that the appropriate silencers and/or noise suppression apparatus are correctly fitted to construction plant and equipment.

Project Co shall fit all compressors, percussion tools and vehicles with effective silencers of a type recommended by the manufactures of the compressors, tools or vehicles but in any event to the requirements of BS 5228-1:2009.

Any equipment of a semi-permanent nature used by Project Co, which produces noise on a regular basis, shall be positioned to cause the minimum disturbance to adjacent areas. Project Co shall ensure absolute care is taken at all times throughout the course of the Works to prevent the egress of water, dust, debris or any microbiological contamination out

of the Site and into adjacent buildings. In particular, Project Co shall establish any specific requirements for the control of dust.

Project Co shall ensure that all of the contractor and subcontractor's workforce are trained on the pollution and noise reduction measures in operation during the Works.

4.5.13 Meetings with Consort during the Construction of the Works

Project Co shall attend meetings with the Board and Consort during the construction of the Works. The Board shall manage the meetings including chairing and preparing the minutes except for the fortnightly Health and Safety Group meetings that Consort chair and minute. Project Co shall have the same lead person or a named deputy, at all meetings. The meetings that Project Co shall attend are to be agreed with the Board.

4.5.14 Meetings with Immediate Neighbours

Project Co shall attend meetings with the Board and all immediate neighbours during the construction of the Works. Project Co shall manage the meetings including chairing and preparing the minutes Project Co shall have the same lead person, or a named deputy, at all meetings. The meetings that Project Co shall attend are to be agreed with the Board.

4.5.15 Meetings with the Board during the Construction of the Works

Project Co and the Board shall agree the day-to-day; week-to-week meetings to be attended by Project Co and the Board. The purpose, timing, structure, management and content of the meetings are to be agreed by the Board and Project Co. Project Co shall have the same lead person at all meetings as far as possible or a named deputy.

4.5.16 Restrictions on Images and Videos during Construction of the Works

Project Co are required to obtain the Board's agreement prior to the use of CCTV cameras, webcams and the like to take images, videos and the like of the Works whether on or outside the Site.

4.5.17 Completion Requirements

On completion of the Works, Project Co shall provide the Facilities as clean to comply with the Completion Criteria. During the Post-Completion Commissioning Project Co shall provide the Facilities to a "clinically clean" standard of satisfaction of the Board's Head of Service Infection Control. Project Co shall liaise with the Board's Head of Service Infection Control in terms of agreeing the process and standards required to achieve the appropriate level of cleanliness for each location within the Facilities. Project Co shall demonstrate how the proposals facilitate the control and management of an outbreak and spread of infectious diseases in accordance with SHTM 03-01 and SHFN 30.

Project Co shall adopt a systematic and thorough approach to the commissioning of the Facilities including the setting to work, testing and providing the handover documentation for the same.

Project Co shall approach the commissioning activities as an entirely separate procedure undertaken by Project Co and ensure all activities interface with the buildings themselves, building services and equipment provisions.

Project Co shall ensure that the ability to commission the systems and installations is considered at an early stage and is designed into the Facilities and is an inherent part of the overall buildings solution.

During the design stage Project Co shall detail outline commissioning periods required on-site such that these are built into the Programme and Outline Commissioning Programme.

During the Construction Phase Project Co shall ensure that installations comply with the design intent of the drawings and that all installation and commissioning activities at the Facilities are performed correctly. This shall include ensuring physical access is easily achievable to all commissioning stations and devices.

By the date for Project Co to make available the principal operation and maintenance manual set in Clause 18.5 of the Project Agreement, Project Co shall provide to the Board a complete set of electronic records representing the design, construction, testing and commissioning and completion of the "as-constructed" Facilities that include the routes of all building services. This shall include, but not be limited to, a full set of as-built records, drawings, specifications and the like and the documents in the Completion Criteria, incorporating all changes to the design and all remedial works during construction. The documents and drawings format(s) and [ ] number of copies are to be provided by Project Co. For the purposes of Clause 17.18 and 18 of the Project Agreement all final as-built records for the Facilities shall include, as a minimum:

a) Design information including all relevant design calculations, parameters, assumptions, standards, specifications, product data sheets for all components and parts, including details of the influence on the design of actual construction methods, including any change or remedial works during construction.

b) As built drawings for all component parts of the Facilities;

c) Testing & Commissioning records for all discrete components, subsystems, systems and the Facilities as a whole;

d) Operating and Maintenance manuals;

e) Health and Safety File;

f) Full set of design, construction, testing and commissioning and completion records/certification.

g) All other information that is required to be collated under the Construction (Design and Management) Regulations 2007 as amended from time to time.

Project Co shall provide to the Board, at the Actual Completion Date, a certificate confirming that the Facilities comply with the requirements of NHS Scotland Firecode.

Construction records and all information relevant to the construction of the Facilities shall be stored in a secure electronic data room created specifically for this purpose by Project Co for access after completion. The system for storage of data and information shall be designed by Project Co and shall generally be compatible with the Board's existing systems. The format of the data room and the system for storage of data shall be designed by Project Co and submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement. Project

Co shall be responsible for management and administration of the data room for the Project Term.

4.5.18 Oversailing Activities

When Project Co intends to oversail any part of the Retained Site and/or Retained Estate in connection with the Works and/or any works in the Operational Term then Project Co shall comply with the Oversail Strategy and Section 4 (Oversail) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A and/or where applicable any Additional Oversail Strategy agreed or determined pursuant to Section 1 (Oversail) of Part 2 (Interface Proposals Procedure) of Appendix A.

5 General Construction Requirements

5.1 Schedule of Life Expectancies

The buildings, including building services components, shall be designed with materials, components and techniques that are readily available, reliable, sustainable and easily maintainable in use. The Board supports buildings constructed using components with proven technology, with high life expectancy, leading to minimum cost in use.

Good Industry Practice for a design life at the Actual Completion Date for the elements listed below shall as a minimum be:

a) Structure, including substructure	70 years
b) Floor Structure	70 years
c) Roof Structure	70 years
d) Drainage and below ground civil engineering infrastructure	70 years
e) External Walls	70 years
f) External Openings, windows and door	25 years
g) Roof Finishes	25 years
h) External finishes	25 years*
i) External Hard Surfaces	20 years
j) Internal partitions including openings	25 years
k) Internal Doors	25 years
l) Internal finishes (excluding soft flooring)	15 years*
m) Soft flooring	12 years
n) Internal fixtures and fittings	15 years
o) Engineering plant	CIBSE Guidance

p) Engineering services distribution systems CIBSE Guidance

*excluding painted finishes

Project Co shall demonstrate that the design life proposed for any element will be achieved.

Materials and components forming part of the Facilities, which require maintenance and replacement within the life of the Facilities, shall be selected, located and fixed in such a way as to minimise future inconvenience, disruptions and to avoid temporary closure of the Facilities.

5.2 Infection Prevention & Control

The Board requires the highest priority on infection prevention and control to be given in relation to the movement of goods and in particular the segregation as far as is reasonably practical of clean linen, food trolleys and the removal of waste, soiled linen and empty food trolleys.

Project Co shall ensure all aspects of the Facilities allow for the control and management of any outbreak and/or spread of infectious diseases in accordance with the following:

a) Infection Control in the Built Environment: Design and Planning (SHFN 30);

b) Scottish Infection Manual – “Managing the Risk of HAI in NHS Scotland”;

c) Health Facilities Scotland – Healthcare Associated Infection – System for Controlling Risk in the Built Environment (2007)

d) Guidance provided by Clinical Standards Board NHS HIS;

e) Textiles and Furniture (SHTM 87);

f) Ventilation in Healthcare Premises (SHTM 03-01);

g) “Guidance on Prevention and Control of Clostridium difficile Infection (CDI) in healthcare settings in Scotland” Health Protection Scotland, 2009; and

h) NHS Lothian Infection control web based manual http://www.nhslothian.scot.nhs.uk/Services/A-Z/InfectionControl/Pages/default.aspx;

5.3 Thermal Requirements

Project Co shall ensure the buildings’ envelopes complies with Section 6 of 2011 Non-domestic Technical Handbook to The Building (Scotland) Amendment Regulations 2010 and the following criteria:

a) The entire building envelope shall be thermally broken and no details that allow cold bridging shall be used;

b) The whole building envelope shall be provided with a continuous air and vapour tight skin layer with a vapour resistance of not less than 200 Mns/g when tested in accordance with BS 3177. This barrier shall be on the accommodation side of any insulation and may be formed of differing materials at different parts of the construction provided that continuity is maintained in all places. The vapour barrier material shall be non-combustible;

c) The building fabric shall include passive design measures to limit summer temperatures to figures given within the Environmental Matrix; and

d) The work to the fabric to achieve the above standards shall include but not be limited to enhanced window performance, high solar performance glazing systems, brise soleil and enhanced thermal insulation value.

5.4 Acoustics

Project Co shall define the acoustic criteria to be adopted on a room-by-room, and corridor-by-corridor basis with reference to SHTM 08-01: Acoustics. Project Co shall be responsible for demonstrating compliance with the agreed criteria.

Project Co shall endeavour within their design, to minimize the transfer of noise, dust and vibration throughout the Facilities. In particular, the design shall take account of the potential for disruption to the clinical function of the Facilities caused by noise, dust, vibration or other nuisance, however caused, as a result of future modifications / remedial works that may be required to the Facilities.

Project Co shall demonstrate in their design, how it shall address the issue of undesirable noise transmission in patient waiting areas. Project Co shall endeavour to minimise and mask ambient noise sufficiently to preserve patient privacy, confidentiality and maintain a calming atmosphere.

Project Co shall ensure that the acoustic design of the Facilities shall give due consideration to the requirements of the deaf and hard of hearing. In particular the level of background noise shall be such that it does not cause particular difficulty for those with such conditions.

In addition, Project Co shall ensure all specialist audiology sound-proofing in accordance with the Board's Construction Requirements this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements), Sub-Section E (Specific Non Clinical Requirements) and this Schedule Part 6 Section 6 (Room Data Sheets) are designed into the Facilities.

5.5 Room Mock-ups

Project Co shall provide the design of the room mock-ups including the 1:50 floor plan with loaded floor, walls and ceiling including details showing Equipment. The design for the mock-ups shall include the detailing for the floor finishes including skirting interface. Project Co will provide accommodation for, and full scale mock-ups of the following rooms, as a minimum, for use in the design development and approval process:

a) Touch Down Base;

b) Adult Single Bedroom with ensuite;

c) Paediatric Single Bedroom with ensuite

d) Paediatric Four Bedded room;

e) Clean Utility Out Patient Department and

f) Clean Utility In-patients

These shall be built with all services, equipment, doors and windows. They shall include the floor, wall and ceiling finishes. The services and equipment do not need to be live. Group 3 equipment will be provided by the Board for Project Co to install into the rooms.

The design and construction of the room mock-up shall be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement. They shall be provided in a timely manner, to ensure they add value to the design development and approval process.

5.6 Integration with Engineering Services

Internal walls, partition systems, ceiling voids and service risers shall be capable of integrating services, e.g. wiring, plumbing, medical gases and service terminals as required without detriment to the performance of any building services and other Facilities performance criteria such as fire resistance or acoustic properties. Engineering Services shall be co-ordinated such that satisfactory means of maintenance access is provided which minimises the potential for disruption to the Board's operations.

5.7 Building Envelope

The building envelope includes all external wall, façade and roof cladding elements associated with the Project. Project Co shall design the building envelope to provide a high quality enclosure to the accommodation and shall provide resistance to impact damage and intruder break-in, either by cutting or disassembly of the wall components. It shall incorporate an external finish which is essentially self-cleaning irrespective of the frequency of maintenance. Whilst selection of all materials and construction techniques is the responsibility of Project Co, there are a number of key criteria which must be satisfied by Project Co, as follows:

a) All selected materials shall be compatible with each other;

b) All selected materials shall be subject to the approval of The City of Edinburgh Council as part of the overall planning approval process;

c) The selected materials shall have a verifiable life expectancy in line with the criteria set out in paragraph 5.1 and certain specific elements, such as sealants, which may have a design life of less than the period stated, shall be identified and submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement and shall be the subject of a planned maintenance programme for replacement;; and

d) Any cladding systems chosen for use on this Project shall be designed and constructed to resist silently, without detriment to the required performance or appearance, the action of the elements including wind, rain, hail, snow, ice, solar radiation, temperature changes, moisture movement, structural movements, construction tolerances, thermal movements, the internal environment of the buildings and dead or imposed loads. The systems shall include the necessary provisions to enable regular cleaning from outside and regular routine maintenance to take place, without disturbance to the activities within the buildings, in accordance with the current provisions of the amended Workplace (Health, Safety and Welfare) Regulations 1992 and Ability to Open Windows Safely guidance.

Project Co shall ensure that the buildings are constructed and the design is detailed to limit air infiltration to minimum levels to reduce energy consumption and improve internal environmental conditions.

Performance demonstration tests for all roof and wall elements shall be carried out by Project Co in accordance with the following:

Project Co shall ensure all testing of mock-up assemblies of parts of the buildings construction are completed satisfactorily before work starts on the Site in relation to the building envelope.

Project Co shall arrange for the testing of all completed wall and roof assemblies to prove compliance with the requirements of The Building (Scotland) Regulations 2004 and its amendments

Project Co shall ensure that the external hard and soft landscaping around the buildings shall allow access for the appropriate maintenance / cleaning system and equipment utilising the hierarchy of control measures included within the Work at Height Regulations 2005 as amended. Appropriate provisions shall be incorporated by Project Co to allow the safe use of the appropriate maintenance / cleaning system including but not limited to safe access to the workplace and equipment. The structural frame and external skin of the buildings shall be designed by Project Co to accommodate the loading requirements of access equipment and operatives, where the cleaning and maintenance system uses this method.

Project Co shall design the buildings' envelope to prevent rainwater entry into the building structure and the internal accommodation. Where water penetrates cladding elements, as part of the functional design and construction techniques, Project Co shall ensure it is controlled and drained externally.

5.8 Internal Areas

Project Co shall ensure that the internal areas of the buildings shall allow access for the appropriate maintenance / cleaning system and equipment utilising the hierarchy of control measures included within the Work at Height Regulations 2005 as amended. Appropriate provisions shall be incorporated by Project Co to allow the safe use of the appropriate maintenance / cleaning system including but not limited to safe access to the workplace and equipment. The internal frame and internal skins of the buildings shall be designed by Project Co to accommodate the loading requirements of access equipment and operatives, where the cleaning and maintenance system uses this method.

5.9 Ceilings Heights & Voids

The floor to ceiling heights, or the floor to the underside of ceiling mounted plant where there are no ceilings, shall be designed to accommodate the nature and use of the accommodation.

Project Co shall provide ceiling heights and voids that provide an interface between the mechanical and electrical services installations and the accommodation below with the integration of service outlets, lighting, grilles and other fittings.

Project Co shall configure the design, wherever possible, to accommodate future flexibility.

The Board accepts that there will be a limited number of areas where future flexibility will be less easily achieved. These areas may include (but not be limited to): operating theatres; shielded rooms; and rooms designed to accommodate heavy imposed loads.

An appropriate and safe void allowance above all ceilings shall be provided, including appropriate and safe points of access for maintenance of services. These shall be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement. The void

allowed shall be adequate for the proper co-ordination and installation of engineering, cabling (including IT) and other services.

Co-ordination with the electrical, mechanical and communication services shall be an inherent part of the ceiling and building design. Within each area the installation of the engineering services provision shall be co-ordinated with the ceiling layout and allow simple relocation if required.

Suspended ceilings shall be readily demountable without suffering damage or becoming soiled and shall be easily cleaned. Frequently accessed voids shall be fitted with robust hinged locking doors or hatches.

Project Co shall ensure that the void above the ceiling is fully accessible from below, unless otherwise agreed by the Board, and adequate for the proper installation and co-ordination of the services, and for their future maintenance, repair and replacement. Allowance shall be made by Project Co for the installation of additional services in the future wherever possible. Where the design does not include the need for ceiling voids for services there shall be an allowance made by Project Co for a dedicated zone for the installation of ceilings and services at a later date.

Project Co shall ensure that the ceiling layouts are co-ordinated with the drainage, mechanical and electrical services installations. Project Co shall demonstrate its solution to this requirement prior to the commencement of construction.

Ceiling mounted booms required for patient support and monitoring systems in theatres, Paediatric Intensive Care Unit (PICU), treatment or x-ray rooms shall be co-ordinated with the ceiling layouts.

Project Co shall ensure the design and construction provide flexibility in terms of fixtures and fittings, i.e. locations of individual pieces of equipment can be readily changed and not unduly restricted by the type of construction.

Project Co shall ensure that the ceiling voids are designed to accommodate the specific requirements of the fire strategy for the Facilities – and in particular, the provision of cavity fire-barriers within compartments.

5.10 Corridor Widths and Heights

Corridor widths and heights shall satisfy the relevant guidance provided by:

a) BS8300:2009

b) The Equality Act 2010;

c) SHFN14 “Disability Access”;

d) HBN 00-04;

e) SHTM 81; and

f) Other relevant statutory guidance.

The hospital streets are to have a minimum unobstructed width of 3 metres. Other corridor widths shall be as defined by the nature and use of the accommodation. Corridor heights shall be as defined by the nature and use of the accommodation. Main interdepartmental

corridors in areas that patients may travel in beds shall be of sufficient width to allow two beds, with any attached equipment, to pass. The corridors width and height shall allow the installation, removal or replacement of clinical and non clinical equipment. Minimum widths and heights shall apply along the whole length of the corridor.

5.11 Door Widths and Heights

Clear widths and heights of all door openings in addition to satisfying the requirements of The Building (Scotland) Regulations 2004 and The Building (Scotland) Amendment Regulation 2011, shall comply with the guidance of BS 8300:2009, SHTM 81, SHTM 58 and the relevant section of HBN 40. Door widths shall be identified in the relevant Room Data Sheet.

The door opening widths and heights in clinical areas shall be sufficient to allow the safe passage of a four section profiling electric bed with associated equipment and escort alongside.

Notwithstanding the above, Project Co shall be responsible for establishing, through detailed consultation with the Board, additional specific requirements for door widths and heights in all areas of the Facilities. Consideration shall be given to providing sufficient door width in areas where the Board's operations rely on the use of larger items of equipment such as waste containers and regeneration trolleys.

Door widths, heights and door configuration shall be provided to allow for the delivery and removal of equipment to each area.

5.12 Windows

Project Co shall ensure that due consideration is given to the location and extent of glazing on external walls with regard to solar gain and heat loss. Solar control glazing, or appropriate solar shading, shall be used on windows on east, west and south facing elevations. The use of blinds or other device placed between secondary glazing or double sashes shall not be considered appropriate solar shading.

Courtyards, and courtyard elevations, shall be designed by Project Co so that daylight to usable room spaces at the lowest level of the courtyards is adequate for normal tasks within the rooms.

The Board wish to see the use of natural daylight contributing towards the achievement of a high standard of environmental quality.

Natural light shall be provided in public spaces and in occupied private and staff spaces within the Facilities as far as is practical. Natural and artificial light sources shall be designed to avoid or minimise glare.

Window area and sill height, privacy and security requirements will require special consideration for ground floor accommodation to allow sufficient daylight and views out whilst maintaining privacy from people outside the building.

Where transparent window glass requires to be rendered translucent for reasons of privacy either by obscure glazing or by the use of applied reflective films, then consideration shall be given to the effect of internal artificial lighting during the hours of darkness. This particularly, but not exclusively, applies to all patient areas situated at or adjacent to external public spaces.

Project Co shall provide all windows with a security rating classification of 2 or 3 for manual intervention attack when tested in accordance with Loss Prevention Standard LPS 1175 : Issue 6 : Table 4: May 2007 and shall meet the relevant performance standard in the appropriate British Standard. Glazing and glazing sizes shall be kept to the minimum compatible with the requirements of lighting, surveillance and visibility.

Where possible all windows shall be designed by Project Co to be cleaned both externally and internally from the inside, unless otherwise agreed by the Board. Project Co shall ensure no portions of windows, either fixed or opening shall come below the level of worktops or desks included in the Schedule Part 11 Equipment Schedule.

Project Co shall ensure opening windows are provided with good quality well-fitting seals and shall be capable of opening at the top and bottom of the frame and shall be fitted with restrictors to give a maximum opening of not more that 100mm in normal use. The effect of such restrictors shall be taken into account by Project Co when calculating the effect on efficient and effective natural ventilation requirements for the room. Project Co shall ensure all windows required for ventilation shall be provided with controllable trickle ventilators within the head of the frame or with two stage key lockable handles giving 5 – 10mm ventilation gap. The opening lights of the windows, and any control devices, shall not interfere with the location or operation of blinds or curtains. All windows and fittings shall be compliant with anti-ligature requirements.

External sills shall be designed to prevent birds from roosting.

Project Co shall ensure that locking devices, to enable the windows to be released for cleaning purposes, shall be by key or other device such that the locks cannot be released by unauthorised persons.

Project Co shall ensure that all handles or control gear shall be placed at levels which enables them to be operated by staff standing on the floor without the use of loose poles, and which do not conflict with the location of the adjoining construction elements, including blinds and curtains. Where windows are placed over worktops or desks, or where the operation as described above is not achievable, mechanical or electrical means of opening shall be provided by Project Co with controls located in a suitable position within the room concerned.

Project Co shall test the windows and other external opening assemblies (louvres and doors) in accordance with the following.

a) BS EN 1027:2000 Windows and Doors – Watertightness – Test Method;

b) BS EN 12210:2000 Windows and Doors – Resistance to Wind Load - Classification; and

c) The Test Report Format contained in the withdrawn standard - BS 5368, Part 4: 1986 (EN86).

5.13 Finishes

5.13.1 General Finishes

Project Co shall select finishes on the basis of the following:

a) Accessibility;

b) Appropriateness;

c) Durability;

d) Robustness;

e) Compatibility;

f) Maintainability;

g) Suitability for life cycle replacement;

h) Co-ordination with other finishes;

i) Suitability for infection control;

j) Health and Safety attributes;

k) Life Expectancy set out in paragraph 5.1;

l) Easy of future maintenance; and

m) Appearance.

All wall finishes and backgrounds shall be selected and installed in accordance with the NHS Requirements set in paragraph 2.3, and appropriate British and European Harmonised Standard Specifications and Codes of Practice. The Board's requirements are identified in this Schedule Part 6 Section 6 (Room Data Sheets) and the finishes listed in the table set out in paragraph 1.2.3 of Schedule Part 8 (*Review Procedure*).

Areas of the Facilities that are subject to potential damage from trolleys, vehicles, beds or other similar traffic shall have adequate protection to comply with SHTM 69 as a minimum.

The finishes detailed in the Table of Finishes in accordance with Schedule Part 8 Review Procedure and shall demonstrate the finished quality standards of certain specific fittings and finishes that will be constructed by Project Co during the design and construction stages. Project Co will create these mock-ups that will form the benchmark for quality control of site operations.

Project Co shall also select finishes which do not give rise to offensive odours developing. Accordingly, finishes shall be selected with due regard to usage, potential spillage and cleaning regimes (details provided in Sub-Section E) and health and safety issues in relation to performance and cleaning regime.

Project Co shall ensure that all floor, wall and ceiling finishes include adequate provision for movement joints, in accordance with current recommendations, to cater for any movements of the structure and/or the background material of the finish. Project Co shall ensure that the location and detail of the joints shall be fully co-ordinated with the overall interior design. Project Co shall indicate the position of all movement joints on drawings to be submitted as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

The use of inspirational colour patterning, motifs and texture shall be considered by Project Co in appropriate areas throughout the building. Where carpeted areas are required due consideration shall be given by Project Co to the use of durable wool-rich carpets if appropriate to the room function.

Project Co shall submit to the Board for review by the Board in accordance with paragraph 1.2.3 of Schedule Part 8 (Review Procedure), Table of Finishes and clause 12.6 of the Project Agreement the decoration for the Teenage Cancer Trust accommodation.

Where possible, internal surfaces shall allow cleaning and repair of elements that may be vandalised, with the minimum of effort.

5.13.2 Flooring

Project Co shall ensure all level, stair treads and nosings, and inclined flooring shall meet the following minimum slip resistance requirements:

a) “Pendulum Test Value” of 36 or greater (when either dry or contaminated); and

b) “Rz surface micro-roughness (microns µm)” of 20 µm or greater for water-wet, low activity pedestrian areas.

Project Co shall procure that test results in the “installed” condition are independently verified by the Health & Safety Laboratory, Buxton, Derbyshire. The pendulum test shall be performed using a pendulum-coefficient of friction instrument with “Four-S” rubber (Standard Simulated Shoe Soil) and Slider 55 rubber, in accordance with approved HSE test methodology.

For the avoidance of doubt, the obligation to follow the pendulum-coefficient of friction methodology is a specific obligation and is derived from the HSE, which is their preferred method of test.

Project Co shall ensure that all entrances to the Facilities incorporate sufficient length of appropriate floor matting designed to remove contaminants including water, dirt and leaves from footwear, trolley wheels etc. A water evaporation system such as a hot air curtain shall be provided at each entrance.

All floor finishes shall comply with SHTM 61 and have low absorption, low radius of ignition and low dirt retention.

Project Co shall comply with all of the recommendations provided in SHS Safety Action Notice SAN(SC)05/08.

Project Co shall prepare a Flooring Finish Selection Matrix in accordance with SHTM 61, 2009 in order to demonstrate to the Board that the selected finishes are suitable for their locations.

The particular conditions in the plaster suite accommodation shall be taken into account when selecting floor finishes.

5.14 Partitions

Project Co shall ensure partitions address special construction requirements including x-ray protection and gamma ray shielding i.e. concrete or lead. It is important that Project Co comply with the shielding requirements from the Board’s Radiation Protection Advisor.

Partitions shall be designed to take account of following criteria:

a) Structural strength of overall partition, and adequacy of support for fittings, fixtures and equipment, both planned and future;

b) Sound reduction;

c) Fire resistance;

d) Moisture resistance;

e) Resistance to biological infection;

f) X-ray shielding;

g) Gamma ray shielding; and

h) Protection from damage.

5.15 External Materials

Project Co shall ensure that selected materials are robust and durable. The choice of materials for cladding and external surfaces shall comply with the performance levels of the Board's Construction Requirements and provide an appropriate design solution in terms of quality, scale, colour, texture, serviceability, statutory and environmental requirements.

5.16 Architectural Hardware

The locking system shall be fully suited across the Facilities, and shall interface with swipe card/other entry systems where provided. The locking system shall interface with the Board's existing 'swipe card' or other electronic entry systems currently employed at the RIE Facilities. Particular requirements with respect to electronic door access / security requirements are contained in paragraph 9.19.6.

5.16.1 Ironmongery

Project Co shall provide ironmongery which shall enhance the overall quality of the interior design concept. Project Co shall ensure ironmongery is of robust construction suitable for its specific purpose and usage characteristics and in accordance with the Room Data Sheets. For ease of use by elderly or disabled persons Project Co shall ensure handles are colour contrasted with the door background colour and of easy grip design.

Samples of all the ironmongery products shall be prepared in accordance with paragraph 2.3 and paragraph 5.5. The lock suiting information is to be provided as Reviewable Design Data for review in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement post Financial Close. This is so that details of lock suiting will be submitted by Project Co to the Board to allow adequate time for discussion and amendment if necessary before the fittings are required for installation in the buildings. All door closers shall be fully adjustable.

5.16.2 Blinds & Curtains

Project Co shall select blinds and curtains to relate to the overall interior design concept and to the specific requirements for each in relation to colour, pattern, material, fire resistance,

non-flammability, opacity, light reflectance and light absorption. Blinds and Curtains shall be Class O rated. Windows in clinical areas shall be fitted with disposable curtains. Windows in non-clinical areas shall be fitted with blinds that are of the non-disposable type.

Project Co shall ensure that materials for blinds and curtains shall also comply with the requirements of the Board's Head of Service Infection Control for cleaning, washing and maintenance, and comply with SHFN 30 and SHTM 87 and relevant Safety Action Notices. All blinds and curtains shall be compliant with anti-ligature requirements.

The locations and fixings for both blinds and window curtain tracks shall be co-ordinated by Project Co with the window and internal window sill design from the outset of the building design development and the fixings shall be designed by Project Co to take the proposed maximum loadings possible for the tracks concerned. Curtain tracks shall be designed by Project Co to overlap the window openings so that they do not allow light to pass into the room when drawn. Controls for blinds and curtains shall be co-ordinated by Project Co with the window design and its opening gear, including any operating handles, levers or stays that may be required and shall be located conveniently for staff or patients to operate as appropriate.

Project Co shall fix bed curtain tracks at the height recommended in the relevant guidance and Project Co shall ensure bed curtain tracks are co-ordinated with other service outlets and the window positions, where applicable. An adequate ventilation gap must be provided by Project Co at the curtain head.

Where Project Co are required to provide "vistamatic" blind type controls to observation panels, doors and screens, appropriate sight lines shall be maintained into single bedrooms and counselling / interview rooms.

Where blinds are required for privacy reasons, but are deemed not to meet the infection control criteria for a particular area then Project Co shall provide an alternative means of ensuring that privacy is maintained.

5.17 Hand Washing Facilities

Project Co shall ensure that all hand washing facilities comply with CEL 03 (2012) Water sources and potential infection risk to patients in high risk units and in clinical areas are provided with sensor taps and electronic valves to the supply spouts and that they shall conform to SHTM64 in all relevant respects; particularly;

a) Single spout mixer to achieve correct temperature;

b) Water temperature thermostatically controlled; and

c) Supply and waste connections to concealed services.

5.18 Staircases, Ramps, Balustrades, Walkways, Escalators & Lifts

Where staircases, ramps, balustrades, walkways, escalators and lifts are provided in addition to those required to satisfy means of escape criteria, these shall be designed to relate to the anticipated capacity of use and clearly designated for public, staff or service circulation.

Where ramps are provided in addition to those required to satisfy means of escape criteria these shall be suitable for independent and/or assisted wheelchair users, trolleys and ambulant disabled people.

Dependent on the nature and configuration of the Project Co's design proposals, Project Co may be required to provide staircases for fire fighting access, smoke control, dry and wet riser provision agreed with The City of Edinburgh Council's Building Control Department and the Scottish Fire and Rescue Service.

Particular attention shall be given to evacuation lifts where there may be a high percentage of wheelchair users on upper floors.

Any passenger or bed / passenger lifts required for vertical transportation shall have a minimum clear entrance of 1300 mm.

5.19 Soft Landscaping Requirements

Project Co shall incorporate areas of soft landscaping into the Facilities to complement both buildings and hard landscaped areas' of the Site and the adjacent areas of the Retained Site in accordance with the requirements of paragraph 7.1.

5.20 Wayfinding & Signposting

Wayfinding shall be so designed to meet the needs of different groups of people coming onto the Site, such as children, the elderly, the physically and visually impaired, as well as for service delivery purposes and contractors.

Signs shall be consistent to the end of the journey, identify functional specialities to facilitate the separation of different clinical zones.

Signposting from parking areas to entrances shall be clear and unambiguous.

Project Co shall observe the guidance and advice referred to in paragraph 2.2 General Design Issues item b.

Non-specialist language shall be used. Consideration shall be given to the use of iconic and pictorial signs as an alternative to written words.

5.21 Wall Protection

Project Co shall establish the most suitable form of protection at the most effective height location and orientation that shall prevent direct impact with the building fabric, its fixtures and fittings. SHTM 69 provides guidance and recommendations on this subject.

Project Co shall undertake a detailed review of those pieces of mobile equipment both Clinical and Non-Clinical, that are expected to be used by the Board and Project Co within the Facilities. This review shall include a process of risk assessment and shall be organised to determine the type and extent of protection that is required to the building fabric. Project Co shall submit the findings of the review to the Board as Reviewable Design Data for review by the Boards (in particular the Board's Radiation Protection Adviser) in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement. Project Co shall comply with the findings of the review including providing the design and construction required by the review.

Project Co shall be required to demonstrate that the proposal provides the most effective height, location and orientation of protection that shall prevent direct impact with the building fabric.

Mobile equipment currently used by the Board includes (but is not limited to) the following, however Project Co shall be responsible for establishing a comprehensive schedule of all mobile equipment and associated dimensions sufficient to inform the design:

- Cots / Incubators / Beds / Patient Trolleys / Mobile X Ray Machines / Resuscitation Trolley's / Mobile Ultrasound Machines / Mobile EEG / Retrieval Team Equipment / Mobile Hoists / Wheelchairs / Food Trolleys / Mortuary Box / Supply delivery trolleys / Cleaning Equipment - Hoovers/Washers / Disposal Holder collection trolleys / Linen Trolleys / Sterile Supply Trolleys

Project Co shall endeavour to minimise the extent of impact damage incurred by ensuring corridors are free of awkward corners / obstructions. Project Co shall ensure that doors in corridors are of sufficient width to accommodate all forms of hospital traffic and shall, where necessary, be designed to be held in the open position or to automatically open where appropriate.

A combination of some or all of the following forms of protection would be deemed appropriate in corridors and hospital streets:

a) Crash rails;

b) Defensive coves; and

c) Corner treatment and reinforcement.

Exposed services such as ducts, radiators and pipework can be badly damaged when struck by trolleys etc. Project Co shall incorporate measures to avoid damage to these elements.

5.22 Static Discharges

Project Co shall seek to eliminate, by choice of material coupled with control of the environment the release of static charge, in accordance with the recommendations contained in SHGN Static Discharge (1999).

Project Co shall co-operate with the Board in the production of relevant risk assessments in accordance with HTM 00-07 “Resilience planning for the healthcare estate”.

5.23 Standardisation & Prefabrication

The use of standardised / prefabricated elements and building components to achieve good quality control, ease and speed of installation and flexibility for future use is welcomed. Their use shall ensure Operational Functionality can be achieved and offering value for money.

In order to take advantage of the repetitive nature of construction, maximise productivity and efficiency and minimise construction periods and waste, consideration shall be given to off-site prefabrication. It shall specifically be applied to repetitive elements e.g., sanitary assemblies, bathrooms or complex equipment such as plant assemblies.

Project Co shall adopt standardised and / or pre-fabricated components and elements of construction which improve product quality, guarantee consistency of performance enhance efficiency of maintenance, and provide flexibility for future changes, ease of replacement and value for money.

5.24 Materials

Project Co shall ensure that all materials incorporated into the works shall comply with the requirements of The Construction Products (Amendment) Regulations 1994, and all other parts of the Board's Construction Requirements.

Project Co shall ensure that all products and materials to be incorporated into the Facilities shall be of sound and satisfactory quality and unless otherwise agreed by the Board shall be new. Project Co shall not construct the Works utilising substances which are hazardous to health, including but not limited to substances referred to as being hazardous to health and safety in The Control of Substances Hazardous to Health Regulations 2002 and The Control of Substances Hazardous to Health (Amendment) Regulations 2004.

Where materials and components are not specifically identified as complying with The Construction Products (Amendment) Regulations 1994, Project Co shall ensure that they comply with the relevant British Standards, Eurocodes and Codes of Practice. Where materials and components are available in varying qualities complying with two or more of the relevant regulations or standards, the higher quality products shall be used.

Project Co shall ensure that the whole quantity of each product and material required to complete the Works is of a consistent type, size, quality and overall appearance and is fit for its intended purpose. Project Co shall ensure all products and materials are handled, stored, prepared and used or fixed strictly in accordance with the manufacturers' written instructions or recommendations and not be damaged when incorporated into the Works.

Project Co shall not construct the Works utilising substances which are hazardous to health, including but not limited to substances referred to as being hazardous to health and safety in "The Control of Substances Hazardous to Health (Amendment) Regulations 2004"

Project Co shall ensure that:

a) the materials selected or specified by or on its behalf for use in the Facilities (or any part or parts thereof) are in accordance with the guidance contained in the Good Practice Guidance for selecting materials and this paragraph 5.24; and

b) there shall not be specified for use nor shall there be incorporated or used in connection with the Facilities any materials or substances which are expressly prohibited by the Project Agreement or any part of it or which are generally known not to be in accordance with British or European Standards and Codes of Practice at the time of specification or use (as applicable), or any materials or substances which are deleterious to health and safety or to the durability of buildings and/or other structures and/or finishes and/or plant and machinery in the particular circumstances in which they are used, or any materials or substances identified as deleterious, unsatisfactory or unsuitable in the relevant circumstances in the Good Practice Guidance for selecting materials and, in addition to and separate from the foregoing, any substances or combination of substances publicised prior to the time of construction in any Building Research Establishment Limited ("BRE") publications issued as part of the BRE Professional Development service which the BRE recommend are not used for building purposes or for the type of buildings comprised in the Project.

Project Co shall obtain confirmation that all timbers are "Certified Wood".

Project Co shall certify at the Actual Completion Date that none of the materials, products or constructions defined as not being appropriate above have been used in the construction of the Facilities, or incorporated in them, other than where specific written consent from the Board has been obtained. Project Co shall also notify the Board of any other material which

may become designated as prohibited at any time after incorporation into the project, during the Project Term.

5.25 Sustainability

Project Co shall promote sustainable development by demonstrating an integrated approach to the social, environmental and economic well-being of the area served, now and for future generations. The Facilities shall also reflect the objectives of any local agenda strategy supported by The City of Edinburgh Council including Edinburgh Standards for Sustainable Building (2010).

Project Co shall design the Facilities to support the environmental services and to conserve and utilise energy in line with the Climate Change Scotland Act 2009 and the public sector duty to meet national targets of 42% reduction of CO2 emissions arising from burning of fossil fuels and 80% by 2050. NHSScotland HEAT targets on energy conservation and CO2 emissions are in place to meet the requirements of this public sector duty. The design of the environmental control system shall be co-ordinated and integrated with the design of the structure and the occupied areas in order to maximise the control and flexibility of the installations.

A grey water recycling scheme should be assessed for applicability in this project.

Project Co shall promote sustainable development by demonstrating an integrated approach to the social, environmental and economic well-being of the area served, now and for future generations. Project Co shall ensure that the design and completed Facilities comply with the recommendations of Local Agenda 21, including reflecting the objectives of any Local Agenda 21 strategy supported by The City of Edinburgh Council.

The Facilities shall, as far as reasonably practicable, deliver benefits to the environment. Project Co shall:

a) Implement a strategy to meet the BREEAM requirements outlined in 5.25.1 below;

b) Minimise waste during construction and operation;

c) Using Corporate Greencode, implement an Environmental Management System (EMS) for accreditation aligned to ISO 14001;

d) HTM 07-07 Sustainable Health and Social Care Buildings: Planning, design, construction and refurbishment;

e) Reduce the use of fuels which contribute to ozone depletion, global warming, air and water pollution and depletion of non-renewable resource;

f) Respect the local landscape and protect natural habitat and species and comply with the UK Biodiversity Action Plan;

g) Avoid sources of ionising and electromagnetic radiation to the extent determined by the relevant HTM;

h) Avoid any design features associated with sick building syndrome;

i) Maximise the opportunity for waste minimisation and re-cycling;

j) Maximise efficient and effective removal and transport of waste;

k) Adopt maintenance regimes which maintain optimum performance;

l) Where possible avoid the use of harmful building products and processes; and

m) Explore the use of prefabricated elements to achieve good quality control, ease and speed of installation and flexibility for future use;

n) Project Co shall comply with the relevant NHS Requirements, including, but not limited to:

1. The development of a Local Environmental Strategy in line with sustainable development in NHS;
2. New environmental strategy for the National Health Service;
3. Corporate Greencode;
4. Good Corporate Citizenship Assessment Model (GCCAM);
5. Carbon/ energy management in healthcare; and
6. The Board's target of utilising some 20% of renewable energy sources shall be achieved by Project Co.

Project Co shall design the Facilities to support the environmental services and to conserve and utilise energy. The design of the environmental control system shall be co-ordinated and integrated with the design of the structure and the occupied areas in order to maximise the control and flexibility of the installations.

5.25.1 BREEAM

Project Co shall ensure that the Facilities achieve as a minimum a "Very Good" rating when assessed against BREEAM 2011 New Construction (SD5073).

Under the BREEAM 2011 New Construction (SD5073) there are now mandatory requirements specifically under energy, CO2 emissions, water and ecology. In addition, BREEAM embraces energy efficiency and passive design strategies for ventilation and thermal control to enhance internal comfort. The Facilities shall therefore also meet a BREEAM ENE1 target of 6 credits (excellent) in accordance with the BREEAM Scheme Document for New Construction (SD5073) Section 6.ENE1

BREEAM requires a design stage assessment, carried out and completed before construction starts on site, by Project Co. In addition a post construction review is required at completion carried out by Project Co. The post construction review assesses "as built" specifications and actual construction practice on site and shall maintain the 'Very Good' rating.

BREEAM Pre-assessment is in the Disclosed Data..

5.26 Energy Strategy

Project Co shall provide Facilities that achieve an optimum level of energy and utility conservation. Project Co shall:

a) Minimise internal areas requiring mechanical ventilation;

b) Minimise direct solar gain to avoid air conditioning/comfort cooling;

c) Maximise daylight factors in staff, patient and visitor areas;

d) Maximise utilisation of plant and systems;

e) Maximise control and flexibility of the installations; and

f) Ensure that the Facilities are designed and built to facilitate their operation in accordance with the Corporate Greencode.

Project Co shall provide Facilities that achieve a maximum water consumption target of 170,000 litres/bed/year and include measures that they propose to allow the Board to minimise consumption.

Project Co shall take due account of developments in Information and Medical Equipment Technology and any potential impact that this technology may have on the Energy Strategy for the buildings. Particular attention shall be paid to potential opportunities for heat gain within the Facilities provided due to the installation of additional or higher performance plant and equipment.

5.27 Fire Planning Strategy

Project Co shall demonstrate in the design for the Facilities a clear understanding of the policies and principles underlying fire safety in NHS premises.

In all cases the proposed fire strategy shall be fully co-ordinated and be agreed with the Scottish Fire and Rescue Service, The City of Edinburgh Council's Building Control Department and the Board's Fire Officer. Any proposals which deviate from the stated requirements of The Building (Scotland) Regulations 2004 and The Building (Scotland) Amendment Regulations 2011, SHTM 81 and SHTM 82, shall be supported by a specialist fire engineer's report which provides a clear understanding of the risks and protection measures to be included. Calculations and supporting information shall also be provided.

5.28 Storage of Gas Cylinders

Project Co shall ensure that all gas cylinders, whether they are connected to external supplies or not, are stored in accordance with SHTM 2023.

Signage must be sited and designed in accordance with the Health and Safety (Safety Signs and Signals) Regulations 1996, BS 5499-10:2006 Safety signs, including fire safety signs - Part 10: Code of practice for the use of safety signs, including fire safety signs and the Health and Safety at Work Act 1974.

5.29 Radiation Protection

Project Co shall be responsible for the design and build of clinical and support facilities where exposure to ionising radiation might occur. This includes the use of x-rays, CT scanners and gamma cameras, and radioactivity (both in the form of sealed and unsealed sources).

Areas where ionising radiation is used shall require the walls, ceilings, floors, doors and screens to act as radiation shields. The design of the Facilities shall be compatible with specialised operational procedures, employed by the Board in order to ensure the health and safety of staff, patients and the public in radiation areas.

Project Co shall comply with the requirements of the Board's Radiation Protection Advisor to ensure that the Facilities combined with the Board's working practices provide adequate radiation protection.

Project Co shall submit proposals for providing screening to rooms containing radiology or other equipment emitting ionising radiations. These must be submitted to the Board as Reviewable Design Data for review by the Boards (in particular the Board's Radiation Protection Adviser) in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

5.29.1 The Designing-in of Radiation Protection

Adequate restriction of the radiation exposure of patients, staff and the public cannot be achieved by considering in isolation either the design of the Facilities, or the working practices to be adopted within it. The inter-relationship of the design of the Facilities and systems of work will be crucial in determining whether or not procedures can be completed quickly and efficiently and thus with the minimum irradiation of staff. Accordingly Project Co shall comply with the requirements of the Board's Radiation Protection Advisor and the operational managers of the relevant services.

Dedicated x-ray rooms and other appropriate areas require the walls, ceilings, floors, doors and screens to be shielded.

X-ray rooms and other appropriate areas are controlled areas whenever an exposure is in progress. The usual practice is to use electrical signs that illuminate at the room entrances when an exposure is underway.

Diagnostic x-rays are taken in other areas, e.g. operating theatres. The workload and x-ray energies involved will determine the amount of shielding required.

5.29.2 Work with Radioactive Materials

Project Co shall make provision so that arrangements can be made to monitor waste prior to being removed for disposal and linen prior to being sent for laundering.

A combination of shielding and speed of operation is required to avoid causing high radiation exposures to patients, staff and others.

Unsealed-source therapy also leads to the production of solid items and waste contaminated with radioactivity (e.g. clothing, food remnants, linen etc). Some can be disposed of by disposal or by maceration. The rest will need to be stored by Project Co in a secure shielded store away, from clinical area, until the radioactivity decays to background levels.

5.29.3 Transport, Delivery & Collection of Radioactive Materials

The arrangements for delivery, collection and storage of radioactive materials need to guarantee the safety of the materials in transit at all times. Appropriately trained staff must be used for moving radioactive packages both within the Facilities and by road. This shall require provision of short term parking.

Project Co shall give consideration to establishment of designated routes for the frequent transport of radioactive sources.

5.30 Static Magnetic Field Protection

The siting and planning of facilities for the use on patients of magnetic resonance imaging (MRI) shall pay particular attention to the characteristics of the equipment required and the need to screen unwanted radio signals from interfering with the MRI equipment and conversely the signals arising from the MRI equipment interfering with equipment elsewhere.

In areas where it is proposed to install MRI equipment Project Co shall ensure that effective magnetic fringe field protection is provided around such areas in accordance with the equipment suppliers' recommendations. Project Co shall discuss and agree proposals as

Reviewable Design Data for review in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement for any such screening with the Board prior to the installation of the MRI equipment.

The design of the Facilities shall be compatible with the specialised operational procedures employed by the Board in order to ensure the health and safety of staff, patients and the public in areas where this type of equipment is to be installed.

Project Co shall ensure that adequate provision for the removal, and replacement, of the equipment is provided and Project Co shall be responsible for agreeing with the equipment supplier reinforced routes through the Facilities, suitably sized access panels in walls, suitable ceiling heights, corridor widths and door openings to facilitate equipment replacement.

The design of the Facilities internally and externally, the patient journey and the construction of the buildings shall recognise the hazards associated with the powerful magnetic fields generated by the imaging equipment.

5.31 Electromagnetic Interference Protection

The siting and planning of facilities for the use on patients of Electroencephalography (EEG) and Evoked Potential Recordings shall pay particular attention to the characteristics of the equipment required and the need to screen unwanted electromagnetic signals from interfering with the EEG and Evoked Potential Recordings equipment and conversely the signals arising from the EEG and Evoked Potential Recordings equipment interfering with equipment elsewhere. Project Co shall comply with the requirements of SHTM 06-01.

Areas where electromagnetic interference will occur shall require the walls, ceilings, floors, doors and screens to act as electromagnetic interference shields. Project Co shall submit proposals for providing screening to rooms containing (EEG) and Evoked Potential Recordings equipment or other equipment emitting electromagnetic interference. These must be submitted to the Board as Reviewable Design Data for approval in accordance with Schedule Part 8 Review Procedure.

The design of the Facilities shall be compatible with the specialised operational procedures employed by the Board in order to ensure the health and safety of staff, patients and the public in areas where this type of equipment is to be installed.

The design of the Facilities internally and externally, the patient journey and the construction of the buildings shall recognise the hazards associated with electromagnetic signals generated by the EEG and Evoked Potential Recordings equipment.

5.32 Facilities Maintenance

The Project Co shall provide Facilities that ensure that the maintenance and replacement of services, finishes, components, elements, systems, furniture and equipment can be carried out effectively within the requirements of clinical operations and functionality.

Project Co shall ensure that the access routes within the buildings shall allow access for the appropriate maintenance / cleaning system, and equipment utilising the hierarchy of control measures included within the Work at Height Regulations 2005 as amended. Appropriate provisions shall be incorporated by Project Co to allow the safe use of the appropriate maintenance / cleaning system including but not limited to safe access to the workplace and equipment. The structural frame, floors and internal walls of the buildings shall be designed

by Project Co to accommodate the loading requirements of access equipment and operatives, where the cleaning and maintenance system uses this method.

5.33 Pest Control

Project Co shall incorporate pest control measures and measures to prevent pest entry to the Facilities.

6 Civil & Structural Engineering Requirements

Project Co shall in carrying out the Works comply with the following non-exhaustive list of civil & structural engineering requirements.

Project Co shall take cognisance of all the civil engineering and structural implications of the requirements described in the Board's Construction Requirements in this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements).

For the avoidance of doubt the hierarchy of standards and advice detailed in paragraph 2.5 shall apply to this paragraph 6.

6.1 General Requirements

Project Co shall ensure that the design and construction of the civil and structural engineering elements of the buildings and external works meets the following criteria:

a) Be fit for their intended purpose;

b) Be fully co-ordinated with the design of the building fabric, finishes, services, facades, internal walls, medical equipment and existing Site features, including buildings / structures;

c) Include the design and construction of any secondary framing necessary for the support of plant, services, ceiling mounted tracking hoist systems, other lifting equipment or medical equipment;

d) Provide adequate space for the distribution of services, while maintaining the required finished floor levels and the floor to ceiling heights called for in the Room Data Sheets, and elsewhere in this Schedule Part 6 Section 3 Sub-Section C;

e) Maximise the clear zone above the ceilings for services to the degree consistent with overall economy for the Board;

f) Provide fire resistance required by the appropriate SHTM and HTM, and the requirements of the Scottish Technical Standards;

g) Be economically adaptable to meet changing clinical needs; and

h) Require minimum maintenance and be designed to accommodate maintenance requirements for services, equipment and building fabric.

6.1.1 Sewers under the Site

Project Co requires to be aware of the Sewers serving the RIE Facilities and other neighbouring properties on and off the Campus Site part of which Sewers are located within part of the Site as shown coloured green in drawing numberAS/209592/X(52)X/01P1 entitled

"Zone For Diverted Scottish Sewers to South of Site" which forms part of the Disclosed Data, and Project Co shall ensure that:

a) No buildings or other erections are to be constructed nor any trees, shrubs, bushes or other plants or vegetation planted, grown, cultivated or permitted to grow over the route of the Sewer or within a lateral distance measuring from the centre line thereof which are likely to adversely affect the Sewer or would impair safe and reasonable access thereto (which shall be not less than 6 metres);

b) No underground works will be undertaken within a lateral distance measuring from the centre line thereof which may adversely affect the Sewer or would impair safe and reasonable access thereto (which shall be not less than 6 metres).

c) Access shall be provided at all times to the Board and any Board Party and Consort and any Consort Party to the extent required to maintain, repair and renew the Sewer and in accordance with the requirements in Clause 9 (Nature of Land Interests) of the Project Agreement (as varied, amended or supplemented from time to time in accordance with the Project Agreement; and

d) Project Co shall be fully responsible for the consequences of failing to comply with these requirements and the losses which may be suffered or incurred by the Board and/or any Board Party and/or Consort and/or any Consort Party as a result of any act or omission of Project Co and/or a Project Co Party exercising any of the rights and/or performing any of its obligations and/or failing to do so and the provisions of Clause [49.1.6] of the Project Agreement shall apply.

6.1.2 Gas Pipe under the Site

Project Co requires to be aware of the possibility of the gas pipe serving the RIE Facilities part of which may be located within part of the Site and Project Co shall ensure that:

a. No buildings or other erections are to be constructed nor any trees, shrubs, bushes or other plants or vegetation planted, grown, cultivated or permitted to grow over the route of such service media or within a lateral distance measuring from the centre line thereof which are likely to adversely affect the service media or would impair safe and reasonable access thereto (which shall be not less than 6 metres);

b. The provisions of paragraph (a) above shall also apply to any service media being located within a lateral distance of 15 metres from the gas pipe measuring from the centre line thereof;

c. Access shall be provided at all times to the Board and any Board Party and Consort and any Consort Party to the extent required to maintain, repair and renew the gas pipe and in accordance with the requirements in Clause 9 (Nature of Land Interests) of the Project Agreement (as varied, amended or supplemented from time to time in accordance with the Project Agreement; and

d. Project Co shall be fully responsible for the consequences of failing to comply with these requirements and the losses which may be suffered or incurred by the Board and/or any Board Party and/or Consort and/or any Consort Party as a result of any act or omission of Project Co and/or a Project Co Party exercising any of the rights and/or performing any of its obligations and/or failing to do so and the provisions of Clause [49.1.6] (Indemnities) of the Project Agreement shall apply.

6.2 Architectural / Structural Interface

Structural floors shall be designed to have penetrable zones co-ordinated with the modular framework for partitions and services.

For the avoidance of doubt, structural timber floors shall not be permitted.

Columns shall be located in-so-far, as is reasonably practical to coincide with corridor walls in order to minimise intrusion into rooms or corridors. The relationship of columns, ducts and walls shall permit clear internal room surfaces and not obstruct equipment or fittings.

As far as practical, the walls to vertical service shafts shall be non-load bearing and therefore maximising opportunity for future services installation, alteration and maintenance.

The elevation design shall facilitate distribution of services at the building perimeter.

6.3 Performance Standards

Unless otherwise agreed with the Board, Project Co shall ensure that all structural elements are designed in accordance with current revisions of the following standards:

a) Eurocode 0 – BS EN 1990:2002 – Basis of structural design;

b) Eurocode 1 Series – BS EN 1991 Actions on structures;

c) Eurocode 2 Series – BS EN 1992 Design of concrete structures;

d) Eurocode 3 Series – BS EN 1993 Design of steel structures;

e) Eurocode 4 Series – BS EN 1994 Design of composite steel and concrete structures;

f) Eurocode 5 Series – BS EN 1995 Design of timber structures;

g) Eurocode 6 Series – BS EN 1996 Design of masonry structures;

h) Eurocode 7 Series – BS EN 1997 Geotechnical design;

i) Eurocode 8 Series – BS EN 1998 Design of structures for earthquake resistance;

j) Eurocode 9 Series – BS EN 1999 Design of aluminium structures;

k) BS 8500-1:2006 – Concrete: Complementary British Standard to BS EN 206-1. Part 1 Method of specifying and guidance for the specifier;

l) BS 8500-2:2006 – Concrete: Complementary British Standard to BS EN 206-1. Part 2 Specification for constituent materials and concrete;

m) BS 8102:2009 – Code of practice for protection of below ground structures against water from the ground;

n) BS 8204 – Screeds, bases and in-situ floorings;

o) BS 5606:1990 – Guide to accuracy in building; and

p) BS 8000 – Workmanship on building sites.

Note: Eurocodes 0 to 9 – Corresponding National Annexes shall be used where applicable for Nationally Determined Parameters (NDP).

Construction tolerances, unless otherwise stated by the Board shall be no greater than those specified in Tables 1 and 2 of BS 5606. Where the operational constraints of the buildings require special levels of construction accuracy then Project Co shall be responsible for establishing and designing for these.

The performance of components shall be in accordance with the appropriate British Standards and Eurocodes.

Project Co shall ensure that building structures are designed to resist imposed, roof and wind loads not less than those required by current revisions of Eurocode 1 Series – Actions on structures. Project Co shall ensure that building structures are designed to carry the loads of heavy plant, the helipad and helicopters and medical equipment (including ceiling mounted tracking hoist systems) in their permanent positions and any loads that will be imposed upon the structures during the installation, removal or replacement of such heavy items. This requirement may involve the design of 'strong routes' through the buildings and / or specially strengthened areas of the roof onto which heavy items can be lifted. These areas and routes shall be identified by Project Co in their design as Reviewable Design Data for review in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement for agreement by the Board. Consideration by Project Co shall also be given to selection of floor screeds which shall have adequate strength and resilience to resist abrasion and indentation from the use of medical equipment.

Project Co shall ensure that any measures considered necessary shall be taken to protect the buildings from ingress of naturally occurring ground gases.

6.4 Loadings & Structural Flexibility

The Facilities' structural flexibility shall reflect the overall Adaptability Strategy designed by Project Co. Despite any connection to the RIE Facilities the Facilities are to be free standing and must not rely on any other buildings outwith the Site for support.

Project Co's structures shall be designed to cater for the dead loadings associated with the chosen materials for the structure, finishes, partitions and cladding to the buildings. As a minimum, it shall also be designed for the imposed loads as specified in current British Standards and Eurocodes. The design shall also take into account the need for specialist measures to allow for the installation of special equipment and associated services. Structural deflections shall be limited as necessary for the proper installation and functioning of specified equipment.

Project Co shall account for (but not be limited to) the following loading schedule:

a) General floor loadings;

b) Point loads for Clinical equipment and Services;

c) Impact loads;

d) Vibration loads;

e) Special plant foundation loads; and

f) Service loads.

Project Co shall take account of concentrated point loads from both mobile and stationary plant and equipment. The structure shall incorporate reasonable measures to accommodate updated versions of such machinery without major disruption. In addition, Project Co shall ensure that floors and supporting structures have the capacity for retro fitting lifting devices for all fixed items of plant and equipment weighing 35kg or more.

The Room Data Sheets have indicative details on anticipated items of heavy equipment.

For the avoidance of doubt, the Board recognise that no upper limit has been identified and this information will be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement on a departmental / unit / area basis.

Project Co shall take cognisance of the requirements in specified areas for ceiling mounted tracking hoist systems etc with point loads ranging from 375 kg to 750 kg. The structural capability and configuration of these areas shall allow the Board complete flexibility for re-configuration and extension of this equipment and / or retro-fitting of future lifting equipment in these areas.

Project Co shall take account of the need for special screeds, raised or lowered floors, ceiling grid support grids and other such measures to allow for the installation of special equipment and associated services.

Project Co shall ensure that specific areas of the Facilities satisfy particular requirements of the Board's operations or equipment in those areas. Relevant constraints may include but are not limited to maximum allowable structural deflections, differential settlement, vibration and the meeting of any specific tolerances. Project Co shall be responsible for establishing and resolving and seeking approval of any such constraints by submitting details to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

Project Co shall take account of dynamic loads from general movement of people through to activities such as aerobics, dance or other rhythmic activities that can give rise to adverse harmonic effects that affect the design.

Lateral stability bracing systems shall not obstruct or hinder clinical or non-clinical or any other use and/or operations at the Facilities and without limitation shall not obscure the windows or doors.

The vibration response of the buildings shall comply with the requirements of SHTM 08-01 Acoustics and be compatible with the requirements of the equipment to be installed.

With respect to the Facilities, Project Co shall:

a) Take due account of future flexibility of the Facilities (in terms of future change of use and / or relocation of equipment);

b) Specifically make allowance for future flexibility of ceiling mounted tracking hoist equipment in specified areas, including the requirement for re-configuration, extension and / or retro-fitting of lifting equipment i.e. the whole of the specified area shall be structurally capable of accommodating hoist equipment;

c) Make specific allowance for items of particularly heavy equipment and / or other onerous loading conditions; and

d) Make specific allowance for installation, transfer and / or removal routes for heavy equipment throughout the Facilities.

Parts of the structure potentially subject to damage from trolleys or vehicles shall be designed with adequate protection to prevent such damage from occurring.

Structural deflections shall be limited as necessary for the proper installation and functioning of special mobile, rail mounted, or fixed equipment.

Project Co shall include, within the design, provision for removal, replacement and upgrading of installed plant and equipment. As part of this element of design, a comprehensive replacement strategy shall be prepared for implementation. This strategy shall, wherever possible, consider how these works can be undertaken whilst minimizing disruption to the function of the completed Facilities.

6.5 Foundations & Sub-structure

All foundations shall be designed by Project Co to Eurocodes to comply with current Codes of Practice taking into account the loadings to be sustained, prevailing ground conditions and the effects of any settlement on new superstructure and on links to adjacent buildings. Proposed solutions shall take account of adjacent foundations or structures and engineering services below ground. Despite any connection to the RIE Facilities the Facilities are to be free standing and must not rely on any other buildings outwith the Site for support.

6.6 Movement Joints

Structural movement joints shall not be located through:

a) Theatre rooms;

b) Treatment and surgery rooms;

c) X-ray and imaging rooms;

d) Pharmacy manufacturing rooms;

e) Kitchens and food preparation areas;

f) Any room with (now or in the future) with ceiling mounted tracking hoists or other similar lifting equipment;

g) Any other room requiring a sterile environment; and

h) Any rooms where there is a risk of biological or other hazard, or risk of penetration by water, grease / oil, or other hazardous or detrimental substance.

Lateral stability bracing systems shall not obstruct or hinder clinical or non-clinical operations and shall not obscure the windows or doors.

6.7 Building Super-Structure & Envelope

Vertical, oblique and lateral loadings from the external walls must be safely transmitted through the structure to the load bearing strata. When under maximum design stress, joints shall maintain full water exclusion properties and design appearance. Despite any connection to the RIE Facilities, the Facilities are to be free standing and must not rely on any other buildings outwith the Site for support.

Project Co shall provide the means for replacing the x-ray equipment during the Operational Term through the external envelope of the rooms housing the x-ray equipment including intermediate support if the equipment is to be transferred into the building from the exterior at upper floors. The external structural solution for the replacement of x-ray equipment shall not adversely impact on architectural appearance of the Facilities. Project Co shall provide the means of replacing the x-ray equipment to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

In addition to providing safe, aesthetically pleasing and durable structures, the structural design must enable the required clear spaces to be achieved with adequate provision of services taking into account maintenance and replacement during the operational life of the buildings. The design must consider construction methods and future maintenance and demolition of the structures and make provision for these to be carried out safely.

The environmental criteria to be applied in confirming the design performance shall be assessed and confirmed by Project Co. Formal testing of elements of the construction by a recognised testing authority will be required as part of the approval process.

6.8 Fire & Corrosion Protection

Project Co shall provide fire protection to all elements of structure and ensure fire ratings are in compliance with space use and the more onerous of Scottish Technical Standards / the Board's requirements. When the more onerous requirement is to be used the Board will have the right to decide what constitutes the more onerous requirement.

6.9 Durability & Maintainability

All elements of the structure shall be capable of withstanding potential deterioration due to weather, ground conditions, wear and tear, and accidental damage relevant to their location and environment.

Where the requirement for maintenance is less than the required life expectancy of the element(s) practical and realistic arrangements shall be designed into the construction of the Facilities to allow for any necessary repairs, replacements, and painting etc. to be carried out safely without compromising the operational activities within and around the Facilities.

6.10 Other Performance Requirements

Project Co shall ensure that all building elements and retaining structures shall incorporate appropriate means to resist the passage of dampness, both into the building structure and fabric, and into the accommodation, including the resistance to any hydrostatic pressure. Project Co shall ensure that all such construction shall be in accordance with the requirements of The Building (Scotland) Regulations 2004 and its amendments, BS 8102 and Code of Practice CP 102 for Protection of Buildings against Water from the Ground.

6.11 Drainage

Project Co shall design and provide separate foul and surface water drainage systems in accordance with the requirements of The Building (Scotland) Regulations 2004 and its amendments.

Project Co shall be responsible for liaising with Scottish Water to agree connection requirements to the surrounding public sewers and for compliance with relevant provisions of paragraph 4 and paragraph 6.1.1 as regards sewers.

Project Co shall provide, where necessary within the on-site drainage network any isolators, grease traps, retention traps, interceptor tanks and other such devices necessary to prevent the discharge of any potentially dangerous or otherwise contaminative materials to the public sewers.

Foul and surface water drainage shall be designed on separate systems and shall discharge into the existing systems, subject to necessary approvals and for compliance with relevant provisions of paragraph 4 as regards surface water drainage.

Surface water discharge shall be in accordance with the following requirements:

a) A SUDS system designed and constructed in accordance with the Regulations and the guidance contained in 'SUDS: Design Manual for Scotland and Northern Ireland';

b) Water Environment (Controlled Activities) (Scotland) Regulations 2005;

c) A public sewer provided under the Sewerage (Scotland) Act 1968 and amendments;

d) An outfall to a watercourse that complies with any notice and / or consent by SEPA.

SUDS features shall be designed as an integral part of the landscaping.

The drainage systems shall be designed to require no regular maintenance other than the cleaning of gully traps etc. and access for maintenance shall be provided to all drainage runs.

All drainage shall be designed to avoid the risk of local flooding and flooding of the system into which they discharge and/or to properties and/or land served by such systems. Flooding of electrical equipment areas and areas where stray current leakage may occur in the presence of water shall be prevented.

Drainage shall be sufficient to ensure that no areas of standing water occur. The drainage systems shall be capable of coping with, as a minimum, the foul loading and the storm event specified by the relevant authority and shall be considered an integral part of the public sewerage system. The drainage system shall be capable of taking such detritus as may normally arise during the operation of the system and during normal and winter maintenance conditions and those within the design criteria of the relevant authority.

A free passage of air shall be maintained through the foul drainage system.

Flat roofed areas wherever possible shall be drained to eaves gutters. Where such roof is enclosed, without eaves, it shall be drained by a minimum of two grated roof outlets and rainwater pipes, which shall be designed to pass the design rate of run-off assuming one outlet or 33 per cent of the outlets are out of use, whichever is the greater number.

Project Co shall design the drainage system in such a way as to minimise the requirement for internal manholes.

Project Co shall construct the drainage installation such that it complies with the Initial Drainage Proposal and shall comply with relevant provisions of paragraph 4 as regards drainage installation.

7 External Works

Project Co shall design and construct an external works environment for the Facilities that fully integrate with the buildings.

Project Co shall design the external works for ease of navigation around the site by staff, patients and visitors.

Project Co shall appoint an appropriately qualified professional and prepare a comprehensive hard and soft landscaping scheme.

In preparing the hard and soft landscaping scheme for the external works, Project Co shall ensure that due account is taken of the Board's requirements with respect to the integration of artwork.

Project Co shall select external works materials on the basis of the following:

a) Accessibility;

b) Appropriateness;

c) Durability;

d) Robustness;

e) Compatibility;

f) Maintainability;

g) Suitability for life cycle replacement;

h) Co-ordination with other finishes; and

i) Suitability for infection control

j) Health and Safety attributes

k) Life Expectancy set in paragraph 5.1;

l) Easy of future maintenance;

m) Appearance.

In preparing the hard and soft landscaping scheme for the external works, Project Co shall ensure that due account is taken of the Board's requirements with respect to the integration of artwork.

Project Co shall carry out landscaping works outwith the Site boundary in the Yellow Area and Hatched Orange Areas in accordance with the relevant provisions of paragraph 4. All landscaping works shall be compatible with the adjacent parts of the external environment at the Retained Site.

Project Co shall seek advice from the Board to seek to minimise the risk of crime and vandalism on the Facilities. This advice shall be pro-actively sought by Project Co as part of the design process.

Project Co shall seek advice from Lothian and Borders Police's crime prevention representative on the proposals for external works to minimise the risk of crime and vandalism on the Site and the Facilities.

Where possible, Project Co shall ensure that external surfaces allow easy cleaning of vandalised elements, with the minimum of effort.

Project Co shall provide the following principal elements:

7.1 Soft Landscaping Requirements

Project Co shall design, as an integral part of the Facilities, a soft landscaping scheme that will enhance the environment of the Facilities.

The soft landscaping shall be easy to maintain, and plants and shrubs shall reach a state of maturity within three years of Actual Completion Date.

The design of landscaping and selection of plants and shrubs shall aid the reduction in risk of crime.

Project Co shall ensure that the landscaping and gardens are designed in accordance with the following:

7.1.1 General

Project Co shall involve the Board in the decision making process for all proposed planting for the Facilities details of which shall be submitted to the Board as Reviewable Design Data for review by the Board in accordance with paragraph 1.2.3 of Schedule Part 8 (Review Procedure), Table of Finishes and clause 12.6 of the Project Agreement.

Project Co shall carry out accurate site surveys prior to design of soft landscape to determine site levels and identify on survey drawings all existing features including any existing mature trees.

Project Co shall by reference to their own ground investigation data; confirm the need for imported topsoil or whether amelioration of existing soil is sufficient to support their soft landscaping proposals. Project Co shall then provide new or utilise existing soils, as appropriate.

Project Co shall carry out any necessary remedial measures to suit planted areas and hard landscaped areas.

7.1.2 Soil Preparation & Topsoil

Soil preparation shall be carried out by Project Co in accordance with BS 4428:1989, Code of practice for general landscape operations (excluding hard surfaces). Project Co shall ensure care is taken with the use of weed-killers. Project Co shall ensure that all topsoil complies with BS 3882:2007, Specification for topsoil and requirements for use.

7.1.3 Trees

Project Co shall ensure that any work to existing trees, whether or not covered by Tree Preservation Orders, shall only be undertaken with the appropriate licence as stipulated by the Tree Preservation Order or with the approval of The City of Edinburgh Council.

Project Co shall ensure that tree protection complies with BS 5837:2012, Trees in relation to design, demolition and construction - Recommendations. A register of the existing trees shall be made including giving each tree a unique number. Before construction commences Project Co shall take photographic records of the existing trees on and adjacent to the Site. The photographs shall record the trees' unique number. A site plan shall record the position of the existing trees noting their unique number.

7.1.4 Shrubs & Groundcover

Project Co shall ensure that all shrubs shall comply with BS 3936 Part 1:1992, and shall be planted to BS 4043: 1989.

Project Co shall ensure that shrub and groundcover protection complies with BS 5837:2012, Trees in relation to design, demolition and construction - Recommendations. A register of the existing shrubs and groundcover shall be made including giving each shrub and area of groundcover a unique number. Before construction commences Project Co shall take photographic records of the existing shrubs and areas of groundcover on and adjacent to the Site. The photographs shall record the shrubs and areas of groundcover's unique number. A site plan shall record the position of the existing shrubs and areas of groundcover noting their unique number.

7.1.5 Planting & Watering

Project Co shall ensure that planting and watering is carried out while soil and weather conditions are suitable for relevant operations.

7.1.6 Turf

Project Co shall ensure that turf is in accordance with BS 3969:1998, Recommendations for Turf for general purposes. Turf shall be free from undesirable grasses and weeds.

Project Co shall avoid grass in courtyards, unless the courtyard is very large. If provided Project Co must ensure there is a suitable, sufficiently wide access away from occupied areas for bringing mowing machinery to the turfed areas.

7.1.7 Health & Safety Considerations

Project Co shall ensure that all weed-killer / pesticides and herbicides and any other chemicals used in association with the landscape works preparation comply with SEPA regulations, the COSHH Regulations, and any other relevant regulations applying to hospital sites.

7.2 Therapy Gardens

The landscaping and therapy gardens provide an opportunity to soften the whole image of the Facilities by a visual presentation of quality and sensitivity that relates to pleasure and emotion rather than the essential clinical impressions that will inevitably be gained by users and visitors.

The gardens shall be easily accessible from the units / departments. It shall be secure and provide space for therapy and privacy. The needs of the patients will be varied and descriptions of their needs can be found in the Board's Construction Requirements in this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements) for the individual departments / units.

Certain parts of the therapy gardens shall be open for general use; other parts shall be private for use by specific patient groups.

The therapy gardens shall be available 24/7, 365 days a year. Attention shall be paid to the lighting of the gardens to allow use after dark and to enable the gardens to be enjoyed in the evenings when viewed from inside the building. Attention shall also be paid to providing covered / heated areas to allow the external environment to be enjoyed in different weather conditions.

All paved areas shall be wheelchair accessible and constructed using non-slip materials. Handrails shall be provided at intervals to allow ambulant disabled people equal access to the gardens. There shall be a number of paved areas thus allowing a number of 'walks' throughout the garden areas, away from the road network and car parks. Kerbs to the paved areas are necessary to avoid the risks of wheelchairs becoming stuck in soft earth.

Seating shall be provided throughout the garden areas. This shall be of a range of styles and heights so that it suits the needs of all service users. Protection from wind and some covered areas shall be provided throughout the garden(s).

7.3 Site Boundary Requirements

No work shall commence on Site until the details of the proposed boundary treatment have been submitted to and approved by The City of Edinburgh Council.

Project Co shall provide boundaries to the Facilities, which provide security, appropriate visual screening and essential maintenance access. Project Co shall engage the Board in the design process for all boundaries details of which are to be submitted to the Board as Reviewable Design Data for review by the Board in accordance with paragraph 1.2.3 of Schedule Part 8 (Review Procedure), Table of Finishes and clause 12.6 of the Project Agreement.

Where appropriate, proposals for the Site boundary treatment shall comply with the relevant parts of BS1722: Fencing.

7.4 Site Access & Circulation

Always subject to complying with the relevant provisions of paragraph 4 and Clause 9 (Nature of Land Interests of the Project Agreement as regards access for pedestrian and vehicular access on and around the Campus Site, the entrances and exits to the Facilities shall be clearly defined and signed; their design shall enhance ease of movement from and to the public roads. The road system shall be designed to facilitate safe, convenient routes

separating transportation groups as far as practical. Attention is to be given to provide clear and well defined routes for emergency vehicles, fire, police and ambulance. The requirements of the Firecode in relation to 'Site Access' shall be considered.

All of the access requirements shall satisfy the requirements of the Board and The City of Edinburgh Council.

Project Co shall define as Reviewable Design Data for review and agreement by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement and seek agreement of The City of Edinburgh Council for the creation of additional pedestrian and / or emergency road access points to suit the specific requirements of the final design.

The colour of the road surfaces shall be black and all footpaths shall satisfy the requirements of the Board details of which are to be provided as Reviewable Design Data for review and agreement by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement, and the requirements of The City of Edinburgh Council.

Project Co shall also provide suitably robust signage for easy site navigation during construction and operational phases.

7.5 Roads, Footpaths, Cycleways & Car Parking

Project Co shall ensure the following as a minimum:

a) Parking for vehicles is to be as close as possible to relevant parts of the Facilities served and the diminishing of the visual impact of parking by appropriate planting shall not impinge on individual parking places;

b) Direct routes from parking areas to the building entrances are provided; and

c) Appropriate and secure cycle storage.

Project Co shall provide as a minimum a network of private roadways on the Site and at the Campus Site providing access to:

a) Car parking;

b) The delivery entrance(s) to the Facilities, waste compounds and service infrastructure; and

c) A taxi / car / ambulance drop off and layover bay.

Project Co shall ensure that all roads, delivery and refuse collection areas have sufficient headroom above them to allow for the passage of appropriate delivery and refuse collection vehicles and are designed to provide sufficient space to allow efficient manoeuvring of such vehicles without undue difficulty, risk of impact or adverse effect of exhaust fumes on occupants of the buildings. Project Co shall ensure that all roads, car parks and other areas that may be used by fire fighting appliances shall have sufficient headroom for such vehicles equipped with fire fighting appliances and are designed to allow their efficient manoeuvring. Project Co shall submit details of the types of delivery vehicles which require to be considered in the design to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

Where areas of car parks are required to be traversed by vehicles heavier than 2500kg for maintenance or access purposes, the sub-base, base and surfacing of these areas shall be specifically designed by Project Co for these heavier loads.

Roads, delivery and refuse collection areas, and car parks, together with their supporting groundworks and structures, shall be designed by Project Co to provide full and sufficient access for inspection, maintenance and repair of roads, car parks, delivery and refuse collection areas, structures, underground and underground drainage and sewerage, including existing drainage items such as manhole covers and drains and sewers. Where access for maintenance, repair or replacement of underground services is required under the terms of an easement, the design of all elements affecting the exercise of such an easement or servitude shall also be in accordance with the requirements of the party that has the right to exercise the servitude or easement. See also drainage requirements detailed at paragraphs 4, 6.1.1, 6.11, 8.7.20 and 10.3 of this Sub-Section C.

Project Co shall also comply with the following criteria:

a) Finish: to be macadam, hot rolled asphalt or, if approved by the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement, block paving. Project Co shall provide a black finish to roads, green finish to cycle routes and a red finish to pedestrian routes (subject to agreement with The City of Edinburgh Council);

b) Kerbs: to comply as a minimum standard with BS.1339:2003 “Concrete paving flags - Requirements and test methods”. Dropped, flush, kerbs shall be provided at all pedestrian crossing locations;

c) Pedestrian crossings: details of types, locations, lighting and controls shall be Reviewable Design Data for review and agreement by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement;

d) Markings: to The Traffic Signs Regulations and General Directions 2002 and all Chapters of The Traffic Signs Manual and details of such shall be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement;

e) Gradients: All gradients shall comply with the provisions of The Building (Scotland) Regulations 2004 and its amendments as applicable. No gradient in excess of 1:20 shall be allowed in parking areas (other than access roadways), and 1:15 on pedestrian staff, patient and visitor access paths from parking areas to the building entrances; and

f) Parking bays: comply with the SHFN 20, HFN 21 and the item on gradients above. Variation from the standard (to make optimum use of the space for example) may be desirable and Project Co shall submit details to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

Designs shall cater for the access and parking needs of pedestrians and the physically disadvantaged. This shall involve catering for visitors and staff using different modes of transport in adapted vehicles and with multiple aids / equipment.

Accessible parking bays shall incorporate a minimum additional 1.2m section to the end of each bay. This is to allow tailgate access by disabled people without the need to set down ramps or lifts within the main circulation routes of car parks. The first and last accessible parking bays in a row of ‘in line’ spaces shall be provided with a minimum clear area of 1.2m to both sides.

Parking for the transport requirements of deliveries and waste disposal, ambulances, fire appliances and other specialist and emergency vehicles shall be segregated from public and staff parking.

Car parking provision shall take into account the following requirements:

a) Drop off points;

b) Dedicated parking for those with disabilities, the elderly and those with small children located close to the clinical areas, especially for those with limited mobility and eyesight;

c) Automated controlled entry / egress barrier arms to service vehicles access defined in paragraph 3.8.6 of this Sub-Section C, emergency department parking defined in paragraph 3.9.2 of this Sub-Section C, RHSC Disabled Parent and Child Parking and DCN Disabled Parking defined in paragraph 3.9.3 of this Sub-Section C shall be installed by Project Co. Care shall be taken that the location and design of the control mechanism has sufficient capacity to cope with peak flows and that there shall be clearly defined instructions. The controlled barrier to the proximity parking shall be provided with a height gauge to prevent unwanted high-sided vehicles from entering and shall be well lit at all times;

d) Appropriate parking for on-call clinical night staff as near as practical to the controlled night entrance(s) for staff; and

e) Project Co shall design and provide appropriate signage external to the Facilities to ensure ease of navigation around the Site.

7.6 Hard Landscaping Requirements

Project Co shall incorporate into the Facilities all associated hard landscaping for the Site, including but not limited to the following;

a) Access and hardstanding for emergency and delivery vehicles;

b) Access for building maintenance and window cleaning;

c) Access and circulation for, visitors and patients both on foot, bicycles, in cars or on public transport;

d) Parking for vehicles and bicycles including disabled facilities;

e) Drop-off facilities including lay-bys and bus/transport stops;

f) Service areas, as appropriate;

g) Accommodation for building services plant, waste and materials management, as appropriate;

h) Amenity areas for staff, patients and visitors;

i) Suitable pathways and paving;

j) Protection against noise and environmental pollution;

k) Security provisions, as appropriate;

l) Appropriate Site boundary treatment;

m) Walls, fencing, gates / barriers and hedgerows as appropriate along the Site Boundary and at particular locations inside the Site;

n) CCTV surveillance of the building perimeter, to all car parks, pedestrian routes, therapy gardens, courtyards, roof terraces, external play areas and helipad;

o) External lighting;

p) Suitable means of shelter against adverse weather conditions at entrances, bus / transport waiting, and drop off locations and covered links provided, as appropriate;

q) Automatic vehicle access barriers, as appropriate; and

r) Fire hydrants.

All hardstanding, Site roads, paths, car parks, cycleways, and footpaths etc shall be designed and constructed so as to be free from standing water.

8 Mechanical & Electrical Engineering Requirements

Project Co shall provide the Works to comply with the Environmental Matrix.

Project Co shall in carrying out the Works comply with the following non-exhaustive list of mechanical & electrical requirements.

Project Co shall provide mechanical and electrical systems that help create a “state-of-the-art” building with innovative design. Project Co shall provide an engineering system that utilises the latest technology to create a high quality working environment that will provide a reassuring, enjoyable and convenient hospital for all patients, their families, visitors and staff. Project Co shall ensure the services network is efficient, effective, flexible and unobtrusive. Project Co shall ensure that the system is easy to maintain and shall maximise the opportunities for flexible adaptation and extension of the Facilities.

Electrical, mechanical and communication services shall be designed to be an integral and co-ordinated part of the design. Services shall be clearly identified at regular intervals and at all locations where maintenance access is required.

The location of engineering and utility services shall be co-ordinated with the structure and not constrain or conflict with Operational Functionality. Access to all services shall facilitate ease of maintenance which shall be safe and able to be effectively undertaken. There shall be provision for space to give flexibility for future re-planning and / or re-modelling of the Facilities.

The Board requires the buildings to be designed to achieve an optimum level of autonomy along with energy and utility utilisation. The energy centre shall be for the sole use of the Facilities. The services provided from the energy centre shall be provided from sources solely on the Site.

Project Co shall take cognisance of all the building services implications of the requirements described in the Board’s Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements).

For the avoidance of doubt the hierarchy of standards and advice detailed in paragraph 2.5 shall apply to this paragraph 8.

8.1 Minimum Engineering Standards

In addition to the publications in paragraph 2 of this Sub-Section C Project Wide Requirement, Project Co shall ensure that the design, construction and selection of components for the mechanical and electrical works comply with, including but not limited to, the following design reference documents :

a) NHS Scotland Firecode;
b) All current relevant legislation and Codes of Practice by CIBSE;
c) All current relevant legislation by HVAC;
d) All current relevant British Standards;
e) European Harmonised Standard Specifications and Codes of Practice;
f) ACS Accreditation (formerly CORGI Regulations);
g) Gas Safety Regulations;
h) The Management, Design and Operation of Microbiological Containment laboratories. HSE 2001
i) Biological Agents: Managing the Risks in Laboratories and Health Care Premises HSE 2005
j) Biological Agents: The Principles, Design and Operation of Containment Level 4 Facilities.
k) Water Research Centre Codes;
l) The Water Supply (Water Quality) (Scotland) Regulations 2010;
m) Electricity at Work Regulations1989;
n) BS 7671:2008) (IEE Wiring Regulations);
o) The control of legionella bacteria in water systems approved Code of Practice;
p) The Electrical Equipment (Safety) Regulations 1994; and
q) Electromagnetic Compatibility Regulations 2006.

The design of the environmental control system shall be co-ordinated and integrated with the design of the structure and the occupied areas as to maximise the control and flexibility of the Facilities.

The following is a non exhaustive list of SHTM's, HBN's and HTM's applicable to the Facilities:

a) SHTM 64: Building Components Series Sanitary Assemblies:
b) SHTM 2010 Parts 1 - 6: Sterilization;
c) SHTM 2023: Access and accommodation for engineering services;
d) SHTM 2030: Washer-disinfectors
e) SHTM 2031: Clean steam for sterilization
f) SHTM 2035: Mains signalling;
g) SHTM 02-01 Parts A and B: Medical gas pipeline systems
h) SHTM 03-01: Ventilation in Healthcare Premises;
i) SHTM 04-01 Parts A - G: The control of Legionella, hygiene, 'safe' hot water, cold water and drinking water systems;
j) SHTM 06-01: Electrical services supply and distribution;

k) SHTM 06-02: Electrical safety guidance for low voltage systems;

l) SHTM 06-03: Electrical safety guidance for high voltage systems;

m) SHTM 08-01: Specialist Services – Acoustics;

n) SHTM 08-02: Specialist Services – Lifts;

o) SHTM 08-03: Specialist Services - Bedhead Services;

p) SHTM 08-04: Pneumatic Tube Transport Systems;

q) SHTM 08-05: Parts A to D: Building Management Systems;

r) SHTM 08-06: Specialist Services - Pathology Laboratory Gas Systems;

s) HBN 00-07: Resilience Planning for Healthcare Establishments;

t) HTM 07-02: EnCO2de; and

u) HTM 07-03: Transport Management and Car Parking.

Project Co shall consider the requirement for ligature resistance fittings and fixings within the building services provision in appropriate areas (identified or otherwise in the Specific Clinical and Non-Clinical Requirements), and generally in keeping with Good Industry Practice.

8.2 Infection Control

Mechanical and Electrical equipment selections and designs shall take cognisance of HAI-SCRIBE in its entirety.

8.3 Engineering Services Interface with Building Fabric

Project Co shall ensure that co-ordination of the electrical, mechanical and communication services shall form an inherent part of the Facilities design.

Services provision, e.g. luminaires, fire alarms, and mechanical services, shall be co-ordinated with the ceiling layout and allow simple relocation if required.

Access to services shall be provided and the services clearly identified at regular intervals and at all locations where maintenance access is required, for example at valves and electricity connection points. Access to building services shall be in accordance with SHTM 2023: Access and accommodation for engineering services.

The positioning of sockets, light switches, alarm buttons and fire “break-glass” panels etc shall be consistently located throughout the Facilities and to specifications set out in BS8300 (unless specific clinical needs take precedence). The positions shall be detailed and shall be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

Structural design shall ensure that structures are co-ordinated to ensure the logical and sequential installation and maintenance of services. For example the use of columns adjacent to vertical service voids shall be minimised.

8.4 Unrestricted Access to Patients

Project Co shall take due consideration of the servicing strategy for highly serviced areas. This shall be inclusive of but not limited to bed areas where clinical staff require 360º free access. Project Co shall not gain access to services above beds for maintenance purposes

8.5 Performance Standards

8.5.1 Energy Performance Certificate

Project Co shall ensure that the Facilities shall operate to achieve an Energy Performance Certificate (EPC) rating of C or better.

Project Co shall provide and display the Energy Performance Certificate (EPC) for each building in the Facilities.

8.5.2 Thermal Comfort

Where maximum internal summer time temperature calculations indicate that the internal temperature will exceed those limits set out in the Environmental Matrix, Project Co shall provide means of reducing the temperature rise.

Measures shall be assessed, modelled and implemented to demonstrate that the internal air temperature of any room or area does not exceed the maximum acceptable level of 25°C for more than 50 hours per annum.

For any room or area that does not meet this criterion, there should be a hierarchy of remedial action to prevent the high temperature by passive means as a priority, adopting a suitable means of comfort cooling as a last resort.

8.5.3 Air Quality

i. Internal

Air quality in all areas shall take account of occupancy levels, internal pollutants, heat gains, external pollutants and atmospheric conditions and shall be controlled to provide adequate comfort and fresh air levels appropriate to the functions of each department area.

Particular attention shall be given to the risk of cross infection within the hospital / healthcare environment and shall be such as to minimise the spread of infection. Project Co shall demonstrate through submission of information to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement, how the proposals facilitate the control and management of an outbreak and spread of infectious diseases, and in particular shall comply with the requirements of SHTM 03-01 (Ventilation in Healthcare Premises). In order to reduce cross-contamination, the design of the Facilities shall incorporate 100% fresh air supply systems only.

Project Co's demonstration referred to above is to cover all aspects of the building, its services, spatial relationships, soft and hard FM proposals and incorporate requirements of the Board's Infection Control Team.

Project Co shall provide natural ventilation wherever possible, except where:

a) The level of outside noise is unacceptable;

b) Safety or security features must be provided;

c) Unpleasant smells are generated either inside or outside the building;

d) Where inflows of air are undesirable;

e) Clinical requirements, as detailed in the Room Data Sheets, do not allow in areas such as isolation rooms, where positive or negative pressure are required; and

f) Areas which are air-conditioned.

ii. External

a) The Project Co shall comply with the requirements of City of Edinburgh Council and other statutory bodies regarding airborne emissions from the Site and shall undertake all studies necessary to prove that emissions and their dispersal will not have any adverse impact on the local community or staff, patients and visitors to the Campus Site.

8.5.4 Vibration

Project Co shall ensure that building services plant and equipment are suitably isolated from the building structure in order to prevent the transmission of vibration. Project Co shall comply with the guidance on the satisfactory magnitude of building vibration with respect to human response given in BS 6472-1:2008 Guide to evaluation of human exposure to vibration in buildings Part 1 Vibration sources other than blasting. Project Co shall comply with the following vibration limits detailed below:

a) Plant rooms on occupied floors 0.015 m/s^2;

b) Plant rooms above and below occupied floor levels 0.050 m/s^2;

c) Remote plant rooms 0.100 m/s^2 ;

d) No structure borne vibration is perceptible within any nearby living apartment.

8.5.5 Acoustics

To allow the effective control of building services noise in the provision of a satisfactory acoustic environment Project Co shall satisfy the following criteria (with reference to British Standards and Minimum Health Planning Standards in particular SHTM 08-01 Acoustics.

a) Careful selection of plant and equipment;

b) Good installation;

c) Correct operation and maintenance;

d) Be such that any associated noise complies with NR25 when measured within any nearby living apartment.

8.6 Incoming Services

8.6.1 General

Project Co shall be responsible for the provision of all new utilities and the energy supply infrastructure to and from the Facilities (whether this is internal or external to the Site boundary), including:

a) Confirmation of the capacity of the proposed system;
b) Liaison with potential suppliers;
c) System development and planning;
d) Any supplies modifications to the periphery of the Site;
e) Any supplies modifications within the Site;
f) Metering and sub-metering of supplies;
g) Strategic planning;
h) Emergency systems; and
i) Power factor correction.

Project Co shall carry out the work outwith the Site boundary in accordance with the relevant provisions of paragraph 4.

8.6.2 Security of Incoming Supplies

Project Co shall provide back up to respond to the failure of the incoming supply of electricity, gas and water supplies to the Facilities.

In particular, Project Co shall provide 100% standby generator capacity for electrical services in accordance with the requirements and recommendations of SHTM 06-01. For the avoidance of doubt, Project Co shall also ensure that the Facilities are provided such that all the requirements detailed in SHTM 06-01 are satisfied.

Project Co shall ensure that energy, water, power supplies, medical gases and communication supplies to and within the Facilities are maintained by agreement with the utility suppliers, the Board, and where necessary by providing standby sources of supply (e.g. dual fuel boilers etc).

Project Co shall develop a strategy to ensure the security of the supply. Project Co shall be required to demonstrate the feasibility of the strategy to the satisfaction of the Board.

Project Co shall investigate adequacy, and provide the Board a report on location and number of connections of local town's water supply, gas and electrical supplies around and to the Site. Project Co shall ensure their town's water, gas, electrical and data/telecommunication connections to the Site maintains an adequate, autonomous and robust service and shall submit full connection details with the proposals.

The incoming gas supply shall be housed in a stand alone gas meter house of adequate size to accommodate the gas supply with gas meter, twin governor gas streams with associated valves and where each stream is sized to meet full Facilities capacity.

8.6.3 Provision for Isolation

Project Co shall ensure that all sections of the supply mains, whether supplying electricity, gas or fluids, can be taken out of service for maintenance without interrupting the supply to the Facilities or to any part of the Retained Estate and/or Retained Site.

Project Co shall provide external isolation of water supplies to the new Facilities. Local isolation of the water supply to all sanitary appliances, and at the final equipment connection points, shall also be provided.

8.7 Mechanical Systems

The Project Co shall design, supply, install, test, commission, operate and maintain all mechanical building services necessary to support the Clinical Services at the Facilities. The following systems are indicative of those anticipated by the Board but are not exhaustive and sole responsibility shall be Project Co's to determine all necessary systems are included.

Systems shall be design, supplied, installed, tested, commissioned, operated and maintained all in accordance with the regulations and standards.

8.7.1 Building Management Systems & Controls

Project Co shall provide a building management system (BMS) to be installed to allow easy, remote, monitoring of measured values and control set points. Communication with (and between controllers) will utilise the main hospital data network and therefore the data traffic between controllers and dependency on the network shall be minimised. There will not be a requirement for CCTV video or sound files to be transferred, via the network, and therefore it is not envisaged that a high data bandwidth will be needed. All BMS systems generally have the same functionality and therefore the choice of manufacturer shall be the responsibility of Project Co, but consideration should be given to existing systems that are currently on the network which are "Sigma" from Schneider Electric or "Desigo" from Siemens.

Should multiple BMS systems/suppliers be used Project Co shall require to fully integrate these into a single 'master' BMS system and to provide training to the Board in the areas required for 'read only' access.

Project Co shall ensure all plant can be operated in automatic mode (via a BMS) or manual mode should a corruption in BMS software occur. Furthermore, physical bypasses shall be provided where appropriate for maintaining service, for example at control valves.

Project Co shall install a new digital BMS that controls all mechanical systems. The BMS should not be considered as a "life & limb system" and should only control the mechanical systems but should interface to the other systems such as lighting. Monitoring of security, CCTV, lifts etc will only be of an information type and BMS will not be relied upon to deliver "life alarms". Also, future replacements of systems should be considered at this point and one system should not control everything. Systems do become obsolete (and manufacturers fail) and if one system were to be used for "everything" then all the system could be compromised and need changing at the same time. This would be a very costly exercise with multiple complications. If "interfaces" were to be used between separate systems the

problem of catastrophic failure is avoided with only one system compromised making it easier to manage during restoration of services.

It shall assist in minimising energy consumption. Project Co shall ensure that the Facilities have a hard-wired link between the BMS and fire alarm and other life safety systems to enable plant shutdown if required during fire situations as well as complying with the relevant provisions of paragraph 3 and 4 as regards fire, security, and CCTV. Project Co shall ensure that the BMS is capable of producing energy consumption reports to the Board's requirements. The Board shall have full access to all new graphics which shall be fully visible to the Board with 'read only' rights to the BMS. The BMS front-end shall be internet enabled to allow secure access from any internet based PC without the need for further licences.

Project Co only shall have control and adjustment of BMS settings.

The BMS system shall be designed, installed and commissioned in accordance with the manufacturers' instructions and industry best practise. The following documents shall also be taken into consideration:

a) Standard Specifications for BMS, AG 9/2001, BSRIA;

b) Library of system control strategies, AG 7/98, BSRIA;

c) Automatic control, CIBSE Commissioning Code C: 2001;

d) Specifying building management systems, TN 6/98, BSRIA; and

e) SHTM 08-05.

The Board controls philosophy is to provide a safe, healthy and comfortable environmental condition in the Facilities, whilst focusing on energy conservation measures. Project Co shall ensure that the controls effectively deliver the requirements of the Board. Project Co shall adopt Good Industry Practice in the application of BMS controls.

Project Co shall ensure that an energy and life cycle cost conscious approach is adopted for all stages of the BMS. Project Co shall ensure that this includes the initial design of a system through to final commissioning; the planned maintenance; and the servicing of the plant.

Project Co shall ensure that the programming of the outstations shall be carried out in a consistent, structured manner. Project Co shall ensure that strategies shall be kept as simple and as uniform as possible. Project Co shall ensure that the BMS incorporates the following non-exhaustive list of full functionality and monitoring points;

a) The control and timing of heating, cooling and ventilation plant to ensure optimum energy and environmental performance, including multiple temperature zone controls, zone valves and individual area and room temperature sensors.

b) Optimum start of heating, cooling and ventilation plant to minimise the operational costs of achieving desired values by occupation time.

c) Optimum stop of heating, cooling and ventilation plant to minimise the operational costs of running plant during the required occupancy period.

d) Facility to program night set back set points for individual areas, individual optimisers, individual time schedules and areas that require heating continuously but not consistently.

e) Protection for the mechanical plant and building fabric during external frost conditions.

f) Protection for the building fabric, from condensation, when the mechanical plant is timed off.

g) Protection for the mechanical plant and building fabric during severe external air low temperatures.

h) Provision to automatically shut off heating plant when the external air temperature has risen above a pre-determined set value. The plant will automatically restore normal operation when the external air temperature falls to below a separate pre-determined value.

i) Weather compensation of any heating circuit dependant on external air temperature. This compensated set value will be accessible for easy adjustment.

j) Weather compensated heating circuits will also have room temperature influence to raise (and lower) the calculated set point with reference to a room temperature set point.

k) Where dual plant has been installed this shall be able to be automatically duty cycled by the BMS on a weekly or hours-run basis. Failure of the duty plant shall notify the system and automatically (after a short period of time) bring on the standby plant.

l) All ventilation plant and air handling units shall be individually monitored and controlled through the BMS.

m) All extract fans shall be individually timeclock controlled and monitored through the BMS.

n) Representative graphic slides will be required for all the controlled plant on the system. A hierarchical structure shall be adopted that allows other relative slides to be directly accessed from the current slide. These slides shall match the standard slides for the respective existing systems details of which shall be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

o) The system shall automatically flag-up alarms for remote interrogation. Essential critical alarms shall be also routed via SMS texts to an out-of-hours “on call” mobile phone. Great care shall be given to selection of the alarms that are deemed to be essential critical alarms.

p) The current state of plant, temperatures, set-values etc shall be accessible from a simple, intuitive index tree structure on the BMS “front-end” interface.

q) Application of energy metering, via the BMS, will allow Renewable Heat Incentive and energy saving schemes and to be implemented. This will require heat meters to be installed on each plate heat exchanger and heating circuit and connected into the BMS via MODBUS type interface. These meters may be used for fiscal purposes and would assist in providing information as to energy use.

r) The BMS shall monitor but not control the fire alarm system. The fire alarm system shall be hard-wired to the heating/ventilation plant to switch the plant off when required. The BMS input from the fire alarm system would mirror the action of the fire alarm hard-wired connection to also switch the plant off to prevent nuisance alarms from being generated.

s) The BMS shall monitor the control circuit state within each control panel and on failure of the control circuit would switch off the demands for the connected plant. This will assist in identifying the control circuit state and also in preventing the system

from being swamped by nuisance alarms. Care shall be taken that the control circuit failure does not give the impression that a fire alarm event has happened.

t) The automatic start-up of plant (timed on, restoration of fire alarm or control circuit) will be staged in over a period of a few minutes to prevent surges on the supply to the control panels.

u) The BMS will status monitor other systems such as medical gas alarm, fire alarm fault, security system fault, lift motor fault etc but will NOT be expected to carry out any function with this information. All the systems connected will have their own strategy that will not be affected by the operation of the BMS.

v) The BMS will monitor common fault alarms for security, smoke dampers, CCTV, staff attack, disabled alarms and nurse call.

w) Local independent cooling systems serving IT rooms will be controlled by their own control system to the dictates of their own, independent, temperature control sensor. The BMS will have a dedicated sensor located beside the control sensor for monitoring purposes only. Information from the cooling system such as “Running” and “Failure” will be connected into the BMS.

x) Boilers and Chillers independent control systems will have electronic interfaces to connect to the respective BMS. This is envisaged to be a MODBUS connection that will allow operational data – such as temperatures, conditions, set values, run-times and alarms to be “mapped” onto the BMS as real values.

y) Fans and pumps will be inverter driven and speed set via an analogue output from the BMS. This will allow trim to be applied to reduce operational costs as and when possible. Independent pump (and fan) speed control should be avoided as remote speed control, by BMS, is unlikely to be achievable.

z) Information from inverter drives used for fans and pumps such as running state and trip state will be echoed back to the BMS via connections internal to the respective control panels. These signals will also illuminate indicators on the control panel facia.

aa) Piped across pumps and fans will be differential pressure switches that will provide indications of actual running condition of the plant. These conditions will be echoed back to the BMS via connections internal to the respective control panels. These signals will also illuminate indicators on the control panel facia.

bb) The BMS will be programmed with settable operational user levels to allow the filtering of functionality to be determined dependant on users experience and training.

cc) Where local room temperature controllers are utilised they shall be integrated with the BMS to allow the BMS to monitor the current characteristics of the controller. Characteristics such as current room temperature, actual room set-point, controller state, valve positions etc. It should also be possible to set values into the controllers remotely from the BMS. Examples of the set values are: Enabling the controller, main set values, lower set point limit, upper set point limit. Every room controller will be represented individually on the BMS to allow specific rooms default conditions to be set remotely. The BMS software shall be written to allow for night set-back room temperature set points to be applied if required.

dd) Electricity metering shall be provided on specific distribution boards and connected into the BMS via MODBUS type interface.

ee) All renewable/LZC technology systems shall be individually metered and connected into the BMS via MODBUS type interface to permit the Board to monitor record and maximise financial benefits from each system.

ff) The BMS shall be capable of monitoring the hot and cold water temperatures, including stored cold water and volume records.

gg) The BMS shall be capable of monitoring the UPS/Emergency generators.

hh) The BMS shall be capable of remote monitoring of all critical fridge/freezers.

For clarity "multiple temperature zone controls" throughout this BMS section refers to BMS connected equipment to allow for zoning throughout the building to ensure that each department and on a floor-by-floor basis can be time controlled via the BMS to allow for current (and future) changes to departmental occupational / heating requirements.

The BMS will include all the required control equipment (Fan / pump starters, sensors, valve actuators, pressure switches, pressure transducers, relays, power wiring, control wiring, network wiring, hand over-ride switches, panel indicator lamps, all other associated control panel items, site specific software including graphic slides) to provide a complete working system control system.

Project Co shall ensure the BMS is set up in a way that enables the monitoring of points on a continuous basis by the Board in order to facilitate trend analysis. Project Co shall ensure that this includes temperature profiles, valve positions and plant operation periods. Project Co shall ensure that it is possible to obtain historic data on specified points for a period of at least 14 days in order to facilitate fault diagnosis in the event of a problem.

Project Co shall ensure that the monitoring of domestic hot water and cold water (including tanks and end-of-line outlets) is continuous and carried out throughout the Facilities (not just at central plant) in order to demonstrate compliance with the Board's Legionella prevention strategy and conforms to relevant legislation, and NHS guidance.

Project Co shall ensure that the BMS is installed to control all plant where there is an operational requirement or a life cycle cost benefit, including but not limited to:

a) Boiler plant;

b) Air handling plant;

c) Ventilation plant;

d) Cooling plant;

e) Domestic hot water plant;

f) Duty/Standby control; and

g) Lighting interior and exterior (localised control shall also be considered).

Project Co shall ensure that all major plant items shall be designed and controlled to provide "real time" status monitoring, including run, fault, and alarm reporting. Project Co shall ensure that this includes boilers, pumps, pressurisation units, air handling plant, fans and air conditioning. Project Co shall provide a modular boiler system for the Facilities which will be of a dual fuel nature with storage capacity to meet the Board's statutory civil contingency requirements, which is 200 hours of peak winter demand.

Project Co shall ensure that the requirements of the following paragraphs are incorporated into the proposed Building Management System for the Facilities;

i. Zone Control

Project Co shall ensure the Facilities are capable of individual temperature control for all patient areas; to be achieved with the use of BMS controlled zone controls. Areas of 24-hour operation shall be independently controlled from non 24 hour areas to ensure optimum efficiency and in discrete areas consideration shall be given to localised zoning depending on the orientation of the buildings. Proper consideration is required to the level and extent of temperature sensing and monitoring devices to provide both accurate and cost effective zonal control.

ii. Optimisation & Compensation

Project Co shall ensure Good Industry Practice is adhered to regarding control regimes incorporating time, optimisation and weather compensation.

iii. Smart Metering

Project Co shall ensure the use of meters giving high accuracy at low flow rates and that metering points give consumption in SI units including any time bands as appropriate. Project Co shall ensure data collection and report production is by electronic systems.

Project Co shall allow sub-metering of electricity, heating and domestic water usage for each individual department / unit.

Project Co shall allow sub-metering of electricity usage for each individual department / unit and as required to satisfy the requirements of Section 6 of the Scottish Technical Standards.

As a minimum all incoming utilities shall be metered. In addition, any relatively large use of electricity, such as DHW trace heating, external lighting or mechanical plant, shall be metered separately and in line with BREEAM Healthcare stipulations.

The metering equipment shall be located at the most appropriate location for easy manual accurate reading to be taken of the load and reading should also be relayed to a central meter station in the energy centre.

Project Co shall make provision to allow the regular monitoring and reporting procedures to be implemented during the Operational Term. The installation of sub-metering is required and is to be introduced to allow accurate departmental energy usage and costing information to be obtained.

The Board believes that the feedback of information on consumption levels is essential to ensure that any adverse variances are recognised and a course of remedial action initiated. The system shall be designed and installed so that monitoring can be carried out on a continuous basis to enable energy consumptions to be data logged and profiled.

The system shall be designed and installed to permit calibration/accuracy checks on all meters (primary and sub) on an ongoing basis as an integral part of the services commissioning and prior to project completion to ensure BMS accuracy.

The BMS shall be installed to automatically read and provide trend analysis to a range of energy / water meters. All meters including those of the utility supply companies and internal sub-meters shall be automatically read by the BMS at pre-determined intervals. Project Co shall ensure that the BMS is capable of reading utility meters on a continuous basis in order to facilitate trend analysis. The energy metering shall include (but not limited to):

Electricity

a) Main incoming HV supply;

b) Main LV Switchboard;

c) External lighting (separate sub-meter for car park lighting);

d) All distribution boards with separate meters for power and lighting;

e) Departmental power and lighting;

f) HVAC control panels;

g) Cooling plant;

h) Standby electrical energy sources, rotating and static; and

i) Tenant areas (if provided).

For the purpose of energy estimates, hours run meters shall be provided for all Air Handling Unit (AHU) fans.

Water

a) Main incoming water supply; and

b) Internal sub-meters.

Gas

a) Main incoming gas supply; and

b) Internal sub-meters.

Oil

a) Delivered to Site; and

b) Used on Site, by individual pieces of equipment.

iv. Smart Meter Type

The new smart meters must be capable to ‘store measured energy consumption data for multiple time periods; and at least half hourly’ and they must ‘provide remote access to such data by the licensee’. The meter shall allow access to data to be available in a day + one.

The metering shall be provided by an independent provider of metering and data services. This will allow the supplier to be changed without being bound by any metering and data services, and without losing meter data during the supplier change over.

v. Communication Protocol

In recognition of the advances being made in building management systems, Project Co shall ensure that the BMS platform is compatible with a range of diversified core systems and standard protocols such as BACnet, LonTalk, Modbus, and OPC. The use of these standard

communication protocols will allow for more effective integration and help prepare for future devices and technologies. It will also facilitate the use of communication between different manufacturers control equipment.

vi. User Interface

Project Co shall ensure that once installed and commissioned the 'smart' meters have a BMS user interface that is sufficiently user friendly to facilitate multi-user access, without the need for the users to be controls or software specialists. Project Co shall meet the requirements of the Board in so far as that; the Board envisages that navigation around the BMS, via the "front end" will be by a combination of floor plans, plant & equipment graphics and drop down menus or "software" knobs.

Project Co shall provide the Board with a system capable of remote off-site access through the BMS from a number of locations, in order that it can monitor internal and utility consumptions / trends. Software access to be security password controlled.

Project Co to prepare and present sample software tutorial on BMS graphics (Graphical User Interface) to the Board/end user as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement at a time suitably in advance of project completion to allow software/graphic modifications in line with the Board comments.

vii. System Selection

Project Co shall ensure that all materials and equipment used are standard components, regularly manufactured for this and/or other systems and not custom designed specially for this project. Project Co shall ensure that all systems and components have been thoroughly tested and proven in actual use, for at least two years, within other NHS establishments of a similar size and complexity to this one. All components and/or systems shall be type tested and carry the CE mark.

Project Co shall confirm that both the hardware and software will be fully supported for a minimum period of 15 years from the Actual Completion Date. Future compatibility shall be supported for no less than 10 years from the Actual Completion Date. Compatibility shall be defined as the ability to upgrade existing field panels to current level of technology, and extend new field panels on a previously installed network.

8.7.2 Towns Water Connection to the Site

Project Co shall provide a secure as possible single towns water connection to the Site from the local Scottish Water network exploring opportunities for and if feasible incorporate dual supplies to ensure increased site resilience and subject to complying with the relevant provisions of paragraph 4.

8.7.3 Site Mains Water, Fire Water, Quality & Distribution

Project Co shall develop the Site potable and fire water networks as separate systems, each arranged in a ring with adequate valving to achieve robustness in continuity of supply.

Project Co shall filter the Site potable water to the criteria set out in SHTM 04-01 Parts A - G and commensurate with the piping material proposed.

In determining the pipework material the Project Co shall take cognisance of the latest best practice in the Scottish NHS.

8.7.4 Fossil Fuels

Project Co shall be responsible, in conjunction with Transco in determining the philosophy for the provision of fossil fuels to the Site. Options that Project Co may consider are un-interruptible gas or the provision of dual fuel burners and a heating oil standby facility. Irrespective of the option proposed by Project Co the availability criteria described elsewhere in Clause 9 and Schedule Part 14 (Payment Mechanism) of the Project Agreement and/or the Services Specifications will be strictly adhered to.

8.7.5 Heating System

Project Co shall provide all heating systems required to support the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and to:

a) Zone and control heating circuits to provide an efficient and comfortable environment;

b) Provide valve isolation such that isolation of circuits/sub-circuits shall have minimal disruption to the remaining departments;

c) Provide 24 hour occupied (and unoccupied) wards and departments with a night set-back facility;

d) Provide temperature and ventilation night set-back facilities so that when departments are unoccupied they will have frost and anti-condensation protection.

Project Co shall provide high efficiency, low NOx heat generation and heating water distribution plant, serving good quality heat emitters to ensure satisfactory heat distribution within the area served. Project Co shall arrange heat emitters and all heating pipework such that in all areas, the surface temperature limits as laid down in SHTM 04-01 Parts A - G are not exceeded. Project Co shall not utilise heating pipework as a heat emitter within patient areas.

Project Co shall pay particular attention to effective use of warm air curtains in entrance / draft lobbies.

8.7.6 Domestic Water Services

The water supply system for the Facilities shall include a new dedicated supply from Scottish Water's off site infrastructure and also incorporate on-site bulk water storage (24-hours) and subject to complying with the relevant provisions of paragraph 4.

Treatment of potable cold water supplies is considered undesirable and the provision of a wholesome supply from Scottish Water's mains with the minimum of storage and handling is the preferred approach.

Project Co shall design and install the domestic cold and hot water supply installations to fully comply with the requirements of SHTM 04-01 Parts A - G. Project Co shall include for all specialist treatment plant that may be necessary. Project Co shall provide water sampling points as required by SHTM 04-01 Parts A - G with due regard for clinical requirements and provision of Clinical Services.

Secure local isolation shall be provided by Project Co at all sanitary appliances, and at final connection points to equipment. Project Co shall provide secure external isolation to the buildings.

Project Co shall provide plumbed in water dispensers at ward level in accordance with Schedule Part 11, Equipment Schedule. The installation of ice machines is prohibited.

Project Co shall provide plumbed water to specialist services such as, but not limited to, washing machines in specialised units and dishwashers in ward areas in accordance with the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements), and in particular Schedule Part 11, Equipment Schedule.

Project Co shall provide plumbed water to all vending machines as required throughout the Facilities in accordance with the Board's Construction Requirements Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements), and in particular the Schedule Part 11, Equipment Schedule.

The Project Co's attention is drawn in particular to SHTM 04-01 Parts A - G concerning pipework materials and standards of filtration to be used in Scottish health care facilities.

All clinical hand washing facilities shall be provided with automatic sensor taps. In order to assist in achieving the water consumption target (see paragraph 5.26 of this Sub-Section C) Project Co shall consider the use of low flush toilets and insert spray caps where appropriate to taps to ensure the conservation of the water supply. Project Co shall install systems into the urinal facilities to reduce the flush requirements.

As required within SHTM 04-01 Parts A - G, no flexible or braided hoses shall be permitted for final connections between domestic water distribution pipework and appliances/outlets.

Project Co shall consider the environmental benefits and economic viability of greywater re-cycling on Site and if beneficial to the project shall incorporate such a system into the building services and flood abatement philosophy for the Site. Project Co shall describe fully its mode of operation and integration into the Site.

Project Co shall evaluate the benefits and feasibility of rainwater harvesting for process areas only which if adopted, Project Co shall ensure that the rainwater from the roof of the Facilities and hardstandings is collected, stored and re-used for toilet flushing purposes and if appropriate separated to serve supply points for irrigation of the external areas of the proposed Facilities.

Project Co shall ensure that the recycling facility for the separate greywater and rainwater systems allows for appropriate filtration and complies with any flood abatement philosophy for the site.

8.7.7 Hot Water Supply

Appropriate operational engineering systems for hot water and steam shall be included in the design of the Facilities.

Domestic hot water systems shall be designed to provide adequate flow to satisfy maximum demand whilst minimising stored hot water and energy consumption. The provision of some storage is desirable to minimise the impact of hot water generation on boiler power.

Project Co shall install Type 3 (in accordance with NHS Model Engineering Specification D08) thermostatic mixing valves at all HWS outlets to comply with SHTMs and SHGNs except where 60°C water is a particular requirement so that the mandatory requirements for the control of Legionella and other bacteria within the system are met.

Energy efficient hot water boilers shall be provided in all staff rest rooms and kitchen areas.

8.7.8 Mechanical Ventilation & Air Conditioning

The heating, ventilation and air conditioning systems shall be logically designed to operate efficiently incorporating heat recovery and providing local control where required. Project Co should ensure avoidance of simultaneous heating and cooling, either by the ventilation system itself or between the ventilation system and any other heating and cooling system,

The energy and power systems shall be appropriately designed to provide fully integrated designs in terms of the incorporation of engineering services into the building fabric and external spaces.

The need to maintain comfort conditions in accordance with the Room Data Sheets in all areas but particularly in clinical areas is of paramount importance and Project Co shall develop strategies for achieving these conditions together with minimum energy consumption.

Project Co shall provide natural and mechanical ventilation, comfort cooling, and air conditioning to suit the Facilities and clinical requirements and provision of the Clinical Services. Project Co shall provide a climate control facility in clinical and staff areas which are provided with comfort cooling (if applicable). The use of low carbon solutions is anticipated for such requirements.

Project Co shall provide the air lock to the first floor of the Link Building to the RIE Facilities in accordance with the Interface Output Specification, the Connection Proposal and relevant provisions or Paragraph 4 concerning any connections to the Link Building.

Project Co shall ensure heat gain from all equipment and personnel is allowed for in sizing and selection of the systems.

Project Co shall demonstrate how the proposals facilitate the control and management of an outbreak and spread of infectious diseases in accordance with SHTM 03-01, SHFN 30 and HAI-SCRIBE.

Project Co demonstration is to cover all aspects of the building, its services, spatial relationships, Soft and Hard FM proposals (as appropriate) and incorporate requirements of the Board's Infection Control Team.

Project Co shall ensure that ventilation systems installed in areas classified as hazardous are designed to relevant standards.

Where grilles or diffusers are used within rooms Project Co shall ensure they are:

a) Arranged to avoid draughts; and

b) Designed to minimise noise intrusion into the space.

Project Co shall incorporate provision to include humidification to the AHU plant at a future date.

8.7.9 Combined Heat and Power

Project Co shall consider the environmental benefits and economic viability of Combined Heat and Power (CHP) and if beneficial to the project shall incorporate CHP into the building design, avoiding any 'dumping' of heat or export of power off-site. Project Co shall describe fully its mode of operation and integration into the mechanical and electrical services to demonstrate their assessment and viability.

8.7.10 Medical Gases

Project Co shall provide all medical gases required to support the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific-Non Clinical Requirements), such as but not limited to:-

a) Oxygen Vacuum Insulated Evaporator (VIE) shall be for the sole use of the Facilities. The Oxygen VIE shall be provided from sources solely on the Site.

b) Nitrogen provided on the Site

c) Nitrogen oxide provided on the Site;

d) Medical air 4 bar;

e) Surgical air 7 bar; and

f) 50% oxygen / 50% nitrous oxide provided on the Site.

Medical gas bottles, plant areas and stores shall be accommodated within suitably designed buildings / rooms / enclosures with good access, natural ventilation and satisfactory noise emissions control.

All medical gas installations which serve clinical departments shall be connected to essential electrical supplies.

The status of the central medical gas plant shall be monitored by an alarm system with a status signal to an alarm panel located in a manned office. The panel shall also report the alarm to the BMS.

Project Co shall install the piped medical gases in accordance with SHTM 02-01 and "Model Engineering Specification C11".

Project Co shall install outlets as defined in this Schedule Part 6 Section 6 (Room Data Sheets).

Project Co shall provide a medical gas distribution system sized to accommodate the demand of the Facilities at the Actual Completion Date and handover, with the capacity to accommodate an increase in demand (flow and consumption) of no less than 25% throughout the Facilities.

Project Co shall ensure that the provision of medical gases to the point of use is continuous. Where Project Co are providing medical gases via cylinders they shall provide manifold systems with automatic change over from duty to standby to no less than two equal banks of cylinders. The capacity of such arrangements should be in line with that outlined within SHTM 02-01 and "Model Engineering Specification C11" along with necessary alarm systems to alert staff as to a fault conditions.

Project Co shall ensure that adequate points of isolation exist to all medical gas systems.

8.7.11 Medical & Dental Vacuum

Project Co shall provide medical and dental vacuum systems as required to support the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements).

Medical and dental vacuum plant areas and stores shall be accommodated within suitably designed buildings / rooms / enclosures with good access, natural ventilation and satisfactory noise emissions control.

Installations shall be connected to essential electrical supplies and shall be in compliance with SHTM 02-01.

The status of the central medical and dental vacuum plant shall be monitored by an alarm system with a status signal to an alarm panel located in a manned office. The panel shall also report the alarm to the BMS.

8.7.12 Anaesthetic Gas Scavenging System

Project Co shall provide an active Anaesthetic Gas Scavenging System (AGSS) as required to support the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements).

AGSS plant areas and stores shall be accommodated within suitably designed buildings / rooms / enclosures with good access, natural ventilation and satisfactory noise emissions control.

The installation shall be connected to essential electrical supplies.

The status of the AGSS shall be monitored by an alarm system with a status signal to an alarm panel located in a manned office. The panel shall also report the alarm to the BMS.

8.7.13 Non-Medical Gases

Project Co shall provide all non-medical gases required to support the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific-Non Clinical Requirements).

Non-medical gases shall be provided as either bottled or piped installations as deemed appropriate.

Gas bottles, plant areas and stores shall be accommodated within suitably designed buildings / rooms / enclosures with good access, natural ventilation and satisfactory noise emissions control.

All critical non-medical gas installations i.e. certain laboratories etc shall be connected to essential electrical supplies.

The status of the central non medical gas plant shall be monitored by an alarm system with a status signal to an alarm panel located in a manned office. The panel shall also report the alarm to the BMS.

Project Co shall install the non medical gases in accordance with SHTM 08-06, SHTM 02-01 and "Model Engineering Specification C11".

Project Co shall install outlets as defined in Schedule Part 11, Equipment Schedule.

Project Co shall provide a non medical gas distribution system sized to accommodate the anticipated demand of the Facilities at the Actual Completion Date having regard to Schedule Part 11 (Equipment Schedule) and the Room Data Sheets, with the capacity to accommodate an increase in demand (flow and consumption) of no less than 25% throughout the Facilities.

Project Co shall ensure that the provision of non medical gases to the point of use is continuous. Where Project Co are providing non medical gases via cylinders they shall provide manifold systems with automatic change over from duty to standby to no less than two equal banks of cylinders.

Project Co shall ensure that adequate points of isolation exist to all non medical gas systems.

8.7.14 Bedhead Services

Project Co shall provide bed head services as defined in the Schedule Part 11, Equipment Schedule. Project Co shall ensure that bedhead services are designed and installed in accordance with SHTM 08-03.

8.7.15 Sterilisation

Project Co shall provide clean steam and associated sterilisation plant and distribution systems as required to support the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements). Plant and associated systems shall be designed to SHTM 2031 and SHTM 2010. Discharges to drain are to be treated / managed in accordance with SEPA requirements.

8.7.16 Special Water Services

Project Co shall provide all special water services required to support the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements), such as but not limited to:

a) Special supplies such as de-ionised water to laboratory equipment;

b) Special supplies such as de-ionised water to equipment washers / disinfection equipment; and

c) Special supplies for Renal Dialysis.

8.7.17 Laboratory Gases

Project Co shall provide all laboratory gases required to support the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements), such as but not limited to:-

a) Nitrogen; and

b) Carbon Dioxide.

All pipework shall be distributed in ventilation spaces within the ceiling void with maximum permissible separation from the electrical services and hot pipe services. Natural gas installation in the building shall comply with the all current Gas Safety Regulations, incorporating emergency manual / automatic isolation in each room with gas draw-offs. Reinstatement of natural gas following emergency isolation shall also follow an inherently safe regime.

8.7.18 Local Exhaust Ventilation Systems

Project Co shall provide all LEV systems including but not limited to that required to support the provision of catering, workshop and maintenance facilities on Site.

8.7.19 Fume Cupboard & Micro-biological Safety Cabinets

Project Co shall provide fume cupboard and both CAT II and CAT III microbiological safety cabinet exhaust systems as required to support the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements). Systems shall comply with NHS Specifications and Guidance documentation which shall include a matched supply system into the room(s) containing fume cupboards and micro-biological safety cabinets. Fume cupboard design and installation shall be to BS EN 14175. Microbiological Safety Cabinet design and installation shall be to BS EN 12469: 2000 Biotechnology - performance criteria for microbiological safety cabinets and BS 5726: 2005 Microbiological safety cabinets.

8.7.20 Drainage

Project Co shall provide all necessary drainage to support the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements) and their aspirations regarding reduced water consumption which shall include but not be limited to:

a) General foul water drainage;

b) General surface water drainage;

c) Kitchen drainage, inclusive of grease traps;

d) Laboratory drainage;

e) Radioactive waste;

f) Drainage from areas handling radio isotopes, or other contaminants such as silver;

g) Bedpan disposal system; and

h) Drainage from oil bund areas, inclusive of oil interceptors.

Project Co shall consider the environmental benefits and economic viability of greywater re-cycling on Site and if beneficial to the project shall incorporate such a system into the building services and flood abatement philosophy for the Site. Project Co's Proposals shall describe fully the system's mode of operation and integration into the Site.

Project Co shall ensure all drainage discharges from Site are strictly in accordance with the limits set by SEPA.

Drainage systems shall be provided which function reliably with the minimum of blockages, leaks etc. Materials and jointing systems with a proven track record shall be chosen.

The design of the system shall be such as to create the minimum disruption in the event of blockages.

Project Co shall construct the drainage installation such that it complies with the "Initial Drainage Proposal" and the Supplemental Drainage Proposal and the relevant provisions regarding drainage in paragraph 4.

8.7.21 High Specification Air Conditioning Systems

Project Co shall provide high specification, full function and close control air conditioning systems to support the Board's Clinical Output Specification that are contained in Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements), such as but not limited to:

a) Laminar flow rooms and / or operating theatres; and

b) Areas handling radio isotopes or other radiological contaminants.

Air conditioning systems installed in the above areas shall be higher specification air conditioning systems with standby motors belted up in accordance with SHTM 03-01, 04-01 and NHS Model Engineering Specification C04.

8.7.22 Ventilation and Air Conditioning of Isolation Rooms

Project Co shall provide air conditioning systems to Isolation Rooms to support the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements), NHS Standard Infection Control Precautions (SICPs) and maintaining strict positive / negative pressure differentials.

Ventilation and air conditioning systems for these rooms shall be designed and installed in accordance with SHTM 03-01, 04-01 and NHS Model Engineering Specification C04. Project Co shall demonstrate how the proposals facilitate the control and management of an outbreak and spread of infectious diseases.

8.7.23 Pneumatic Air Tube Transport System

Project Co shall provide a pneumatic air tube transport system for the Facilities with links to the RIE Facilities. The locations to be served in the Facilities are indicated on the RHSC Pneumatic Air Tube Transport System Requirement Table and DCN Pneumatic Air Tube Transport System Requirement Table below and, as required to support the Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements). All of the Facilities pneumatic air tube transport system stations shall deliver to and receive from the laboratories and pharmacy located within the RIE Facilities, Rooms G5119 and S6107 respectively. In addition to the provision of the system within the Facilities, Project Co will also be responsible for the installation of the link to and the system including supporting plant within the RIE Facilities in accordance with predetermined routes advised by the Board. The installation must be consistent with the overall communications policy of the hospital. Project Co shall ensure the pneumatic air tube transport system shall be designed and installed in accordance with SHTM 08-04: Specialist services Pneumatic tube transport systems: Part A: Overview and management responsibilities and Part B: Design considerations and good practice guide. The system shall be 160 mm diameter multiple carrier microprocessor controlled with all associated infrastructure comprising two transmission tubes (one to and one from the RIE Facilities) accommodating up to five carriers travelling simultaneously in any direction. Notwithstanding the foregoing, the system

shall be designed to take a minimum of 21 transactions per hour (not including the return of capsules). The system will have a 70% maximum system capacity.

Project Co shall design and construct the Pneumatic Tube System in accordance with the Appendix B (Interface Output Specification) and the relevant provisions of paragraph 4 as regards the PTS.

RHSC Pneumatic Air Tube Transport System Requirement Table

Ref	Department	Pneumatic Air Tube Delivery System Required and Number	Location
RHSC SPECIFIC DEPARTMENTS			
A	***Front Door - ED / Assessment Ward***		
A1	Emergency Department	2	1 Laboratory Area and 1 outside Resuscitation Room
A2	Paediatric Acute Receiving Unit - 34 Beds	1	Central Location Staff Base
B	***Critical Care / HDU / Neonatal Surgery***		
B1	PICU and HDU's - 24 Beds	2	1 close to Room 5/8 and the other close to Room 14
C	***RHSC In Patient Pathway / Ward Care***		
C1.1	Medical Inpatients - 23 Beds	1	Staff Base Central location
C1.2	Surgical Long Stay Inpatients -15 Beds	1	Staff Base Central location
C1.3	Neuroscience Inpatients - 12 Beds	1	Staff Base Central location
C1.4	Haematology / Oncology Inpatients & Daycases - 17 Beds & 2 Chairs	1	Staff Base Central location
C1.8	Surgical Short Stay Inpatients - 14 Beds	1	Staff Base Central location
C1.9	Inborn Metabolic Disorders Lab	1	
D	***RHSC Ambulatory Care***		
D1	RHSC Main Outpatients	2 - (1 Ground Level 1 First Level)	In corridor In the D1 Area Reception Area
D9	Medical Day Care Unit - 5 Beds	1	Reception Area
H	***Academic***		
H2	Clinical Research Facility	1	Close to reception area

DCN Pneumatic Air Tube Transport System Requirement Table

Ref	Department	Pneumatic Air Tube Delivery System Required and Number	Location
DCN SPECIFIC DEPARTMENTS			
L	***DCN In Patient Pathway / Ward Care***		
L1	DCN Acute Care - 24 Beds	1	Staff Base closest to Resuscitation Room
L2	DCN Inpatients - 43 Beds	1	Near to MD Staff Office closest to PIU
M	***DCN Out Patient Departments***		
M1	DCN Outpatients	1	Reception Area
JOINT DEPARTMENTS			
P	***Combined Theatres***		
P1	Operating Theatres & RHSC Surgical Day Case Unit	2	1 located close to reception area in DCN & RHSC end
Q	***Combined Radiology***		
Q1	Radiology	1	Located close to DCN Reception Area

8.8 Electrical Systems

8.8.1 Main & Sub-Main Distribution

Project Co shall provide a main and sub-main distribution system for the new Facilities incorporating all connections from the utility provided HV supply, LV main switchgear, sub-main cabling and distribution boards as required, to provide separate essential and non-essential supplies to power and lighting throughout the Facilities designed in accordance with SHTM 06-01 and SHTM 06-02 respectively.

The utility provided HV Supply shall include a new Scottish Power substation that may be located adjacent to Car Park F on the Substation Site. Project Co shall comply with the relevant requirements for the substation and cables detailed in paragraph 4 the relevant Interface Proposals and Appendix A.

A new HV board and standby generators shall be housed within a new energy centre which shall supply via an 11kV ring new HV Substations located within the building.

The design of the LV Distribution shall ensure that redundancy is provided throughout the Facilities and include features such as dual fed distribution boards.

Project Co shall incorporate no less than 25% spare capacity (for the Facilities as designed) to the main distribution switchgear, standby generator etc within the Facilities and size the installations (all distribution panels, containment, risers etc.) to accommodate additional future spare requirements.

Project Co shall provide automatic power factor correction equipment in accordance with SHTM 06-01.

8.8.2 Standby Generation

Project Co shall provide a standby mains failure generator system for the Facilities to provide 100% power in the event of loss of the mains supply and comply with requirements set out in paragraph 8.6.2 of this Sub-Section C.

The standby generator design shall be based on a N+1 arrangement.

The system shall include for controls to operate and maintain the generator inclusive of facilities to automatically synchronise with the switchboard.

The provision of services to modern healthcare facilities is critical to its continuous operation and proposals shall include adequate resilience and support systems in all areas of the design.

Project Co shall ensure all critical services shall be maintained in the event of:

a) A primary supply failure;

b) A main distribution failure; and

c) A local distribution or equipment failure.

Loss of any critical service shall not disrupt the operation of the Facilities and sufficient no break back-up systems shall be included to assure continuity of services.

In sizing the generators Project Co shall include the 25% spare electrical capacity identified for the general power distribution systems.

Project Co shall ensure the quality of generated supply is to be compatible with the requirements of specialist clinical equipment.

8.8.3 Electrical Small Power

Project Co shall provide socket outlets throughout the Facilities to provide for general facilities, cleaner’s requirements and for connection of particular items and portable equipment as required throughout the Facilities. Project Co shall provide power supplies suitable for personal domestic appliances (e.g. hairdryer) in changing rooms. Segregation shall be provided between “clean” and “dirty” power supplies.

Project Co shall provide all necessary single and three phase power supplies for plant and equipment.

8.8.4 Lighting

The lighting installation shall be designed by Project Co to comply with the latest versions of the following publications and all other relevant guidance including CIBSE Lighting Guides and in particular LG2

Project Co shall provide the lighting levels and uniformity of light suitable for the task to be carried out and in accordance with the appropriate guidelines. The Board requires a lighting design / installation which provides good uniformity over the task area i.e. ≥ 80%.

Project Co shall ensure that luminaires are complete with an appropriate high efficiency diffuser / controller and be suitable for the application for which they are proposed.

Project Co shall incorporate the use of daylight into the lighting design. Project Co shall design and orientate the building such that the daylight can be used to best effect, supplemented by the artificial lighting system to provide the appropriate levels of illumination.

8.8.5 Interior Lighting

All access routes to plant areas shall be lit to provide safe access for maintenance.

Hazardous areas shall be provided with the appropriate classified luminaires.

All light switches for public areas shall be provided such that they cannot be operated by unauthorised persons.

Whilst the lighting design must be functional for clinical use, Project Co shall ensure that the overall lighting concept will produce an aesthetically pleasing environment. All lighting equipment shall be co-ordinated with the building structure. Project Co shall aim to use a mixture of fittings and retail lighting techniques to create a welcoming atmosphere and balanced visual environment.

Project Co shall provide and install the most energy efficient form of lighting to provide occupiers with improved visual comfort while reducing noise levels and running costs.

Project Co shall ensure that corridor lighting is multi circuited to facilitate use of 100% or 50% of the luminaires. Where the corridor is over 15 metres in length, consideration shall be given by Project Co to zoned lighting and the use of presence detection sensors to maximise efficiency.

Night lighting shall be provided within all corridors either by individual fittings or by selective switching of the general corridor wall/ceiling luminaires. Project Co shall ensure night lighting in corridors shall not spill into patient bedrooms, or other bedded areas.

Luminaires shall be located to provide ready access for lamp changing and maintenance, whilst still providing the recommended level and quality of illumination to the area.

Night lighting shall be provided at nurse stations, patient bed areas and locations where call systems are installed.

Artificial illumination shall be provided to Treatment (activity / consulting) Rooms, etc by fully recessed, hermetically sealed modular light fittings, switched at the room door positions. Treatment Room luminaires which provide the general lighting shall be controlled by at least two circuits depending on the arrangement of fluorescent tubes in each fitting. The design of these luminaires by Project Co must provide ease of access for lamp changing.

Luminaires, their colour and material finish shall be selected to co-ordinate with the architectural intent throughout the circulation areas. Low wattage 2700K luminaires to be used in particular rooms shall be selected on their ability to create a calm and “homely” atmosphere. Project Co shall consider the inclusion of wall mounted luminaires and /or uplighters.

All lamps used in clinical areas shall have as a minimum a colour rendering capability of ≥ 85 CRI. For practical reasons consideration shall be given by Project Co to using the same luminaire in both clinical and non-clinical spaces within the same ward. A reading light with an on/off switch shall be provided at each bedhead location. Project Co shall provide an additional switch on the nurse call handset.

Where luminaires of the fully recessed type (modular and / or downlighter) are installed within fire rated ceilings, they shall be provided with a one hour rated fire canopy. Project Co shall also ensure that they maintain the integrity of the ceiling and that the canopies are tested to “BS 476 Fire tests on building materials and structures Parts 20 and 23, clause 5. Project Co shall also ensure that all canopies meet the requirements of Class O materials”.

Luminaires with prismatic diffusers installed on fire escape routes shall be fitted with flame retardant diffusers to TP(a) classification in Part B (Fire safety) of the Building Regulations in England: Light Diffusers and Wall Coverings, minimum Class 3 surface spread of flame.

Bed head observational lighting (watch lighting) shall be provided where specified in high dependency and critical care wards. The observational lighting shall be separately switched and controlled from the general lighting. Refer to Schedule Part 11, Equipment Schedule for details of where observational lighting is required

Wall or ceiling mounted examination lighting shall be provided where specified in intensive therapy, high dependency and coronary units. Refer to Schedule Part 11, Equipment Schedule for details of where examination lighting is required

Laser and x-ray warning lights shall be provided outside theatres, major treatment rooms and x-ray rooms and interfaced with the laser / x-ray machines

Food factory type luminaires shall be provided in areas in which food is prepared, cooked and stored.

Ensure that in the entrance areas, functional lighting is supplemented by additional lighting to enhance the interior and create an aesthetically pleasing environment.

Plant areas, roof void areas, ducts, lift motor rooms, shafts and similar utility areas shall be additionally illuminated utilising suitably IP rated luminaires.

Project Co to provide over-mirror lights in all male and female changing rooms, where indicated in the Schedule Part 11 (Equipment Schedule).

8.8.6 Exterior Lighting

The perimeter, including any main entrance canopies and pedestrian walkways, to all buildings shall be lit by the use of LED energy efficient luminaires mounted on walls, columns and/or bollards. All on-site access roads, footpaths and cycle ways shall be lit to levels compatible with the adjacent roads. The lighting shall satisfy the requirements of BS EN 13201 and BS 5489:2003 Code of practice for the design of road lighting. Lighting shall be provided to all direction signs around the Site where these are not adequately illuminated by external lighting.

All access routes to plant areas shall be lit to provide safe access for maintenance.

All wall mounted luminaries shall be fed by back entry. Cable runs on the outside of buildings shall not be permitted.

All external columns, bollards etc. shall be provided with fused cut-outs and termination facilities for cabling.

All luminaries shall be wired on multiple circuits to avoid loss of light to whole areas in the event of a mains/circuit failure.

Project Co shall illuminate the main entrances, the buildings perimeter and pedestrian walkways by use of energy efficient luminaires, wall, column and / or bollard mounted. The installation shall achieve the requirements of BS EN 13201 and BS 5489:2003 Code of practice for the design of road lighting, providing external lighting for safety and security purposes.

When selecting luminaires, Project Co shall give consideration to light pollution, vandalism, security, energy efficiency and local residents' needs.

Project Co shall control external lighting to minimise energy consumption, by photocell or movement sensor, the lamp type selected must be sympathetic to frequency of switching dictated by the control means. Project Co shall consider the use of solar powered lighting.

8.8.7 Lighting Control & Wiring

Project Co shall provide automatic control of lighting control using natural light level sensing. Control lighting for unoccupied periods by use of the BMS scheduling capability, with movement sensing override for safety. Project Co shall provide a safe minimum light level at all times.

Project Co shall ensure that the lighting design incorporates a flexible switching arrangement to allow for varying activities within each room and for cleaning purposes. Switches for public areas shall be positioned by Project Co so that unauthorised persons cannot switch the lighting.

Lighting within all WC's, Staff WC's and changing rooms shall be controlled via passive infrared sensors/movement detectors or similar, with adjustable time control facilities.

Lighting within clinical areas shall be manually controlled.

Project Co shall arrange the circuiting of luminaires to control groups of fittings in order to provide flexibility of switching arrangements. Such a facility is particularly important in large spaces where the level of daylight is not uniform and artificial lighting is likely to be needed for long period in areas remote from windows.

Project Co shall provide alternative circuits together with two-way or intermediate switching at all section doors and corridor direction changes for lighting in corridors and circulation areas.

Where multi-gang lighting control switches are required Project Co shall provide a label fixed to the grid under the switch plate, indicating the switches are fed from different supplies.

Project Co shall wire lighting circuits within rooms/areas on the same phase as the general power circuits.

8.8.8 Emergency Lighting

Project Co shall connect the emergency lighting to addressable self-monitoring control panels with each luminaire containing an interface unit that will be monitored and controlled by the control panel which shall report to the BMS system. Project Co shall ensure that the emergency luminaires are automatically tested in accordance with the requirements of the British Standards.

The emergency luminaires may be of either the maintained or non-maintained variety. Project Co shall ensure that they are powered by a suitable battery supply connected by an auto-changeover switch or utilise self-contained battery packs within luminaires (3-hour rated). Project Co shall ensure that the emergency luminaires will be automatically energised in the event of a failure to the local lighting circuit.

Project Co shall comply with the requirements of BS 5266 Emergency Lighting and European Legislation CEN/TC 169 WG3 Emergency Lighting of Buildings.

8.8.9 Standby Lighting

Project Co shall provide 100% standby lighting via the generator to enable normal activities to continue during the loss of a normal mains supply.

Project Co shall ensure that the quality of standby lighting is equal to that of the normal lighting at the task points.

8.8.10 Uninterruptible Power Supplies

Project Co shall provide Uninterruptible Power Supplies (UPS) to serve life-support equipment within area and rooms listed in the UPS Required Table below and the requirements of Board's Construction Requirements of this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) in accordance with SHTM 06-01 Electrical Services. UPS to be provided to individual rooms shall be as stated on the Room Data Sheets. Project Co shall provide UPS for the Helipad and the NHS Lothian Server Room's ventilation/cooling. The UPS shall provide a no-break supply during loss of normal mains power supply and subsequent emergency generator power supply. The UPS System shall be of modular parallel design and will have N+1 redundancy. UPS requirements for the NHS Lothian Server Room are detailed in the Responsibility Matrix within paragraph 9.7.

UPS Required Table

Level	Area	Rooms
Basement		
Ground Floor	Emergency Department Co-Joined Radiology	Resuscitation Room(s) 4 Major Treatment Rooms MRI Rooms CT Rooms Gamma Camera Rooms Control Rooms
First Floor	Co-Joined Theatres Critical Care DCN Acute Care	9 Theatres and anaesthetic rooms MRI Room Angiogram Interventional Room Recovery Spaces 24 Cubicle Spaces Receiving / Resuscitation Room
Second Floor	Ehealth	Server Room's ventilation/cooling
Third Floor	Medical In-Patients	Transitional Care Rooms
Fourth Floor / Roof	Helipad	Helipad RFFS Accommodation Helipad Fire Suppression System Lighting to Helipad; Helipad ramp and Helipad stairs

These units shall provide one hour standby duration in accordance with relevant Health Planning Standard documents.

8.8.11 Lifts

Project Co shall provide bed passenger lifts (suitable for inclusion of at least one hospital bed (orthopaedic bed)), goods lifts, service lifts (dumb waiters), general passenger lifts and evacuation lifts for emergency conditions within the buildings in accordance with but not limited to SHTM 08-02, SFPN 3 and SHTM 81. All lifts provided for the movement of patients shall be supplied from the essential services supply in accordance with SHTM 06-01.

Three of the lifts in the DCN / 'Hot' core are to provide access to helipad located on the roof. Two in number Patient Bed lifts and one in number FM lift shall serve the roof area that the helipad is located on. The lifts are to have call buttons at roof level and key operated access to the roof from inside the lifts.

RHSC Patient Bed and Passenger lifts shall not stop at floors that are exclusively served by DCN departments with manual override.

DCN Patient Bed and Passenger lifts shall not stop at floors that are exclusively served by RHSC departments with manual override.

Project Co shall give consideration to the following in the provision of lifts:

a) The lifts shall be vandal / damage proof but aesthetically pleasing and appropriately sized - (min size for bed and associated equipment);

b) A minimum of one lift shall be sized to accommodate the lifting of the major component parts of medical equipment for replacement during maintenance with particular attention given to lifting the MRI scanner components to and from the ground and upper floors. Project Co shall require to liaise with relevant clinical and estates staff to identify the most onerous components during the design stage. When the more onerous components are to be used the Board will have the right to decide what constitutes the more onerous component.

c) Banks of lifts shall be appropriately controlled to maximize movement;

d) Collective controls of groups of lifts shall be used;

e) All floors including plant levels shall be served

f) Project Co's control rooms shall be easily accessible and designed to minimise the need for artificial cooling;

g) Emergency hands free telephones in lifts shall be accessible to the blind, partially sighted, deaf and wheelchair users. Telephones shall be linked to lift car audio inductive loop;

h) Lifts for people and goods shall be separated;

i) Dedicated lifts are required for theatres or swipe controlled staff access override; and

j) Disabled friendly controls, information etc (wheelchair accessible height of buttons, tactile numbers, voice messages, and visual alarm) shall be incorporated in the lift design.

8.8.12 Escalators

Where Project Co provides escalators within the buildings they shall adhere to the requirements of all relevant British Standards and in particular with BS EN 115 Safety of escalators and moving walks.

8.9 Lightning Protection & Earthing

Project Co shall provide a lightning protection system for the protection of the structure, the contents and occupants. The lightning protection installation shall be in accordance with the latest version of BS EN62305 Protection against lightning. The lightning protection system shall comprise of air termination network, down conductors, earth termination network and all required equi-potential bonds.

Project Co shall provide a system of earthing that shall ensure sufficient and fast operation of protective systems in the case of earth faults.

The earthing system shall comply with BS7671:2008 Requirements for electrical installations (IEE Wiring Regulations), BS7430:1998 Code of Practice for earthing and with the Electricity at Work Regulations 1989.

The earthing system shall comprise of earth electrode system, main and supplementary earth bars, main and supplementary equi-potential bonding.

8.10 Fire Detection & Suppression Systems

Project Co shall ensure that the fully addressable automatic fire detection system for the Facilities is fully compliant with the performance criteria laid down under SHTM 82 (including Supplement A) and the latest revisions to BS 5839. The design of the Facilities shall be in full accordance with HTM 05-02, including both vertical and horizontal compartmentation and evacuation routes. All circulation doors shall be installed with integrated electro-magnetic door hold open devices with all security door locks interlocked for evacuation in a fire condition.

Project Co shall provide sprinkler protection to those departments surrounding High Dependency departments (above, below and adjacent on the same level) as required by SHTM 82 Section 3.

Project Co shall ensure that the system must be an L1 fully addressable analogue system incorporating an auto-dialler / monitoring facilities with the capability for remote site monitoring via an internet PC connection. The system should also be provided with a full 2 way communication link to the RIE Facilities, subject to the details being agreed with the Board and Consort as part of the Project Co's Proposals and/or as Reviewable Design Data for review and agreement by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement and provided. Project Co shall carry out the necessary connection work to the fire alarm system at the interface with the Link Building in accordance with the Interface Output Specification for the Link Building, the Connection Proposal and the relevant provisions of paragraph 4.

The system shall be equipped with sufficient sounders to maintain sound outputs in different areas in accordance with SHTM 82, and incorporate visual strobe indicators for a fire condition in accordance with the requirements of the Equality Act 2010. Project Co will provide voice evacuation announcements and shall agree with the Board if manual voice evacuation or pre-programmed announcements are to be provided as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

Project Co shall ensure that the Facilities are divided into zones by ward / department / unit area as well as by floors with mimic or repeater panels at each nurse station (or equivalent) and at least one panel per floor located in a central circulation area. In the event of fire the Facilities shall be capable of individual zone evacuation with all other zones receiving awareness signalling. Project Co shall ensure that all fire alarm panels are capable of giving details of system status for fire, fault, and alarm conditions including full text descriptions of location. All panels shall be capable of data / event logging and report generation. Manual call points must be provided at every exit and staircase with no point in the building being more than 30m travel from a call device.

Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic fire detection systems and shall be manufacturer's latest standard design that complies with the Board’s Construction Requirements.

Project Co shall ensure that this system will have a documented history of compatibility by design for a minimum of 15 years. Future compatibility shall be supported for no less than 10 years. Compatibility shall be defined as the ability to upgrade existing systems to current level of technology, and extend new field panels on a previously installed network.

Project Co shall take into account the need for maintaining patient security during alarm testing i.e. the testing regime shall not allow for ordinarily secure doors to open as a result of routine testing.

Project Co to provide fire suppression systems in NHS Lothian Server and Node rooms, IPS Room and main HV and LV switchrooms.

Fire hose reels are not acceptable within the Facilities. For the avoidance of doubt, Project Co shall provide all fixed fire fighting equipment to comply with statutory requirements and the requirements and recommendations of NHS Scotland Firecode.

Project Co shall review requirements for fire hydrants with The City of Edinburgh Council's Building Control Department and Scottish Fire and Rescue Service.

The fire systems for the Facilities will have to be designed and constructed and replaced, repaired, renewed and maintained such that they may be connected to, communicate and operate with the fire systems at the RIE Facilities. It is envisaged that such connections and a control box for the fire systems will be proximate to the Link Building. The rights to make and replace, repair, renew and maintain such connections are subject to design, construction and other information being provided as part of Project Co's applicable Interface Proposal for approval by the Board and Project Co shall comply with the requirements for installing, maintaining, repairing, renewing and replacing interface links between the fire alarm system within the Facilities with those within this RIE Facilities as part of the RIE Works subject to and in accordance with:

a) Section 7 (Link Building) of Part 1 (Interface Construction Issues and Interface Proposals) of Appendix A;

b) Interface Output Specification; and

c) Connection Proposal.

8.11 Information and Communications Technology

Refer to paragraph 9.

8.12 Engineering Flexibility & Zoning

Heating, ventilation, electrical and medical gas zoning shall be configured to promote flexibility in order to enable re-modelling and re-planning to be undertaken at a future date.

All engineering services shall be zoned with isolation and safety provision, for the whole of the Facilities and for individual wards and departments. Project Co shall also ensure that zoning accounts for:

a) The requirement for "dirty" / "clean" separation;

b) Solar movement; and

c) The necessity for isolation of part of the Facilities without affecting the entire Facilities.

8.13 Services Capacity Reserve

In accordance with Good Industry Practice, all plant, plant spaces and building services systems shall be specifically designed and provided with defined reserve capacity allowances and future expansion capabilities for the Facilities (e.g. distribution boards with 25% spare capacity for the buildings as designed).

In addition to the reserved capacity allowances in relation to the building as defined in this Sub-Section C, Project Co shall also ensure reserve capacity, service termination, zoning and general arrangement supports any future extension of the building that may be an optional feature of Project Co's Proposals.

8.14 Service Routes

All service voids, risers and other spaces shall allow for installation of additional services and shall provide a defined reserve of a minimum 25% of useable area through routing cross sectional area. All isolating valves and other items requiring particular access shall be positioned at convenient locations with permanent access provision and which do not impede execution of the clinical functions or and/or provision of the Clinical Services in the space.

Services shall be arranged in a clearly zoned spatial hierarchy in ceiling voids, risers and plant spaces.

Access to services shall not be given in clinical areas.

All service voids, risers, plant rooms and other service / plant spaces shall be designed to easily facilitate the future removal of building services within each space.

In order to minimise potential disruption to the Board due to maintenance of building services, Project Co shall where practicable route services through common spaces such as corridors and avoid through routing within department areas.

All new ductwork shall be provided to allow cleaning of internal surfaces and components to be undertaken as detailed in the HVCA Document TR19 Cleanliness of Ventilation Systems.

8.15 Commissioning & Testing

All buildings, services and equipment shall be commissioned by Project Co to ensure that all they are compliant with the quality and performance specifications, including manufacturer's recommendations, and that all systems operate to the Board's satisfaction.

Project Co shall as a minimum commission the Facilities in accordance with the 'Guidance to Engineering Commissioning' published by The Institute of Hospital Engineers (1995).

Project Co shall be responsible for demonstrating and certifying to the Board the successful completion of all commissioning testing, and compliance with all relevant standards.

Project Co shall provide a comprehensive set of Operation and Maintenance Manuals (in hard and electronic forms) for all installed and commissioned equipment in a format specified in paragraph 4.5.17 and in accordance with the requirements in Clauses 17.18 and 18 of the Project Agreement.

Project Co shall provide such staff training as is deemed necessary by the Board details of training proposed shall be submitted to the Board as Reviewable Design Data for review by

the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

9 Information and Communications Technology (ICT) Requirements

9.1 Introduction

The Board recognises the importance of information and communication in the provision of Clinical Services and Non-Clinical Services and Operational Services in the modern health care environment; having the right information available and efficient means of communication enables improved efficiency. There is an increasing reliance on ICT infrastructure to meet these requirements both in terms of performance and availability.

This specification is intended to co-ordinate the various aspects of ICT provision within the Board's operations. The specification does not describe all individual systems and their operation in great detail, but identifies the various information and communication systems, the Board's current strategies for their development and maintenance, the obligations placed on Project Co.

9.2 Overall Requirements

Project Co shall design, construct, manage and maintain a comprehensive, resilient and robust ICT infrastructure for the Facilities. For avoidance of doubt, this includes the detailed requirements set out in the Interface Output Specification and Connection Proposal and relevant provisions of paragraph 4 and in the Schedule Part 11, Equipment Schedule.

Particular consideration shall be given to how ICT can be used to aid patient and staff flow throughout the Facilities.

Project Co shall provide only those ICT systems that are fully compatible with the Board's operational IT systems. For avoidance of doubt, it is the responsibility of Project Co to ensure the full integration and compatibility of the ICT systems. Project Co shall comply with the NHS Lothian E-Health Strategy.

Although this paragraph 9 will be of prime interest to the ICT designer, there is information contained here that Building Services designers and Architects may require for their designs.

9.3 User / Functional Requirements

Project Co shall liaise with the Board to robustly identify and capture all User and Functional Requirements required within each ICT system to support key departmental operational requirements.

Project Co shall ensure that these captured user and technical requirements are contained within the subsequent design and selection of appropriate and compatible manufacturer products and systems.

9.4 System Availability

Project Co shall design each ICT system to meet the System Availability targets set by the Board. This shall include the provision of appropriate hardware and software redundancy within the system design.

9.5 System Assurance

Project Co shall demonstrate that the proposed ICT design solutions comply with the Board's User and Functional Requirements.

Project Co shall submit a Reliability Block Diagram (RBD) for each ICT system to demonstrate that the Board's System Availability targets are met. This shall highlight the Mean Time Before Fail (MTBF) data for each hardware component of the system and show the required hardware and software redundancy implemented within the design.

Project Co shall be responsible for the overall system integration of the telecommunications system, ensuring that all aspects of the system design and installation meet the Board's requirements

9.6 Minimum Engineering Standards

In addition to the publications in paragraph 2 Project Wide Requirement, Project Co shall ensure that the design, construction and selection of components for the ICT works comply with, but not limited to, the following design reference documents:

a) All current relevant British Standards;

b) European Harmonised Standard Specifications and Codes of Practice;

c) Applicable NHS Requirements

d) Electromagnetic Compatibility Regulations 2006;

e) ISO/IEC 11801:2002 Information Technology - Generic Cabling for Customers Premises;

f) BS EN 50173-1: 2011 (Information Technology – Generic Cabling Systems)

g) BS EN 50174-1: 2009 (Information Technology – Cabling Installation Part 1 Specification and Quality Assurance)

h) BS EN 50174-2: 2009 (Information Technology – Cabling Installation Part 2 Installation Planning and Practices inside Buildings)

i) BS EN 50174-3:2003 (Installation technology. Cabling installation. Installation planning and practices outside buildings)

j) BS 6701:2010 Telecommunications equipment and telecommunications cabling. – Specification for installation operation and maintenance.

k) BS 7718: 1996 Code of Practice for Installation of Fibre Optic Cabling.

l) BS 7430: 1998 Code of Practice for Earthing

m) BS EN 50310: 2000 Application of Equipment Bonding and Earthing in Buildings with Information Technology Equipment

n) TIA/EIA-568 B-SET: 2001 (Commercial Building Telecommunications Cabling Standards).

o) TIA/EIA-569 B-SET: 2004 (Commercial Building Standard for Telecommunications Pathways and Space).

p) TIA/EIA-606-A: 2002 (Administration Standard for commercial Telecommunications Infrastructure)

q) TIA/EIA-607: 1994 (Commercial Building Grounding and Bonding Requirements for Telecommunications)

r) TIA/EIA-TSB67: 1995 (Transmission Performance Specifications for Field Testing of Unshielded Twisted Pair Cabling Systems)

s) ISO/IEC 11801:2002/Amd 2:2010/Cor 1:2010 (Information Technology – Generic Cabling for Customer Premises)

t) Relevant technical specifications (or equivalent) in the following order of precedence;

u) British Standards transposing European Standards;

v) European technical approvals;

w) common technical specifications;

x) International Standards; or

y) other technical reference systems established by the European standardisation bodies.

z) If the technical specifications referred to in u) are insufficient to meet the ICT requirements, Project Co shall make reference to the following technical specifications (or equivalent):

aa) British Standards;

bb) British technical approvals;

cc) British technical specifications relating to the design, calculation and execution of the work or works and use of the products; or

dd) DfT publications, standards and technical memoranda.

ee) Relevant OFTEL and DTI Standards, Publications and Regulations.

ff) Relevant Legislation.

In complying with any standard, Project Co shall equally comply with any published amendments and revisions issued up to Financial Close.

9.7 Responsibilities Matrix

Responsibilities for the delivery of aspects of the various ICT systems are set out in the table below:

Service / Technology	System Design	Construction / Provision	Management	Maintain/ Lifecycle Replace
1. Information Technology (IT)				
System management	N/A	N/A	Board (equipment) / Project Co (infrastructure)	Board (equipment) / Project Co (infrastructure)
System architecture, design	Project Co to Board approval	Project Co	Board	Project Co
Hardware (inc. PCs, printers)	Board	Board	Board	Board
Hubs, servers/switches	Board	Board	Board	Board
NHS Lothian Server Room	Project Co to Board approval	Project Co	Board	Board
NHS Lothian Node Rooms	Project Co to Board approval	Project Co	Board	Board
Containment	Project Co to Board approval	Project Co	Project Co	Project Co
Cabling and faceplates	Project Co to Board approval	Project Co	Project Co	Project Co
Testing & Commissioning of Project Co Equipment	N/A	Project Co (with Board in attendance)	Project Co	Project Co
Testing & Commissioning of Board Equipment	N/A	Board	Board	Board
IT dedicated UPS	Project Co (infrastructure only) to Board approval - Board to provide as a part of Hardware	Project Co (infrastructure only) - Board to provide as a part of Hardware	Board (equipment) / Project Co (infrastructure)	Board (equipment) / Project Co (infrastructure)
Final connections to hardware, hubs, UPS, external links and other equipment	N/A	Board	Board	Board
Facilities for seminar rooms, presentation spaces, reception areas, offices	Project Co (infrastructure only) to Board approval, refer Schedule Part 11, Equipment Schedule	Project Co (infrastructure only) / Board (equipment)	Board (equipment) / Project Co (infrastructure)	Board (equipment) / Project Co (infrastructure)
Links to Other Organisations	Project Co (infrastructure only) to Board approval	Project Co (infrastructure only) / Board (equipment)	Board (equipment) / Project Co (infrastructure)	Board (equipment) / Project Co (infrastructure)
Video Conferencing links/ facilities – external, internal	Project Co (infrastructure only) to Board approval, refer Schedule Part 11, Equipment Schedule	Project Co (infrastructure only) / Board (equipment)	Board (equipment) / Project Co (infrastructure)	Board (equipment) / Project Co (infrastructure)

Service / Technology	System Design	Construction / Provision	Management	Maintain/ Lifecycle Replace
2. Telephone System				
System management	N/A	N/A	Board	Board
System architecture/design	Board	Board	Board	Board
PBX System	Board	Board	Board	Board
Operator Console	Board	Board	Board	Board
Hand sets	Board	Board	Board	Board
Pagers / staff location system	Board	Board	Board	Board
Containment	Project Co to Board approval	Project Co	Project Co	Project Co
Cabling and faceplates	Project Co to Board approval	Project Co	Project Co	Project Co
Testing & Commissioning of Project Co Equipment	N/A	Project Co (with Board in attendance)	Project Co	Project Co
Testing & Commissioning of Board Equipment	N/A	Board	Board	Board
Final connections to PBX system	N/A	Board	Board	Board
Telephone System dedicated UPS	Project Co (infrastructure only) - Board to provide as a part of Hardware	Project Co (infrastructure only)	Board	Board
3. Bedhead Services				
System management	N/A	N/A	Project Co	Project Co
System architecture/design	Project Co to Board approval	Project Co	Project Co	Project Co
Nurse Call	Project Co to Board approval (see 4. Nurse Call)	Project Co (see 4. Nurse Call)	Project Co	Project Co
Medical gases	Project Co	Project Co	Project Co	Project Co
Electrical supply	Project Co	Project Co	Project Co	Project Co
Bed lighting	Project Co	Project Co	Project Co	Project Co
ICT – Clinical (Data Outlet(s))	Project Co	Project Co	Project Co	Project Co
ICT – Patients/Public (Data Outlet(s))	Project Co	Project Co	Project Co	Project Co
Voice Outlet	Project Co	Project Co	Project Co	Project Co
Patient Entertainment Systems (TV and Radio facilities)	Project Co (containment and wiring only)	Project Co	Board	Board

Service / Technology	System Design	Construction / Provision	Management	Maintain/ Lifecycle Replace
3. Bedhead Services (Cont'd)				
Testing & Commissioning	N/A	Project Co (with Board in attendance)	Project Co	Project Co
4. Nurse Call				
System management	N/A	N/A	Project Co	Project Co
System architecture/design	Project Co to Board approval	Project Co	Project Co	Project Co
Nurse Call System	N/A	Project Co	Project Co	Project Co
Containment and cabling	Project Co to Board approval	Project Co	Project Co	Project Co
Testing & Commissioning	N/A	Project Co (with Board in attendance)	Project Co	Project Co
5. Fixed Induction Loops				
System management	Project Co	Project Co	Project Co	Project Co
System architecture/design	Project Co to Board approval	Project Co	Project Co	Project Co
System provision	N/A	Project Co to install complete system with potential for expansion	Project Co	Project Co
Testing & Commissioning	N/A	Project Co (with Board in attendance)	Project Co	Project Co
6. Security Systems				
6.1 CCTV				
System management	N/A	N/A	Project Co	Project Co
System architecture / design	Project Co to Board approval	Project Co	Project Co	Project Co
CCTV cameras, detectors, scanners, access units	Project Co to Board approval	Project Co	Project Co	Project Co
Monitors, multiplexes, control equipment hardware and software, recording equipment, servers	Project Co to Board approval	Project Co	Project Co	Project Co
CCTV Equipment Room(s)	Project Co to Board approval	Project Co	Project Co	Project Co

Service / Technology	System Design	Construction / Provision	Management	Maintain/ Lifecycle Replace
6.1 CCTV (Cont'd)				
Containment and cabling	Project Co to Board approval	Project Co	Project Co	Project Co
Testing & Commissioning	N/A	Project Co (with Board in attendance)	Project Co	Project Co
Final connections to hardware	Project Co to Board approval	Project Co	Project Co	Project Co
6.2 Access systems (to be integrated with alarm system)				
Doors and restricted areas	Project Co	Project Co	Board	Project Co
Hold open devices to minimise door damage & fire risk, and optimise "openness" of internal spaces	Project Co	Project Co	Project Co	Project Co
6.3 Alarms (to be integrated with access control system)				
Intruder	Project Co to Board approval	Project Co	Board	Project Co
Personal safety alarms	Project Co to Board approval	Project Co	Board	Project Co
Equipment alarms (Board)	Project Co to Board approval	Project Co	Board	Project Co
Equipment alarms (Project Co equipment)	Project Co	Project Co	Project Co	Project Co
Lift alarms, link to emergency base (REM or similar)	Project Co to Board approval	Project Co	Project Co / Board	Project Co
Patient Tagging	Project Co to Board approval	Project Co	Board	Project Co
Equipment Tagging	Project Co to Board approval	Project Co	Board	Project Co
7. Wireless Network				
System management	N/A	N/A	Board	Project Co
System architecture / design	Project Co to Board approval	Project Co	Project Co	Project Co
Wireless Network Cabling Infrastructure	Project Co to Board approval	Project Co	Project Co	Project Co
Containment and cabling	Project Co to Board approval	Project Co	Project Co	Project Co
Wireless Access Points (Inclusive of Wireless Surveys)	Project Co to Board approval	Project Co	Project Co	Project Co

Service / Technology	System Design	Construction / Provision	Management	Maintain/ Lifecycle Replace
7. Wireless Network (Cont'd)				
Wireless Access System (LAN Controllers, Wireless Control System and network interface / firewalls. This list is not exclusive).	Board	Board	Board	Board
Testing & Commissioning	N/A	Project Co (with Board in attendance)	Project Co	Project Co
Final connections to wireless network	N/A	Board	Board	Board
8. Intercom				
System management	N/A	N/A	Project Co	Project Co
System architecture/design	Project Co to Board approval, refer to Sub-section D Specific Clinical Requirements	Project Co	Project Co	Project Co
Intercom System	N/A	Project Co	Project Co	Project Co
Containment and cabling	Project Co to Board approval	Project Co	Project Co	Project Co
Testing & Commissioning	N/A	Project Co (with Board in attendance)	Project Co	Project Co
9. Video Telemetry				
System management	N/A	N/A	Project Co	Project Co
System architecture/design	Project Co to Board approval, refer to Sub-section D Specific Clinical Requirements	Project Co	Project Co	Project Co
Video Telemetry System	N/A	Project Co	Project Co	Project Co
Video Recording Equipment	N/A	N/A	Board	Board
Containment and cabling	Project Co to Board approval	Project Co	Project Co	Project Co
Testing & Commissioning	N/A	Project Co (with Board in attendance)	Project Co	Project Co
10. Others				
Public Area Phones	Project Co (infrastructure and equipment except handset) / Board (handset)	Project Co (infrastructure and equipment except handset) / Board (handset)	Project Co (infrastructure and equipment except handset) / Board (handset)	Project Co (infrastructure and equipment except handset) / Board (handset)

Service / Technology	System Design	Construction / Provision	Management	Maintain/ Lifecycle Replace
10. Others (Cont'd)				
Television / radio, common areas/patient information systems – Groups 2A, 2B and 3 Equipment as per Schedule Part 11, Equipment Schedule	Project Co (infrastructure only) to Board approval, refer Schedule Part 11, Equipment Schedule	Project Co (infrastructure only) / Board (equipment)	Board (equipment) / Project Co (infrastructure)	Board (equipment) / Project Co (infrastructure)
11. Building Management System (BMS)				
System management	Project Co	Project Co	Project Co	Project Co
System architecture/design	Project Co to Board approval	Project Co	Project Co	Project Co

Where in the foregoing table any item is stated to be for the Board approval then all information relating to such item shall be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

9.8 Structured Cabling System

The Structured Cabling System (SCS) shall be a single fully integrated design to provide the physical connectivity for the following systems, as a minimum:

a) data network;

b) voice network.

Project Co shall provide a data network infrastructure capable of supporting as a minimum but not limited to the following systems:

a) On-line clinical and non-clinical information systems.

b) Internet, intranet and email services; and

c) Patient Entertainment System

Project Co shall provide a voice network infrastructure that is capable of supporting, but not limited to the following systems:

a) Conventional voice;

b) Voice over internet protocol (passive provision for future VoIP installation);

c) Modem and fax services;

d) Phone to the bedhead;

e) Public area telephones; and

f) Public taxi ordering telephones.

Project Co shall provide the necessary resilience within the voice and data network designs.

9.8.1 Cabling

The Board's requirement for structured cabling is Cat 6a.

All cabling installed shall allow for a minimum of 25% spare capacity.

Cables, which pass through the infrastructure of a building shall be suitably protected against damage. Through walls and floors this shall involve an appropriate type of sleeve, through any form of metalwork or stiff plastic then a rubber grommet shall be used.

9.8.2 Data Patch Panels

Project Co shall take cognisance of the ICT requirements and provide patch panels accordingly.

9.8.3 Data Outlets

The data and voice outlets shall be RJ45 and shall utilise lead-frame technology for improved performance and reduced depth. The outlet contacts shall be silver-plated and positioned at 45º to the copper core of the cable to increase the number of possible re-terminations and provide a gas tight seal.

The outlets shall be appropriate for the Board's Construction Requirements in this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non Clinical Requirements); and the rooms / spaces identified.

9.9 NHS Lothian Server and NHS Lothian Node Rooms

Project Co shall provide all NHS Lothian Server and NHS Lothian Node Rooms and any other ICT equipment rooms required to serve the ICT systems to be provided for the Facilities.

No Project Co equipment shall be installed within any NHS Lothian Server Room or NHS Lothian Node room.

The final size and location of the NHS Lothian Server and NHS Lothian Node Rooms shall be dependent upon Project Co's final design the details of which shall be Reviewable Design Data (e.g. physical restrictions of cable run lengths etc).

Project Co shall ensure that the environmental conditions in the NHS Lothian Server and NHS Lothian Node Rooms are sufficient to allow for safe operation and working on plant and equipment. Project Co should also avoid the use of basement spaces due to the risk of flooding. No water, steam or waste services shall be located either in or directly above NHS Lothian Server / NHS Lothian Node Rooms due to risk of water damage. Project Co shall install security bars / shutters on the windows.

9.10 Wireless Network

Project Co shall provide 100% wireless network coverage throughout the Facilities.

Project Co shall establish the required number of Wireless Access Points by means of a comprehensive wireless access survey of the Facilities.

Each Wireless Access Point shall be Power-over-Ethernet (PoE) and provided with a double data outlet mounted below the ceiling,. Project Co shall provide the wireless equipment at each Wireless Access Point, with the cabling used to connect the wireless access points to the Board's Wireless Access System.

9.11 External Services

Routes shall be provided by Project Co from two independent external access points (ducts) to the NHS Lothian Server Room. These shall be of a size suitable for external grade multi-core fibre cable(s), and copper multi-core cable(s). Project Co shall ensure that the Board is granted free access to these ducts at all times so that it may access communications services provided by any third party it wishes to nominate.

9.12 Helpdesk

Project Co will establish a Helpdesk in the RHSC building all in accordance with the requirements of Schedule Part 12 Section 1 with associated to infrastructure to receive respond to calls. The helpdesk and infrastructure should also have the facility to receive and redirect calls to the NHSL Estates Helpdesk as necessary.

9.13 Communication & Connectivity with the RIE Facilities

9.13.1 Infrastructure

Project Co shall provide a 24 core single mode fibre optic cable from the NHS Lothian Server Room in the Facilities to the RIE Facilities. The connection will be to the Communications Rooms 1 and 2 and Server Rooms 1 and 2 in the RIE Facilities. Project Co shall provide 2 x fibre backbone cabling (Topology: - Diverse Star; Type: - OS1 - 9 micron; Cores: - 24 for each type with 100% expansion capacity to be provided in the cable tray runs).

9.13.2 System Connectivity/Interfaces between the Facilities and RIE Facilities

Project Co shall provide links for the Data network to the RIE Facilities. Project Co shall comply with the requirements of the Interface Output Specification, Connection Proposal and the relevant provisions of paragraph 4.

9.14 Induction Loop

The design of the Facilities shall include a system of induction loops with suitably located dedicated sockets and signage in areas such as reception areas, bedded bays, single, treatment, consulting, counselling and interview rooms. Additionally, the design shall reflect these requirements in areas such as offices where staff may require this facility.

Project Co shall provide induction loop or infrared systems in accordance with the Equality Act 2010 requirements. The final provision and locations are to be submitted as Reviewable Design Data for review and agreement by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement, dependent upon the final design solutions. The Board would prefer to see a building-wide system installed but experience has shown that this often raises issues of confidentiality.

Project Co shall therefore ensure the provision of portable hand held systems for use by visitors that shall be made available at Enquiry/Information Desks at the Entrances. This shall ensure that the parts of the Facilities not provided with induction loops or infrared systems are made accessible to all users.

The “ear” symbol denoting the presence of an induction loop shall be prominently displayed. A sign shall explain clearly to people using hearing aids how they can benefit from the induction loop.

Alternatively, proven systems that do not raise issues of patient confidentiality can be proposed by Project Co to provide Facilities wide coverage as appropriate.

9.15 Public Address System

No requirement for a general public address system within the Facilities.

9.16 Intercom

Project Co shall provide an intercom system for the Facilities to meet the requirements of Board’s Construction Requirements in this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and other areas highlighted in Schedule Part 11 Equipment Schedule and Board’s Construction Requirements Part 6 Section 6 Room Data Sheets.

9.17 Video Telemetry

Project Co shall provide a video telemetry system within the Facilities to meet the requirements of the Board’s Construction Requirements in this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) in the rooms identified. The video telemetry system shall be provided over fibre optic connections between the relevant departments.

9.18 Public Telephone Ordering Service

Project Co shall install the telephone system for the public to make free phone calls to order a taxi and contact other organisations that may include Traveline Scotland, Smokeline and NHS24. The Board will determine the organisations to be contacted by the public telephone ordering service. Project Co shall provide a telephone system that shall accommodate new or replacement telephone numbers during the Operational Term. The public telephone ordering service is to be provided in the DCN reception and RHSC reception. The Board will provide the telephone handsets and signage for the handsets as Board Equipment in accordance with the relevant provisions of Schedule 11, Equipment Schedule. The Board will arrange the taxi ordering service prior to Completion and during the Operational Term.

9.19 Security

9.19.1 General

Project Co shall provide security systems specifically designed to meet the requirements of each department / unit and shall comply with the Interface Output Specification, the Connection Proposal and relevant provisions of paragraph 4.

The systems shall present a secure and reassuring environment for patients, staff, families and visitors by providing appropriate security measures within the particular restraints imposed by clinical demand and personal freedom. The design of the Facilities shall ensure maximum protection and minimize exposure to crime in internal and external areas.

Project Co shall provide the required control, monitoring and recording equipment within the security office. The security system needs to allow for the security officer to be able to respond to alerts (staff attack and fridge/freezer alarms) when not in the security office.

The design for all security systems shall be in line with the general principles of the approach suggested by Secured by Design.

Local alarm annunciation shall be provided within wards and at the central security desk.

The Board will monitor the CCTV system, including controlling access to, and the disclosure of, CCTV images.

9.19.2 Panic Alarm System

Project Co shall provide a panic alarm system, which will provide total coverage for the Facilities. The system shall be capable of emitting both audible and visual warnings to alert staff and security to the fact that there is an attack or a situation has arisen in which patients, visitors or other staff members are in danger. Service requirements shall dictate where the alarm is annunciated but as a general guide the panic alarm shall raise an alarm locally and at the security office. The system shall be capable of highlighting the exact location of the staff member in distress.

The system shall be inclusive of personal panic alarms for all staff.

9.19.3 Nurse Call Systems

Project Co shall provide a comprehensive nurse call system at all bed locations (and ensuites), nurse stations, toilets and showers, TV Rooms and all other areas frequented by patients (refer to Schedule Part 11, Equipment Schedule for details). The system must be capable of emitting both audible and visual warnings for the following situations:

a) To summon a nurse (Patient to Nurse);

b) To highlight a medical emergency (Nurse to Nurse); and

c) To highlight a non-medical emergency (Nurse to Nurse).

Project Co shall ensure that both visual and audible warnings are sited in positions that enable the appropriate staff to respond to the exact location of the call both efficiently and effectively. Project Co shall ensure that the warnings, both visible and audible, shall be

specific to the type of emergency and must be consistent throughout all areas of the Facilities. The system incorporates a two-way hands free voice communication system with paging facility.

Project Co shall provide systems that comply fully with the requirements of relevant Health Planning Standards in particular SHTMs, HTMs, SHBNs and HBNs. In addition these systems shall interface fully with the information technology system to enable on-screen alerts at locations details of which are to be submitted as Reviewable Design Data for review and agreement by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

Project Co shall ensure that the nurse call button / cord meet the need of the particular patient that may be required to use the Facilities. Patients may have cognitive problems or have difficulties with mobility. The Nurse Call units for all patients shall be provided with safety cords.

9.19.4 Patient and Equipment Tagging System

Project Co shall provide patient and equipment tagging to the locations detailed in RHSC and DCN Patient and Equipment Tagging System Requirements Table. Details of the method of tagging are to be submitted as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

RHSC and DCN Patient and Equipment Tagging System Requirements Table

Ref	Department	Patient Tagging	Equipment Tagging
RHSC SPECIFIC DEPARTMENTS			
A	***Front Door - A&E / Assessment Ward***		
A1	Emergency Department		√
A2	Paediatric Acute Receiving Unit - 34 Beds	√	√
A3	PARU / Emergency / Radiology Shared Support		√
A4	Adult Link		
B	***Critical Care / HDU / Neonatal Surgery***		
B1	PICU and HDU's - 24 Beds	√	√
C	***RHSC In Patient Pathway / Ward Care***		
C1.1	Medical Inpatients - 23 Beds	√	√
C1.2	Surgical Long Stay Inpatients -15 Beds	√	√
C1.3	Neuroscience Inpatients - 12 Beds	√	√
C1.4	Haematology / Oncology Inpatients & Daycases - 17 Beds & 2 Chairs	√	√
C1.5	Med / Surg / Neuro / Haemo Shared Support	√	√
C1.6	Adolescent Shared Accommodation	√	√
C1.7	Paediatric Neurophysiology	√	√

Ref	Department	Patient Tagging	Equipment Tagging
C1.8	Surgical Short Stay Inpatients - 14 Beds	√	√
C2	RHSC Wards Support Areas		√
C3	Special Feeds Unit	√	√
C4	Sleep Lab	√	
C5	Classrooms		
D	***RHSC Ambulatory Care***		
D1	RHSC Main Outpatients		√
D2	Cardiology & Respiratory		√
D3	Orthoptics		√
D4	Audiology		√
D5	Paediatric Dentistry		√
D6	RHSC Therapies		√
D7	Plastics Dressings Clinic		√
D8	Social Work		
D9	Medical Day Care Unit - 5 Beds	√	√
D10	Ambulatory Care Shared Support		
E	***O-Zone***		
E1	POD		√
F	***Child and Adolescent Mental Health***		
F1	Child & Adolescent Mental Health Services - 12 Beds	√	√
G	***Clinical Support***		
G2	Equipment Library		√
H	***Academic***		
H1	Child Life & Health		√
H2	Clinical Research Facility	√	√
H3	Clinical Education Suite		√
I	***Facilities / Infrastructure Support Services***		
I1	RHSC Entrance		√
I2	Bed & Toy Stores		√
J	***Patient / Family Support***		
J1	Bereavement Suite		√
J2	Spiritual & Pastoral Care		√
K	***Family Facilities***		

Ref	Department	Patient Tagging	Equipment Tagging
K1	Family Support		√
K2	Family Hotel - Ronald McDonald	√	√
DCN SPECIFIC DEPARTMENTS			
L	***DCN In Patient Pathway / Ward Care***		
L1	DCN Acute Care - 24 Beds	√	√
L2	DCN Inpatients - 43 Beds	√	√
M	***DCN Out Patient Departments***		
M1	DCN Outpatients		√
M2	DCN Therapies		√
M3	Programmed Investigations Unit		√
M4	DCN Neurophysiology		√
N	***DCN Support Space***		
N1	DCN Entrance		√
N2	DCN Wards / Health Records Support		
JOINT DEPARTMENTS			
P	***Combined Theatres***		
P1	Operating Theatres & RHSC Surgical Day Case Unit	√	√
Q	***Combined Radiology***		
Q1	Radiology	√	√
R	***Office / Admin Support Services***		
R1	Clinical / Management Suite		√
R2	Health Records		√
S	***Combined Facilities / Infrastructure Support Services***		
S1	Kitchen		√
S2	e-Health Infrastructure		
S3	Domestic Services		√
S4	Materials Management		
S5	Central Staff Changing		
S6	Estates		
S7	Restaurant		
S8	Sterile Supplies Store		√
S9	Helipad Support		√

Ref	Department	Patient Tagging	Equipment Tagging
T	***Combined Plant***		
T1	Node Room		

9.19.5 Alarms & Intruder Detection System

Project Co shall provide an Intruder Detection System (IDS) within the Facilities to provide out of hours security cover. This shall be provided by PIR Detectors located within the corridors, and rooms with ground floor windows internally adjacent to any roof access points. In addition Project Co shall ensure that restricted areas have door contacts available for monitoring unauthorised entry.

Project Co shall ensure that the proposed alarm systems for the Facilities include lifts, refrigeration equipment and other critical equipment. Project Co shall ensure that the alarm systems can be monitored on Site and also remotely outwith the Facilities.

9.19.6 Security Access Control

Project Co shall provide a comprehensive access control system to all external access doors and to internal doors requiring restricted access including access control doors to NHS Lothian Server and NHS Lothian Node Rooms, Main entrance doors to Departments, FM and Patient Bed Lifts, Helipad and each ward bay. Project Co shall provide a comprehensive access control systems to meet the requirement of the Board's Construction Requirements in this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements). In addition other areas with restricted access as defined by the Board.

Ward access control doors shall also be fitted with a video entry door access system. All video entry camera shall be suitable for viewing of visitors in wheel chairs.

Project Co shall ensure the system includes all necessary power supplies, card readers, actuators, egress buttons and emergency "break-glass" release units.

The system installed by Project Co shall be separate from the Board's data network.

Project Co shall provide door entry video intercom systems to the main entrance door and the delivery entrance.

9.19.7 External CCTV

Project Co shall provide a comprehensive colour CCTV system covering all external access points, car parking and external pedestrian circulation routes around the Site.

The system installed by Project Co shall be separate from the Board's data network.

The design shall also take cognisance of the Board's Construction Requirements in this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements).

Project Co shall ensure that the system comprises a multi-channel digital recorder with a recording frame per second for each camera which is in accordance with a detailed engineering specification to be agreed with Lothian and Borders Police.

The digital recorder shall also control playback of images onto a CCTV monitor.

All recorded images should be of sufficient quality to be used for evidential purposes.

9.19.8 Internal CCTV

Project Co shall provide a comprehensive colour CCTV system covering all corridors, entrances, lift lobbies, First Floor link to the RIE Facilities, Emergency Department, hospital street and other areas where members of the public gather or areas where access is to be restricted i.e. wards.

The system installed by Project Co shall be separate from the Board's data network.

The design shall also take cognisance of the Board's Construction Requirements in this Schedule Part 6 Section 3 Sub-Section D (Specific Clinical Requirements) and Sub-Section E (Specific Non-Clinical Requirements).

Project Co shall ensure that the system comprises a multi-channel digital recorder with a recording frame per second for each camera which is of sufficient quality to allow recorded images to be used for evidential purposes.

The digital recorder shall also control playback of images onto a CCTV monitor.

9.19.9 Monitoring of CCTV Images

All internal and external CCTV camera images shall be transmitted back to the CCTV monitoring equipment located within the security office to be provided within the Facilities.

9.19.10 Clinical Equipment

Each ward drug fridge shall be alarmed to warn of common faults. The sounder shall be located locally for ward fridges in areas manned 24/7 or located in the Security base when the area is not manned 24/7.

Each Ultra Low Temperature freezer, laboratory fridge and laboratory freezer in H1 Child, Life and Health, H2 Clinical Research and U1 Inborn Metabolic Disorders Laboratory shall be alarmed to warn of common faults. The sounder shall be located locally for fridges and freezers in areas manned 24/7 or located in the security office when the area is not manned 24/7.

9.19.11 Car Park Barriers

Project Co shall provide all power and control wiring associated with vehicle access barriers and shall be compatible with card solutions in use on other Board sites.

9.20 TV & Radio Facilities

Project Co shall provide the infrastructure for reception and distribution of television and radio for use by patients, visitors and staff. This shall include external aerials / dishes, containment and cabling / distribution and the like to enable Freeview TV services and Radio Lollipop Radio services to be distributed throughout the Facilities.

Television and radio will primarily be required for individual rooms and spaces as set out in the Schedule Part 11, Equipment Schedule.

10 Helipad Requirements

Project Co shall provide a rooftop helipad sited such that it gives direct access to the DCN 'Hot' core.

10.1 Minimum Compliance Requirements

In addition to the publications in paragraph 2 (Project Wide Requirement), Project Co shall ensure that the helipad shall be sited, constructed and maintained in accordance with the compliance requirements contained in:

a) HBN15-03 Hospital Helipads;

b) The Air Navigation Order 2009, as amended;

c) International Civil Aviation Organisation (ICAO) Annex 14 Volume II, as amended;

d) ICAO Doc 9261-AN/903 Heliport Manual;

e) Civil Aviation Authority (CAA) Safety Regulation Group CAP 168 Licensing of Aerodromes; as amended;

f) CAA Safety Regulation Group CAP 437 Offshore Helicopter Landing Areas - Guidance on Standards;

g) CAA Safety Regulations Group CAP 789 Requirements and Guidance Materials for Operators;

h) CAA CAP 637 Visual Aids Handbook:

i) Joint Aviation Authority (JAA) Joint Aviation Requirements JAR-OPS 3: Commercial Air Transportation (Helicopters):

j) National Fire Protection Association (NFPA) 418 Standard for Heliports

10.2 Helicopter Operators

The helipad shall be designed to accommodate helicopters provided by the following helicopter operators:

a) Scottish Ambulance Service Air Ambulance

b) Ministry of Defence (MOD),

c) Maritime and Coastguard Agency (MCA),

d) Police Helicopters,

e) all other emergency service providers, and

f) their replacements.

Project Co shall consult with the helicopter operators during the design, construction and operation of the helipad and this will only be done through the Board. Project Co will have no direct contact with the helicopter operators.

10.3 Helipad Requirement

The helipad shall be designed to permit daytime landings, night-time landings and take offs and flights affected by poor visibility and low cloud. The helipad will require to pass inspection by the Civil Aviation Authority and Mobile Air Operations Team (MAOT) before the Actual Completion Date particularly with regard to compliant visual aids, lighting and Rescue and Fire Fighting Services (RFFS) provision for the helicopters to be served. Adequate space shall be made available for critical engineering services such as fire fighting, helipad access and helipad lighting. Electrical equipment providing power to the helipad must be supported by an Uninterrupted Power Supply (UPS) provided by Project Co. The lighting shall not cause a trip hazard.

The helipad will be constructed at least 3 metres above the roof with at least one ramp. The ramp(s) shall provide a landing at least 1 metre below the level of the helipad on which RFFS personnel can stand with their fire-fighting equipment to observe the arrival and departure of helicopters. The helipad shall be constructed from fire resistant materials. The helipad's drainage shall be separate from both the surface water and foul water drainage systems and shall only pass into the public drainage system once it had passed through a petrol/fuel interceptor.

The patient route from the helipad to the RIE Facilities and RHSC Emergency Departments will be through the Hot Core. There are to be two patient bed lifts, an FM lift and a stair in the Hot Core serving the helipad. The lifts are to have call buttons at the roof of the building (proximate to the helipad) and have key operated access to the roof from the interior of the lifts. Access to the roof area from the lifts and the stair will have security access control. The lifts and stair core structure must terminate below the level of the helipad.

Project Co shall appoint an aviation design specialist with expertise in designing helipads. The Board shall be consulted on the selection and appointment of the aviation design specialist. Project Co shall appoint an aviation design specialist. Project Co shall incorporate the advice and recommendations of the aviation design specialist in meeting the requirements of Schedule Part 6 Construction Matters.

For the avoidance of doubt the Board shall be "the person" referred to in paragraph 2.8 of HBN 15-03 being "the person in charge of an area intended for taking off and landing must cause to be in operation such lighting as will enable the pilot to identify the landing area and direction, and to make a safe landing and takeoff". The Board will provide the trained person for night operations. Project Co shall provide all hardware for the lighting requirements of the helipad. The Board will provide at least one trained person for night operations.

Contrary to paragraph 2.9 of HNB 15-03 the helipad will operate at night, with low visibility and in all levels of cloud cover. The helipad will be provided with Helicopter Approach Path Indicator (HAPI) that complies with CAA CAP 637 Visual Aids Handbook.

There is no requirement for refuelling of helicopters. Helicopters will not be based at the helipad.

The helipad is to be category H2 in terms of ICAO Annex 14 Volume II, Chapter 6 and is to have RFFS to H2 RFFS Standard to comply with CAA Safety Regulations Group CAP 789. Project Co shall ensure that the helipad is sufficiently robust to accommodate the largest of

these helicopters in common use in the UK. In terms of HBN 15-03 item 11.9 the helicopter operator is Air Ambulance.

The RFFS facilities will be provided by Project Co during construction and during the Operational Term. The risk assessment to justify the scale of RFFS facilities and standards will be carried out by the Board and provided to Project Co.

The accommodation for male and female RFFS personnel to store, lay out and put on their protective equipment quickly is to be located on the floor serving the helipad. A drench shower to allow PPE to be cleaned / decontaminated before the RFFS personnel enter the building is to be located by the external entrance to the accommodation for male and female RFFS personnel.

Project Co shall provide the means for CCTV viewing of the whole of the helipad from monitors located in the Security Office. In addition when the helipad is in operation Project Co shall provide the means for CCTV viewing of the whole of the helipad from monitors located in the accommodation for the RFFS personnel.

The Board will provide the RFFS personnel. The RFFS personnel are not expected to spend long periods on the helipad. The Board will provide the RFFS medical equipment. The Board will be required to make contact with the CAA to inspect the (RFFS) and lighting.

The stores for the rescue and medical equipment, complementary fire-fighting agents and dedicated patient trolley and a Unisex WC shall be located on the floor serving the helipad.

The name of the hospital to appear to the pilots is “RIE”.

The Board will produce the Development Control Plan that refers to the helipad.

Project Co shall have responsibilities in regard to HBN 00-07: Resilience Planning for the Healthcare Estate for the helipad. Details of the helipad are to be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement.

The Board should include specific risks created by helicopters using the hospital helipad in their overall site risk assessments.

The Board shall provide the Helipad Operation Manual and audit the helipad routinely for compliance with the Manual.

10.4 Helipad Permissions

The Board will prepare the details for and obtain the necessary permission for the helipad from the Scottish Ministers (in their capacity as land owners). The Board will make the Police aware of the helipad’s presence prior to Financial Close.

PART 6

Section 3: The Board's Construction Requirements

Sub-Section D: Specific Clinical Requirements

This Schedule Part 6 Section 3 Sub-Section D forms the Specific Clinical Requirements included in the Board's Construction Requirements Specification. Project Co shall satisfy all the requirements under this Sub-Section D.

It contains design philosophy and specific requirements for each of the clinical services to be provided from the Facilities.

PART 6

Section 3: The Board's Construction Requirements

Sub-Section E: Specific Non-Clinical Requirements

This Schedule Part 6 Section 3 Sub-Section E forms the Specific Non-Clinical Requirements included in the Board's Construction Requirements Specification. Project Co shall provide Facilities which interface with all the requirements under this Sub-Section E.

PART 6

Section 3: The Board's Construction Requirements

Appendix A: Interface with Campus Site and/or Campus Facilities

PART 6

Section 3: The Board's Construction Requirements

Appendix B: Interface Output Specification

PART 6

Section 3: The Board's Construction Requirements

Appendix C: Environmental Matrix

PART 6

Section 3: The Board's Construction Requirements

Appendix D: Not Used

PART 6

Section 3: The Board's Construction Requirements

Appendix E: Initial Drainage Proposal

PART 6

Section 3: The Board's Construction Requirements

Appendix F: Access Strategy

PART 6

Section 3: The Board's Construction Requirements

Appendix G: Connection Proposal

PART 6

Section 3: The Board's Construction Requirements

Appendix H: Construction Access Proposal

PART 6

Section 3: The Board's Construction Requirements

Appendix I: Oversail Strategy

PART 6

Section 3: The Board's Construction Requirements

Appendix J: Service Proposal

PART 6

Section 3: The Board's Construction Requirements

Appendix K: Substation Proposal

PART 6

Section 3: The Board's Construction Requirements

Appendix L: Supplemental Drainage Proposal

PART 6

Section 3: The Board's Construction Requirements

Appendix M: TMS

IHS LOTHIAN

PCP 4.32 Derogation Register

	Date	Revision	Issued by
IHSL-XX-XX-SH-001	17/11/2014	*Revision J* *Final agreed derogations, duly signed by all required parties.*	LE / IHSL

No.	Reference	Date Issued	Project Co. Signed	NHSL Signed	Revision/Brief Description/ Notes
001	IHSL-ACO-001	15/09/2014	13/11/2014	14/11/2014	03 Drop Seals -REWORDED AS AGREED BY NHSL
002	IHSL-ACO-002	15/09/2014	13/11/2014	14/11/2014	01 Screens in AC rated walls
003	IHSL-FIRE-001	05/09/2014	13/11/2014	14/11/2014	01 Lifts
004	IHSL-FIRE-002	05/09/2014	13/11/2014	10/11/2014	04 Department Adjacencies (Links to C30 - 051 Summary Item)
006	IHSL-FIRE-004	05/09/2014	13/11/2014	10/11/2014	04 Dampers to Ductwork REWORDED
007	IHSL-FIRE-005	05/09/2014	13/11/2014	14/11/2014	01 Adjacencies LINKS TO C30 (Summary 050)
008	IHSL-FIRE-006	05/09/2014	13/11/2014	14/11/2014	05 Atrium REDRAFTED 13/11/14
010	IHSL-FIRE-008	05/09/2014	13/11/2014	14/11/2014	02 Fire Alarm & Detection
011	IHSL-FIRE-009	05/09/2014	13/11/2014	14/11/2014	02 Fire Stopping
012	IHSL-FIRE-010	05/09/2014	13/11/2014	14/11/2014	01Compartmentation
013	IHSL-FIRE-011	05/09/2014	13/11/2014	14/11/2014	04 Escape Routes
014	IHSL-FIRE-012	05/09/2014	13/11/2014	14/11/2014	02 Temporary Waiting Spaces
015	IHSL-FIRE-013	05/09/2014	13/11/2014	14/11/2014	01 Fire Supression
017	IHSL-FIRE-015	05/09/2014	13/11/2014	14/11/2014	01 Fire Hazard Rooms
019	IHSL-MEP-001	05/09/2014	13/11/2014	14/11/2014	02 Fire Suppression REWORDING ACCEPTED
020	IHSL-MEP-002	05/09/2014	13/11/2014	14/11/2014	02 25% Cabling Capacity
021	IHSL-MEP-003	05/09/2014	13/11/2014	14/11/2014	03 Clinical Equipment Alarms-Rewording Accepted
023	IHSL-MEP-005	05/09/2014	13/11/2014	14/11/2014	01 DRAFT Routes through common services
027	IHSL-MEP-009	05/09/2014	13/11/2014	14/11/2014	01 Luminaire Colour/Temperature
028	IHSL-MEP-010	05/09/2014	13/11/2014	14/11/2014	01 Sprinkler Protection
029	IHSL-MEP-011	05/09/2014	13/11/2014	14/11/2014	03 Fibre Optic Cables
033	IHSL-MEP-015	05/09/2014	13/11/2014	14/11/2014	03 Environmental Matrix REWORDED 12.11.14
034	IHSL-MEP-016	05/09/2014	13/11/2014	14/11/2014	02 Sustainability
035	IHSL-MEP-017	05/09/2014	13/11/2014	14/11/2014	02 Mech Vent / Air Con
042	DER/Arch/02	FT	13/11/2014	14/11/2014	**Submitted C30** Single bedroom/ensuite layout HBN 23
044	DER/Arch/04	FT	13/11/2014	14/11/2014	**Submitted C30** Critical care layout HBN 57
046	DER/Arch/07	FT	13/11/2014	14/11/2014	**Submitted C30** Clinical support spaces layout HBN 00-03
048	DER/Arch/09	FT	13/11/2014	14/11/2014	**Submitted C30** Clinical support spaces layout HBN 00-04
051	DER/Arch/12	FT	13/11/2014	14/11/2014	**Submitted C30** Adult in-patient assisted shower rooms HBN 04-01
054	DER/Aco/01	FT	13/11/2014	14/11/2014	**Submitted C30** Ceilings
064	As/Hel/02	FT	13/11/2014	14/11/2014	**REV 01 15/10/14** Helicopter Weights
065	1	FT	13/11/2014	14/11/2014	**Submitted C30** VIE Equipment
067	3	FT	13/11/2014	14/11/2014	03 (Submitted C30) Blinds/Curtain/Shower Curtain Tracks- Clarification
079	18	FT	13/11/2014	14/11/2014	03 (Submitted C30) Planting Maturity REDRAFTED
082	23	FT	13/11/2014	14/11/2014	**Submitted C30** 25% extra capacity
089	33	FT	13/11/2014	14/11/2014	**Submitted C30** FFE to external works
098	IHSL-ARC-001	15/09/2014	13/11/2014	14/11/2014	01 Clinical Output Specifications 1/4
099	IHSL-ARC-002	15/09/2014	13/11/2014	14/11/2014	01 Single Bedroom Arrangement
100	IHSL-ARC-003	15/09/2014	13/11/2014	14/11/2014	01 Multibed Room Bed Spaces
101	IHSL-ARC-004	15/09/2014	13/11/2014	14/11/2014	02 Theatres Size WORDING AMENDED 07/11/14
102	IHSL-ARC-005	15/09/2014	13/11/2014	14/11/2014	01 Sanitary Spaces - Alternative Layout
103	IHSL-ARC-006	15/09/2014	13/11/2014	14/11/2014	01 Sanitary Spaces - Alternative Layout
104	IHSL-ARC-007	15/09/2014	13/11/2014	14/11/2014	01 Consult Exam Room Sizes
105	IHSL-ARC-008	15/09/2014	13/11/2014	14/11/2014	01 Treatment Room areas
106	IHSL-ARC-009	15/09/2014	13/11/2014	14/11/2014	01 Infection Control
107	IHSL-ARC-010	15/09/2014	13/11/2014	14/11/2014	01 100% Single Bedrooms
110	IHSL-ARC-013	16/09/2014	13/11/2014	14/11/2014	03 Assisted Shower toom to multi-bed rooms
111	IHSL-ARC-014	16/09/2014	13/11/2014	14/11/2014	01 Open Linen Bays
112	IHSL-ARC-015	16/09/2014	13/11/2014	14/11/2014	03 4 bed layout
113	IHSL-ARC-016	16/09/2014	13/11/2014	14/11/2014	01 Viewing Zones
114	IHSL-ARC-017	16/09/2014	13/11/2014	14/11/2014	02 Georgian wired glassPco revised confirmation
115	IHSL-ARC-018	16/09/2014	13/11/2014	14/11/2014	01 Georgian Wired Glass
116	IHSL-ARC-019	16/09/2014	13/11/2014	14/11/2014	01 Vision Panels
117	IHSL-ARC-020	16/09/2014	13/11/2014	14/11/2014	03 Georgian wired glass REWORDED 07/11/14
118	IHSL-ARC-021	16/09/2014	13/11/2014	14/11/2014	01 Door widths
119	IHSL-ARC-022	16/09/2014	13/11/2014	14/11/2014	05 Extent of Shielding
120	IHSL-ARC-023	17/09/2014	13/11/2014	14/11/2014	01 Ironmongery
121	IHSL-ARC-024	17/09/2014	13/11/2014	14/11/2014	01 Equipment - Carcasses
122	IHSL-ARC-025	17/09/2014	13/11/2014	14/11/2014	01 Flexible Hoses-CAMHS
123	IHSL-ARC-026	17/09/2014	13/11/2014	14/11/2014	02 Anti- Ligature
124	IHSL-ARC-027	17/09/2014	13/11/2014	14/11/2014	01 Single Rooms - Bed Spacing 02 Proposal wording revised 22/09/14
125	IHSL-ARC-028	17/09/2014	13/11/2014	14/11/2014	04 Bed Spacing REWORDED
126	IHSL-ARC-029	17/09/2014	13/11/2014	14/11/2014	01 Single Room Accommodation
127	IHSL-ARC-030	17/09/2014	13/11/2014	14/11/2014	01 Car Parking
128	IHSL-ARC-031	17/09/2014	13/11/2014	14/11/2014	01 Drop Off
129	IHSL-ARC-032	17/09/2014	13/11/2014	14/11/2014	01 Building Envelope REDRAFTED 30/10/14
130	IHSL-ARC-033	17/09/2014	13/11/2014	14/11/2014	01 Corridor WidthsREDRAFTED 30/10/14
131	IHSL-ARC-034	17/09/2014	13/11/2014	10/11/2014	02 Windows redrafted 10.11.14
132	IHSL-ARC-035	17/09/2014	13/11/2014	14/11/2014	01 Flooring
133	IHSL-ARC-036	17/09/2014	13/11/2014	14/11/2014	02 Gas Cylinder Storage REWORDED
134	IHSL-ARC-037	17/09/2014	13/11/2014	14/11/2014	01 Heated External Spaces
135	IHSL-ARC-038	17/09/2014	13/11/2014	14/11/2014	01 Escalators
136	IHSL-ARC-039	22/09/2014	13/11/2014	14/11/2014	03 Handrails REVISED WORDING
137	IHSL-ARC-040	15/10/2014	13/11/2014	14/11/2014	01 Helipad Ramp Gradient
138	IHSL-MEP-023	04/11/2014	13/11/2014	10/11/2014	Fiscal Metering
139	IHSL-ARC-041	15/10/2014	13/11/2014	14/11/2014	01 Drainage Life Expectancy
140	IHSL-ARC-042	12/11/2014	13/11/2014	14/11/2014	01 Lift Door Widths
141	IHSL-ARC-001 (2)	12/11/2014	13/11/2014	14/11/2014	01 Clinical Output Specifications 2/4
142	IHSL-ARC-001 (3)	12/11/2014	13/11/2014	14/11/2014	01 Clinical Output Specifications 3/4
143	IHSL-ARC-001 (4)	12/11/2014	13/11/2014	14/11/2014	01 Clinical Output Specifications 4/4

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
15/09/2014	*03 Drop Seals -REWORDED AS AGREED BY NHSL*	IHSL-ACO-001

BCR Clause

[copy text from BCR's / PA, include clause numbers]

In Scottish Health Technical Memorandum 08-01: Specialist services Acoustics (May 2011) it is stated that:

Doors
2.71 Doors are inevitably a weakness in a partition and will reduce the overall acoustic performance of most constructions.
2.72 Reasonable acoustic performance cannot be achieved without seals around the whole door perimeter, including threshold and meeting stiles. It is recognised that there can be significant restrictions on the use of door seals; therefore, doors should be sealed as far as practically possible.
2.73 Possible conflicts with the desired acoustic performance include opening force (including under emergency conditions), infection control, patient safety (for example if double-swing doors are required) and ventilation regimes. Designers should make an informed decision about the provision of door seals when the other restrictions are considered.

Relevant Regulation - HBN, SHTM, Building Regulations etc

[copy text from relevant docts, include clause numbers]

Scottish Health Technical Memorandum 08-01: Specialist services Acoustics (May 2011) - SHTM08-01.

Requirement

[summarise what is being asked for in the docts above]

Table 5 of SHTM08-01 - Matrix showing sound-insulation performance required (dB DnT,w), presents the installed sound-insulation performanced (DnT,w) required for different room types.

Derogation

[why derogation is required]

Due to infection control issues drop seals will only be used in the following rooms:

1. Sleep laboratory
2. Audiology rooms
3. Radio Lolipop Studio
4. Medical Resonance Imaging Rooms
5. Laboratory areas within Specialist Biochemistry Lab and Child Life & Health
6. Single isolation room within Clinical Research Facility
7. Testing rooms within Audiology
8. Plaster Suite within ED + RHSC Outpatients
9. Splinting/Casting Room within RHSC Therapies
10. Orthotics Workshop within RHSC OPD

As stated in 2.72 of SHTM08-01 reasonable acoustic performance cannot be achieved without seals around the whole door perimeter.

In terms of airborne sound insulation between adjacent rooms an indirect airborne transmission path occur through the doors of both rooms. The magnitude of this indirect airborne transmission path is essentially determined by: i) the performance of the

both rooms. The magnitude of this indirect airborne transmission path is essentially determined by: i) the performance of the doors, i.e. the magnitude will increase if the performance of the doors decrease (for ex. if seals are not provided around the all door perimeter) and ii) the location of the doors, i.e. the magnitude will increase if doors from both rooms are close to each other or if they are facing each other.

Therefore, derogation of the acoustical requirement regarding airborne sound insulation between rooms is needed (acoustical requirement stated on Table 5 of SHTM08-01) for:

2. All adjacent rooms that due to user requests have their doors close to each other (side by side) or facing each other.

3. All adjacent rooms that have doors, movable walls, gaps or any other system interconnecting each other.

Proposal
It is proposed that in cases where due to user requests adjacent room have their doors close to each other (side by side) or facing each other the requirements stated in Table 5 of SHTM08-01 should be decreased to 6dB. *It is proposed that in cases where due to user requests adjacent rooms are meant to be interconnect to each other by means of doors, movable walls, gaps or any other system, the requirements stated in Table 5 of SHTM08-01 should not be applied.*
Reference Docts - Sketches, drawings, reference material extracts etc
[give all items a full ref code which can be tracked on Aconex]

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
15/09/2014	01 Screens in AC rated walls	IHSL-ACO-002

BCR Clause

[copy text from BCR's / PA, include clause numbers]

In Scottish Health Technical Memorandum 08-01: Specialist services Acoustics (May 2011) it is stated that:

2.67 Where observation windows are included between adjacent rooms, partitions (including the glass) should ideally achieve the target ratings given in Tables 4 and 5. However, it can be difficult to fit windows that meet the full acoustic specification into the width of partitions. In this case, as a minimum, the glazing configuration alone should achieve an Rw that is no more than 10 dB below that of the required Rw for the partition alone. This will reduce the sound insulation by an amount that depends on the size of the observation window in relation to the size of the partition.

Relevant Regulation - HBN, SHTM, Building Regulations etc

[copy text from relevant docts, include clause numbers]

Scottish Health Technical Memorandum 08-01: Specialist services Acoustics (May 2011) - SHTM08-01.

Requirement

[summarise what is being asked for in the docts above]

Table 5 of SHTM08-01, Matrix showing sound-insulation performance required (dB DnT,w), presents the installed sound-insulation performanced (DnT,w) required for different room types.

Derogation

[why derogation is required]

As stated in SHTM08-01 it can be difficult to fit windows that meet the full acoustic specification into the width of partitions, therefore in these cases a derogation of the acoustical requirement regarding airborne sound insulation between rooms is needed (acoustical requirement stated on Table 5 of SHTM08-01).

Proposal

[what is Project Co alternative Proposal]

It is proposed that in cases where observation windows are included between adjacent rooms, the glazing configuration alone should achieve an Rw 10 dB below that of the required Rw for the partition alone.

Reference Docts - Sketches, drawings, reference material extracts etc

[give all items a full ref code which can be tracked on Aconex]

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
05/09/2014	01 Lifts	IHSL-FIRE-001

BCR Clause

2.3 NHS Requirements
In addition to the standards listed in paragraph 2.4 of this Sub-Section C, unless the Board has expressed elsewhere in the Board's Construction Requirements, a specific and different requirement, the Facilities shall comply with but not be limited to the provisions of the NHS Requirements as the same may be amended from time to time:
i. Firecode
Project Co shall ensure the Facilities comply with the NHS Scotland Fire Safety Management - a suite of documents which explains the policy and technical guidance in fire precautions in hospitals and other healthcare premises, comprising the Health Facilities Scotland Fire Safety Policy, the Scottish Health Technical Memoranda (SHTM) and Scottish Fire Practice Notes (SFPN) which all comprise NHS Scotland Firecode, the Fire Safety Documentation Reference Guide and A Model Management Structure for Fire Safety.
Project Co shall prepare proposals in accordance with NHS Scotland Firecode to be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement prior to the submission of the proposals for approval by the Relevant Authority including without limitation building control department.
In the event of a conflict between the requirements of the local building control officers and NHS Scotland Firecode the more onerous requirements shall take precedence. Project Co shall notify the Board as soon as such conflict is known or suspected and shall further advise the Board of Project Co's proposed relevant design solution as early as possible before formal submission for review by the Board. When the more onerous requirement is to be used the Board will have the right to decide what constitutes the more onerous requirement.
Any fire strategy which affects the Site will also have to have regard to, be compatible with and operate in conjunction with the fire strategy and procedures for the RIE Facilities and/or Retained Estate, as applicable.

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 81 part 1 July 2009
5.19 Where vertical travel is a component of the escape arrangements and bed lifts are installed in the building, they should be escape bed lifts.

Requirement

The guidance within SHTM 81 part 1 recommends that bed lifts are designed as escape bed lifts however the guidance within SFPN 3 Escape Bed Lifts notes that provision should be sufficient.
4. Physical requirements for escape lifts
Escape lift provision
4.1 Sufficient escape lifts should be provided and sited appropriately to accord with the fire evacuation strategy for the premises, developed with full consideration
of the issues outlined in Section 3.
4.2 Where an escape lift is one of a group of lifts within one protected enclosure, all the lifts in the group should be escape lifts in accordance with the standards
specified in this SHTM.
4.3 Sufficient escape lifts should be provided, appropriately remote from each other so that should a fire affect one escape lift, sufficient escape lifts will remain
available for use to enable the organisation's fire evacuation strategy and procedures to be implemented.

Derogation

Not all bed lifts will be designed as escape bed lifts however a sufficient number of escape bed lifts will be provided.

Proposal

It is Project Co's intention to negotiate the number and location of lifts designed as escape bed lifts with the NHS. It is acknowledged that due to the management requirements for the use of lifts during evacuation only a limited number would be used at any one time and therefore providing a limited number is more practical.
It is noted that in England and Wales the applicable HTM guidance recommends a minimum of 2 escape bed lifts. RHSC + DCN will be provided with at least 2 escape bed lifts.

Reference Docts - Sketches, drawings, reference material extracts etc

See fire strategy WSP-SZ-XX-DC-572-500_03

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014

NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
05/09/2014	*04 Department Adjacencies (Links to C30 - 051 Summary Item)*	IHSL-FIRE-002

BCR Clause

2.3 NHS Requirements

In addition to the standards listed in paragraph 2.4 of this Sub-Section C, unless the Board has expressed elsewhere in the Board's Construction Requirements, a specific and different requirement, the Facilities shall comply with but not be limited to the provisions of the NHS Requirements as the same may be amended from time to time:

i. Firecode

Project Co shall ensure the Facilities comply with the NHS Scotland Fire Safety Management - a suite of documents which explains the policy and technical guidance in fire precautions in hospitals and other healthcare premises, comprising the Health Facilities Scotland Fire Safety Policy, the Scottish Health Technical Memoranda (SHTM) and Scottish Fire Practice Notes (SFPN) which all comprise NHS Scotland Firecode, the Fire Safety Documentation Reference Guide and A Model Management Structure for Fire Safety.

Project Co shall prepare proposals in accordance with NHS Scotland Firecode to be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement prior to the submission of the proposals for approval by the Relevant Authority including without limitation building control department.

In the event of a conflict between the requirements of the local building control officers and NHS Scotland Firecode the more onerous requirements shall take precedence. Project Co shall notify the Board as soon as such conflict is known or suspected and shall further advise the Board of Project Co's proposed relevant design solution as early as possible before formal submission for review by the Board. When the more onerous requirement is to be used the Board will have the right to decide what constitutes the more onerous requirement.

Any fire strategy which affects the Site will also have to have regard to, be compatible with and operate in conjunction with the fire strategy and procedures for the RIE Facilities and/or Retained Estate, as applicable.

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 81 part 1 July 2009

3.11 The departments in the following List A should:

never be directly below, nor directly adjoin, operating theatres, intensive therapy units or special care baby units; and be provided with a fire suppression system where they are directly below, or directly adjoin, any other hospital department to which patients have access.

List A
- Boiler House
- Central Stores
- Commercial enterprises
- Flammable stores
- Laundry
- Main electrical switchgear
- Main kitchens
- Refuse collection and incineration
- Works department

Other high hazard departments may be adjacent to very high dependency patient access areas if an automatic fire control system is installed in addition to fire resistant structural separation.

A hospital department in List B should be provided with an automatic fire suppression system where it is directly below, or directly adjoins, operating theatres, intensive therapy units, or special care baby units.

List B
- Central staff change
- Central sterile supplies
- Hospital sterilizing and disinfecting unit
- Health records
- Pathology
- Manufacturing pharmacy

('Non-domestic technical handbook'; 2008; Section 2; Annex B; paragraph 2.B.1.)

Requirement

The guidance recommends that certain departments are not located next to one another or are provided with sprinklers.

Derogation

Theatres will adjoin the atrium space and suppression is not proposed for the basement kitchen or plant areas.

Proposal

The theatres will be fire separated from the atrium space with medium duration and the basement kitchen and plant areas will be low risk.

Reference Docts - Sketches, drawings, reference material extracts etc

See fire strategy WSP-SZ-XX-DC-572-500_03 Appendix Design note 2 – department adjacencies

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	10/11/2014

A

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
05/09/2014	04 Dampers to Ductwork REWORDED	IHSL-FIRE-004

BCR Clause

2.3 NHS Requirements
In addition to the standards listed in paragraph 2.4 of this Sub-Section C, unless the Board has expressed elsewhere in the Board's Construction Requirements, a specific and different requirement, the Facilities shall comply with but not be limited to the provisions of the NHS Requirements as the same may be amended from time to time:
i. Firecode
Project Co shall ensure the Facilities comply with the NHS Scotland Fire Safety Management - a suite of documents which explains the policy and technical guidance in fire precautions in hospitals and other healthcare premises, comprising the Health Facilities Scotland Fire Safety Policy, the Scottish Health Technical Memoranda (SHTM) and Scottish Fire Practice Notes (SFPN) which all comprise NHS Scotland Firecode, the Fire Safety Documentation Reference Guide and A Model Management Structure for Fire Safety.
Project Co shall prepare proposals in accordance with NHS Scotland Firecode to be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement prior to the submission of the proposals for approval by the Relevant Authority including without limitation building control department.
In the event of a conflict between the requirements of the local building control officers and NHS Scotland Firecode the more onerous requirements shall take precedence. Project Co shall notify the Board as soon as such conflict is known or suspected and shall further advise the Board of Project Co's proposed relevant design solution as early as possible before formal submission for review by the Board. When the more onerous requirement is to be used the Board will have the right to decide what constitutes the more onerous requirement. Any fire strategy which affects the Site will also have to have regard to, be compatible with and operate in conjunction with the fire strategy and procedures for the RIE Facilities and/or Retained Estate, as applicable.

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 81 part 1 July 2009
6.8 Ductwork passing through a compartment or sub-compartment boundary must be provided with remotely resettable fire and smoke dampers operated by
smoke detection.

Requirement

Fire / smoke damper recommended to all compartment / sub-compartment walls.

Derogation

Derogation required since these areas would not benefit from fire / smoke dampers; fire only are considered more appropriate.
Dampers to ductwork between the following spaces shall operate on fire actuation only.
Dampers between plant spaces
Dampers within ductwork serving Intensive Treatment Areas

Proposal

It is proposed that within the above noted spaces that the guidance within BS9999 Clause 33.4 Method 1 is followed.
This method does not require the ductwork to provide any degree of fire resistance, since the fire is isolated in the compartment of origin by the automatic actuation of fire dampers within the ductwork system.
Fire dampers are therefore sited in the duct at the point where it penetrates a fire-separating element:
Fire Rated walls between noted spaces
Compartment floors between risers and noted spaces
Agreement is required to be reached with the Board and Boards Fire Officer, and the derogation is not approved by the Board until that agreement is obtained through design yet to be fully developed and presented through the RDD process.

Reference Docts - Sketches, drawings, reference material extracts etc

See fire strategy WSP-SZ-XX-DC-572-500_03 Appendix Design note1 damper actuation

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	10/11/2014

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INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
05/09/2014	01 Adjacencies LINKS TO C30 (Summary 050)	IHSL-FIRE-005

BCR Clause

2.3 NHS Requirements

In addition to the standards listed in paragraph 2.4 of this Sub-Section C, unless the Board has expressed elsewhere in the Board's Construction Requirements, a specific and different requirement, the Facilities shall comply with but not be limited to the provisions of the NHS Requirements as the same may be amended from time to time:

i. Firecode

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Project Co shall prepare proposals in accordance with NHS Scotland Firecode to be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement prior to the submission of the proposals for approval by the Relevant Authority including without limitation building control department.

In the event of a conflict between the requirements of the local building control officers and NHS Scotland Firecode the more onerous requirements shall take precedence. Project Co shall notify the Board as soon as such conflict is known or suspected and shall further advise the Board of Project Co's proposed relevant design solution as early as possible before formal submission for review by the Board. When the more onerous requirement is to be used the Board will have the right to decide what constitutes the more onerous requirement.

Any fire strategy which affects the Site will also have to have regard to, be compatible with and operate in conjunction with the fire strategy and procedures for the RIE Facilities and/or Retained Estate, as applicable.

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 81 part 3 April 2013

3.6 Departments that provide care for very high dependency patients should not be located adjacent to an atrium, nor should any part of the department or their

supporting facilities be located within the atrium.

Requirement

theatres not permitted next to atrium.

Derogation

High dependency areas (theatres) are located adjacent to the atria therefore a fire engineered approach has been taken to demonstrate that with the proposed level of fire protection in the atria and adjacent areas the functional requirements of the guidance will be achieved.

Proposal

During the reference design stage the adjacency of the theatres to the atrium was discussed with NHS Lothian fire officer. This adjacency still exists with the proposed design and the same mitigation principles are proposed:

Medium duration fire protection to walls of theatres adjacent to atrium,

Sprinkler protection to atrium,

Smoke control to atrium.

Reference Docts - Sketches, drawings, reference material extracts etc

See fire strategy WSP-SZ-XX-DC-572-500_03 Appendix Design note 10 atrium

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
05/09/2014	*05 Atrium REDRAFTED 13/11/14*	IHSL-FIRE-006

BCR Clause

2.3 NHS Requirements

In addition to the standards listed in paragraph 2.4 of this Sub-Section C, unless the Board has expressed elsewhere in the Board's Construction Requirements, a specific and different requirement, the Facilities shall comply with but not be limited to the provisions of the NHS Requirements as the same may be amended from time to time:

i. Firecode

Project Co shall ensure the Facilities comply with the NHS Scotland Fire Safety Management - a suite of documents which explains the policy and technical guidance in fire precautions in hospitals and other healthcare premises, comprising the Health Facilities Scotland Fire Safety Policy, the Scottish Health Technical Memoranda (SHTM) and Scottish Fire Practice Notes (SFPN) which all comprise NHS Scotland Firecode, the Fire Safety Documentation Reference Guide and A Model Management Structure for Fire Safety.

Project Co shall prepare proposals in accordance with NHS Scotland Firecode to be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement prior to the submission of the proposals for approval by the Relevant Authority including without limitation building control department.

In the event of a conflict between the requirements of the local building control officers and NHS Scotland Firecode the more onerous requirements shall take precedence. Project Co shall notify the Board as soon as such conflict is known or suspected and shall further advise the Board of Project Co's proposed relevant design solution as early as possible before formal submission for review by the Board. When the more onerous requirement is to be used the Board will have the right to decide what constitutes the more onerous requirement.

Any fire strategy which affects the Site will also have to have regard to, be compatible with and operate in conjunction with the fire strategy and procedures for the RIE Facilities and/or Retained Estate, as applicable.

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 81 part 3 April 2013

3.48 An atrium should be enclosed to provide compartmentation between the atrium space and adjacent accommodation, with construction having a minimum

period of fire resistance of medium duration (60 minutes.) for integrity, insulation and load bearing capacity.

Requirement

Enclosing structure (including glazing) of atrium should be medium duration since access to adjoining areas is possible above the atrium base.

Derogation

Atrium glazing (with the exception of those to theatres) to be toughened glass in a suitable framing structure.

Proposal

It is proposed that the atrium enclosure walls meet the medium duration fire protection integrity and insulation. Calculations show that the smoke temperature will be significantly below 140°C therefore it is proposed that glazing within the atrium enclosure will be fixed lights of toughened glass in a suitable framing structure with the

exception of glazing serving the first storey theatre department. This area has an obvious higher patient dependency category therefore 60 / 60 glazing in a suitable framing will be provided to these areas. The glazing which will be used in the atrium has been confirmed by HLM as a choice of two. These options would be either:

- *Single glazed unit at least 12mm thick*
- *Double glazed unit at least 6mm and 4mm thick*

The above types of glass would fail at 470°C-600°C therefore flame impingement is not considered an issue.

This shall be further demonstrated by calculation during RDD. Agreement is required to be reached with the Board and Boards Fire Officer, and the derogation is not approved by the Board until that agreement is obtained through design yet to be fully developed and presented through the RDD process.

Reference Docts - Sketches, drawings, reference material extracts etc

See fire strategy WSP-SZ-XX-DC-572-500_03 Appendix Design note

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN INTEGRATED HEALTH SOLUTIONS RHSC + DCN Edinburgh	**Derogation Request**		
	Date	**Notes**	**Reference**
	05/09/2014	*02 Fire Alarm & Detection*	IHSL-FIRE-008

BCR Clause

2.3 NHS Requirements

In addition to the standards listed in paragraph 2.4 of this Sub-Section C, unless the Board has expressed elsewhere in the Board's Construction Requirements, a specific and different requirement, the Facilities shall comply with but not be limited to the provisions of the NHS Requirements as the same may be amended from time to time:

i. Firecode

Project Co shall ensure the Facilities comply with the NHS Scotland Fire Safety Management - a suite of documents which explains the policy and technical guidance in fire precautions in hospitals and other healthcare premises, comprising the Health Facilities Scotland Fire Safety Policy, the Scottish Health Technical Memoranda (SHTM) and Scottish Fire Practice Notes (SFPN) which all comprise NHS Scotland Firecode, the Fire Safety Documentation Reference Guide and A Model Management Structure for Fire Safety.

Project Co shall prepare proposals in accordance with NHS Scotland Firecode to be submitted to the Board as Reviewable Design Data for review by the Board in accordance with Schedule Part 8 (Review Procedure) and clause 12.6 of the Project Agreement prior to the submission of the proposals for approval by the Relevant Authority including without limitation building control department.

In the event of a conflict between the requirements of the local building control officers and NHS Scotland Firecode the more onerous requirements shall take precedence. Project Co shall notify the Board as soon as such conflict is known or suspected and shall further advise the Board of Project Co's proposed relevant design solution as early as possible before formal submission for review by the Board. When the more onerous requirement is to be used the Board will have the right to decide what constitutes the more onerous requirement.

Any fire strategy which affects the Site will also have to have regard to, be compatible with and operate in conjunction with the fire strategy and procedures for the RIE Facilities and/or Retained Estate, as applicable.

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 82 Fire Alarm & Detection Systems April 2013

3.6 A Category L2 or L3 system should be provided for healthcare premises other than hospitals. A category L1 system should be provided throughout all parts of

hospital premises. However, detectors need not normally be provided in the following areas:

voids and roof spaces of any depth that contain only:

MICC wiring, or wiring clipped to a metal tray or within metal conduit or trunking;

non-combustible pipework and ducts;

metal or plastic pipes used for water supply or drainage.

bath/shower rooms;

toilets in staff areas;

small cupboards (less than 1m2);

operating theatres.

In any case the omission of detectors should be subject to a fire risk assessment taking into account the specific matters identified in paragraph 3.4.

Requirement

The guidance within SHTM 82 recommends that detection is provided within voids unless they only contain items as noted within the guidance.

Derogation

The recommended list of acceptable items within ceiling voids has been expanded upon to include further items that are considered to be of a similar acceptable risk level.

Proposal

Design Note 5 provides an explanation for the methodology to be adopted for the risk assessment of the void content and an overview of the types of items considered to be acceptable.

The items have been assessed on being an ignition source, their ignition potential and their flammability.

It is proposed to develop this process as part of the design development to risk assess the specified products and the quantity to be installed to establish the risk to patients.

Reference Docts - Sketches, drawings, reference material extracts etc

See fire strategy WSP-SZ-XX-DC-572-500_03 Appendix Design note 5 void detection

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
05/09/2014	*02 Fire Stopping*	IHSL-FIRE-009

BCR Clause

2.4 Minimum Design & Construction Standards

Project Co shall also ensure that the Facilities comply with Good Industry Practice, NHS Scotland requirements, relevant statutory requirements (including highways) and required consents including, but not limited to, the following as the same may be amended from time to time:

r) The Non-Domestic Technical Handbook 2011 to The Building (Scotland) Regulations 2004 and its amendments (note the current version is 2013 and this will be applicable to the project under Building Warrant application).

Relevant Regulation - HBN, SHTM, Building Regulations etc

2.1.14 Ventilation ductwork should be fire-stopped in accordance with BS 5588: Part 9: 1999. Section 6 of BS 5588: Part 9: 1999 provides guidance on design and construction including fire resisting enclosures, fire resisting ductwork and the use and activation of fire dampers.

Requirement

the recommendations within BS5588 refer to SHTM guidance (SHTM 81 and 82 are the relevant documents).

Derogation

Derogation required since these areas would not benefit from fire / smoke dampers; fire only are considered more appropriate.
Dampers to ductwork between the following spaces shall operate on fire actuation only.
Dampers between plant spaces
Dampers within ductwork serving Intensive Treatment Areas

Proposal

It is proposed that within the above noted spaces that the guidance within BS9999 Clause 33.4 Method 1 is followed.
This method does not require the ductwork to provide any degree of fire resistance, since the fire is isolated in the compartment of origin by the automatic actuation of fire dampers within the ductwork system.
Fire dampers are therefore sited in the duct at the point where it penetrates a fire-separating element:
Fire Rated walls between noted spaces
Compartment floors between risers and noted spaces

Reference Docts - Sketches, drawings, reference material extracts etc

See fire strategy WSP-SZ-XX-DC-572-500_03 Appendix Design note1 damper actuation

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
05/09/2014	01Compartmentation	IHSL-FIRE-010

BCR Clause

2.4 Minimum Design & Construction Standards

Project Co shall also ensure that the Facilities comply with Good Industry Practice, NHS Scotland requirements, relevant statutory requirements (including highways) and required consents including, but not limited to, the following as the same may be amended from time to time:

r) The Non-Domestic Technical Handbook 2011 to The Building (Scotland) Regulations 2004 and its amendments (note the current version is 2013 and this will be applicable to the project under Building Warrant application).

Relevant Regulation - HBN, SHTM, Building Regulations etc

2.1.14 Compartment walls and compartment floors (including a fire resisting ceiling) are intended to prevent fire passing from one compartment to another. Openings
and service penetrations through these walls or floors can compromise their effectiveness and should be kept to a minimum.

Requirement

Hospitals require compartment floors at each level (atrium passes through compartment floors).

Derogation

Derogation required for inclusion of atrium, (atrium to be designed using fire engineering).

Proposal

Atrium to follow appropriate fire engineering principles and guidance for atria design.

Reference Docts - Sketches, drawings, reference material extracts etc

See fire strategy WSP-SZ-XX-DC-572-500_03 Appendix Design note 10 atrium

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
05/09/2014	*04 Escape Routes*	IHSL-FIRE-011

BCR Clause

2.4 Minimum Design & Construction Standards
Project Co shall also ensure that the Facilities comply with Good Industry Practice, NHS Scotland requirements, relevant statutory requirements (including highways) and required consents including, but not limited to, the following as the same may be amended from time to time:
r) The Non-Domestic Technical Handbook 2011 to The Building (Scotland) Regulations 2004 and its amendments (note the current version is 2013 and this will be applicable to the project under Building Warrant application).

Relevant Regulation - HBN, SHTM, Building Regulations etc

2.9.12 Escape routes in residential buildings
In residential buildings occupants are particularly vulnerable to fire when asleep. Occupants may also be unfamiliar with their accommodation and escape routes.
Those occupants on the fire floor should be provided with the opportunity to reach a protected zone (or other escape route) in relative safety and as quickly as possible, therefore, the movement of fire and smoke to the escape route should be inhibited.
In a residential building, where any corridor escape route serves sleeping accommodation it should be constructed of walls providing a short fire resistance duration and any door in the wall should be a suitable self-closing fire door with a short fire resistance duration. However the fire door to the cleaners cupboard need not be self closing provided it is lockable.
This guidance may need to be adapted in a residential building used as a place of lawful detention due to the unique operational factors.
For additional guidance on residential care buildings and hospitals see annex 2A and 2B.

Requirement

Ward corridors are recommended to be short duration fire protection.

Derogation

Derogation is required since making all these walls / doors / glazing / peentrations fire rated reduces the day to day functionality of the spacesand creates a significant increase in cost / ongoing maintenance without improving fire safety.

Proposal

Project Co consider that the development of reduced patient numbers per room has a positive impact on limiting fire spread and ability to evacuate those at immediate risk within the room of fire origin.
Open Nightingale wards and multiple bed wards require a significantly greater evacuation time to move those at immediate risk of a fire within the room; the same principle also applies to bed bay wards and in each case no further division is required.

Reference Docts - Sketches, drawings, reference material extracts etc

See fire strategy WSP-SZ-XX-DC-572-500_03 Appendix Design note 8 residential corridors

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN INTEGRATED HEALTH SOLUTIONS RHSC + DCN Edinburgh	**Derogation Request**		
	Date	**Notes**	**Reference**
	05/09/2014	*02 Temporary Waiting Spaces*	IHSL-FIRE-012

BCR Clause

2.4 Minimum Design & Construction Standards

Project Co shall also ensure that the Facilities comply with Good Industry Practice, NHS Scotland requirements, relevant statutory requirements (including highways) and required consents including, but not limited to, the following as the same may be amended from time to time:

r) The Non-Domestic Technical Handbook 2011 to The Building (Scotland) Regulations 2004 and its amendments (note the current version is 2013 and this will be applicable to the project under Building Warrant application).

Relevant Regulation - HBN, SHTM, Building Regulations etc

2.9.30 Temporary waiting spaces

The speed of evacuation of occupants with sensory, cognitive and/or mobility impairments can be much slower than other building users. Therefore, a space

should be provided to allow them to wait temporarily, before completing their escape to a place of safety.

Requirement

Temporary waiting spaces required to stair enclosures.

Derogation

Evacuation within the clinical part of the buildingwill be managed by PHE; including those visiting/ working in the areawho require additional assistance with vertical movement therefore temporary waiting spaces are considered necessary within clinical areas.

Proposal

Parents, guardians or carers will remain with child (patient) during an incident and their evacuation will be managed by staff through PHE.

Others will be directed to adjoining compartments not affected by fire where stairs and lifts will remain in use.

The functionality of these vertical routes (lifts & stairs) during a fire incident is considered as adequate mitigation for non-provision of temporary waiting spaces within the stair enclosures.

Reference Docts - Sketches, drawings, reference material extracts etc

See fire strategy WSP-SZ-XX-DC-572-500_03 Appendix Design note 4 temporary waiting spaces

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
05/09/2014	01 Fire Supression	IHSL-FIRE-013

BCR Clause

2.4 Minimum Design & Construction Standards

Project Co shall also ensure that the Facilities comply with Good Industry Practice, NHS Scotland requirements, relevant statutory requirements (including highways) and required consents including, but not limited to, the following as the same may be amended from time to time:

r) The Non-Domestic Technical Handbook 2011 to The Building (Scotland) Regulations 2004 and its amendments (note the current version is 2013 and this will be applicable to the project under Building Warrant application).

Relevant Regulation - HBN, SHTM, Building Regulations etc

2.14.7 / 2.B.6

If a building is not fitted with an automatic fire suppression system, no point on any storey should be more than 45m from the nearest main outlet measured along an unobstructed route for laying a fire hose.

Requirement

Hose laying distances to be max. 45m from outlet.

Derogation

Small sections of the design at ground, first, second and third floors result in areas in excess of the 45m distance. The worst case scenario is 54m, 9m in excess of the guidance requirements.

The number of areas in which the hose laying distance exceeds 45m is negligible. All area in which non-compliance occurs are highlighted in Figure 14, Figure 16, Figure 15 and Figure 16 of the fire strategy document.

Proposal

Historically up until the issue of NDTH 2010, a hose laying length of 60m was permitted within buildings not fitted with an automatic fire suppression system. This change in guidance which resulted in reducing the hose laying length from 60m to 45m came following The Building Disaster Assessment Group research on behalf of the UK Government. This research was to assess the interaction between building design and the operational response of fire and rescue services.

Within this technical report the evaluation in reduction of fire hose laying lengths during fire fighting operations derived from the physiological demands on firefighters engaged in search and rescue and on the restrictions that may be imposed by their equipment.

In practice, attending Fire and Rescue Services appliances are fitted with hoses which are much longer than 45m this is to take account of when operating fire hoses within buildings the fire hoses have a tendency to "snake" when charged thus limiting their effective length. The marginal increase is not considered by Project Co to affect functionality of fire fighting operations.

Reference Docts - Sketches, drawings, reference material extracts etc

See fire strategy WSP-SZ-XX-DC-572-500_03 Appendix Design note 9 hose laying

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
05/09/2014	01 Fire Hazard Rooms	IHSL-FIRE-015

BCR Clause

2.4 Minimum Design & Construction Standards

Project Co shall also ensure that the Facilities comply with Good Industry Practice, NHS Scotland requirements, relevant statutory requirements (including highways) and required consents including, but not limited to, the following as the same may be amended from time to time:

r) The Non-Domestic Technical Handbook 2011 to The Building (Scotland) Regulations 2004 and its amendments (note the current version is 2013 and this will be applicable to the project under Building Warrant application).

Relevant Regulation - HBN, SHTM, Building Regulations etc

2.B.1

Fire hazard rooms

In order to contain a fire in its early stages, the listed rooms are considered to be hazardous and should be enclosed by walls providing a short fire resistance duration (see annex 2.D).

Requirement

Fire hazard rooms to be fire rated.

Derogation

Enclosure of individual fire hazard rooms can cause functionality / maintenance issues due to provision of fire rated walls and fire protection of services passing between adjoining rooms.

The provision of clusters will still ensure that fire and smoke are inhibited from spreading beyond the fire enclosure of origin until any occupants have had the time to leave that compartment and any fire containment measures have been initiated.

Proposal

Where two or more fire hazard room are adjacent, then the enclosure of the rooms (the cluster) will be treated as a fire hazard room.

Patient-access fire hazard rooms are not to be regarded as part of a cluster.

Reference Docts - Sketches, drawings, reference material extracts etc

See fire strategy WSP-SZ-XX-DC-572-500_03 Appendix Design note 11 clustering

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes MER	Reference
05/09/2014	02 Fire Suppression REWORDING ACCEPTED	IHSL-MEP-001

BCR Clause

PART 6 (CONSTRUCTION MATTERS)

SECTION 3 (BOARD'S CONSTRUCTION REQUIREMENTS)

Page 127, Item 8.10 Project Co to provide fire suppression systems in NHS Lothian Server rooms, IPS Room and main HV and LV switchrooms

Relevant Regulation - HBN, SHTM, Building Regulations etc

Not Applicable

Requirement

Project Co to provide fire suppression systems in NHS Lothian Server rooms, IPS Room and main HV and LV switchrooms

Derogation

IHSL Project Co Proposals (PCP) Section 4.12 Fire Strategy, developed for the project has a fire engineered solution that will provide gas suppression to the IT Server Room only . Other areas referenced in the BCR will not be provided with fire suppression systems.

Proposal

IHSL Project Co Proposals (PCP) Section 4.12 Fire Strategy, developed for the project has a fire engineered solution that will provide gas suppression to the IT Server Room only. The PS Room and main HV and LV switchrooms as ~~other areas~~ referenced in the BCR will not be provided with fire suppression systems noting that fire suppression will be provided for in therisk areas identified in the Fire Strategy such as the atrium, and local hood suppression to the basement kitchen.
Consideration of the type of electrical installation within the basement will be carried out to review the need for sprinklers (e.g. by the use of low hazard installations such as cast resin dry type or replacement of oil with Midel in transformers).

Reference Docts - Sketches, drawings, reference material extracts etc

Not Applicable

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes MER	Reference
05/09/2014	02 25% Cabling Capacity	IHSL-MEP-002

BCR Clause

PART 6 (CONSTRUCTION MATTERS)

SECTION 3 (BOARD'S CONSTRUCTION REQUIREMENTS)

Page 139, Item 9.6.1 All cabling installed shall allow for a minimum of 25% spare capacity.

Relevant Regulation - HBN, SHTM, Building Regulations etc

Not Applicable

Requirement

Cat6 Cabling to allow 25% spare capacity

Derogation

The Cat 6 cabling shall be installed to connect the various IT field device outlets with the local IT node room locations. As agreed with the NHS E Health at the ICT meeting workshops, see ICT Meeting Minutes 03 07 14 item 4.09, the provision of 25% spare capacity will be allowed in cabinets and containment systems, not loose cabling.

Proposal

As agreed with the NHS E Health at the ICT meeting workshops, see ICT Meeting Minutes 03 07 14 item 4.09, the provision of 25% spare capacity will be allowed in cabinets and containment systems, not loose cabling.

Reference Docts - Sketches, drawings, reference material extracts etc

Not Applicable

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes MER	Reference
05/09/2014	03 Clinical Equipment Alarms-Rewording Accepted	IHSL-MEP-003

BCR Clause

PART 6 (CONSTRUCTION MATTERS)
SECTION 3 (BOARD'S CONSTRUCTION REQUIREMENTS)
Page 144 Item 9.17.10 Clinical Equipment Alarms
Each ward drug fridge shall be alarmed to warn of common faults. The sounder alarm shall be located locally.

Relevant Regulation - HBN, SHTM, Building Regulations etc

Not Applicable.

Requirement

Each ward drug fridge shall be alarmed to warn of common faults. The sounder alarm shall be located locally.

Derogation

As agreed in the M&E Workshops, the Fridge alarms are by NHS Pharmacy not Project Co.

Proposal

Fridge alarms are by NHS Pharmacy not Project Co.
Project Co will provide local power and data outlets to the ward drug fridge locations. No connections to NHS Pharmacy alarm system.

Reference Docts - Sketches, drawings, reference material extracts etc

Not Applicable.

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN INTEGRATED HEALTH SOLUTIONS RHSC + DCN Edinburgh	**Derogation Request**		
	Date	**Notes MER**	**Reference**
	05/09/2014	*01 DRAFT Routes through common services*	IHSL-MEP-005

BCR Clause

PART 6 (CONSTRUCTION MATTERS)
SECTION 3 (BOARD'S CONSTRUCTION REQUIREMENTS)
Page 128 Item 8.14
In order to minimise potential disruption to the Board due to maintenance of building services, Project Co shall where practicable route services through common spaces such as corridors and avoid through routing within department areas.

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 2023 Access and Accomodation for Engineering Services.

Requirement

In order to minimise potential disruption to the Board due to maintenance of building services, Project Co shall where practicable route services through common spaces such as corridors and avoid through routing within department areas.

Derogation

Generally pipe work and electrical services will run in corridor zones, but due to structural restrictions and available ceiling void depth in certain area of the developing design (such as level 1 downstand beams) the ventilation ductwork will run above the following occupied rooms in the following rooms only:
G-I1-002, 003, 004, 005, 006, 007, 014
G-D5-002, 003, 004, 005, 006, 008, 009
G-D8-001, 002
G-K1-002, 003, 004, 005, 006, 007, 008, 010, 011, 012, 013, 015, 016, 017, 018, 019, 021, 022, 025, 026, 028
G-E1-003, 004, 007, 008, 012
G-D2-005, 006, 007, 008, 009, 010, 011, 012, 013, 014
G-D1-001, 003, 005, 006, 008, 010, 016, 021, 022, 023, 025, 026, 027, 028, 031, 032, 034, 035, 036, 037, 038, 039, 042
G-D10-001
In addition the Pneumatic Tube System will pass through the following rooms only:
Dirty Utility G-A1-007
Plant room 15 B-PLANT-015

Proposal

Generally pipe work and electrical services will run in corridor zones, but due to structural restrictions and available ceiling void depth in certain area of the developing design (such as level 1 downstand beams) the ventilation ductwork will run above the following occupied rooms in the following rooms only:
G-I1-002, 003, 004, 005, 006, 007, 014
G-D5-002, 003, 004, 005, 006, 008, 009
G-D8-001, 002
G-K1-002, 003, 004, 005, 006, 007, 008, 010, 011, 012, 013, 015, 016, 017, 018, 019, 021, 022, 025, 026, 028
G-E1-003, 004, 007, 008, 012
G-D2-005, 006, 007, 008, 009, 010, 011, 012, 013, 014
G-D1-001, 003, 005, 006, 008, 010, 016, 021, 022, 023, 025, 026, 027, 028, 031, 032, 034, 035, 036, 037, 038, 039, 042
G-D10-001
In addition the Pneumatic Tube System will pass through the following rooms only:
Dirty Utility G-A1-007
Plant room 15 B-PLANT-015

Reference Docts - Sketches, drawings, reference material extracts etc

Not Applicable.

Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes MER	Reference
05/09/2014	01 Luminaire Colour/Temperature	IHSL-MEP-009

BCR Clause

PART 6 (CONSTRUCTION MATTERS)
SECTION 3 (BOARD'S CONSTRUCTION REQUIREMENTS)
Page 121 Item 8.8.5
Luminaires, their colour and material finish shall be selected to co-ordinate with the architectural intent throughout the circulation areas. Low wattage 2700K luminaires to be used in particular rooms shall be selected on their ability to create a calm and "homely" atmosphere. Project Co shall consider the inclusion of wall mounted luminaires and /or uplighters.
All lamps used in clinical areas shall have as a minimum a colour rendering capability of ≥ 85 CRI. For practical reasons consideration shall be given by Project Co to using the same luminaire in both clinical and non-clinical spaces within the same ward. A reading light with an on/off switch shall be provided at each bedhead location. Project Co shall provide an additional switch on the nurse call handset.

Relevant Regulation - HBN, SHTM, Building Regulations etc

BSEN12464-1/SLL Code For Lighting

Requirement

Luminaires, their colour and material finish shall be selected to co-ordinate with the architectural intent throughout the circulation areas. Low wattage 2700K luminaires to be used in particular rooms shall be selected on their ability to create a calm and "homely" atmosphere. Project Co shall consider the inclusion of wall mounted luminaires and /or uplighters.
All lamps used in clinical areas shall have as a minimum a colour rendering capability of ≥ 85 CRI. For practical reasons consideration shall be given by Project Co to using the same luminaire in both clinical and non-clinical spaces within the same ward. A reading light with an on/off switch shall be provided at each bedhead location. Project Co shall provide an additional switch on the nurse call handset.

Derogation

The specified 2700K colour temperature can refer to a tungsten source, the modern luminaires we will utilise have 3000K for a warm white lamp that still provides a 'homely' atmosphere and using compact fluorescent or LED energy efficient lamp.

Proposal

The specified 2700K colour temperature can refer to a tungsten source, the modern luminaires we will utilise have 3000K for a warm white lamp that still provides a 'homely' atmosphere and using compact fluorescent or LED energy efficient lamp.

Reference Docts - Sketches, drawings, reference material extracts etc

Not Applicable

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN INTEGRATED HEALTH SOLUTIONS	**Derogation Request**		
	Date	**Notes MER**	**Reference**
RHSC + DCN Edinburgh	05/09/2014	01 Sprinkler Protection	IHSL-MEP-010

BCR Clause

PART 6 (CONSTRUCTION MATTERS)
SECTION 3 (BOARD'S CONSTRUCTION REQUIREMENTS)
Page 126 item 8.10
Project Co shall provide sprinkler protection to those departments surrounding High Dependency departments (above, below and adjacent on the same level) as required by SHTM 82 Section 3

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM82

Requirement

Project Co shall provide sprinkler protection to those departments surrounding High Dependency departments (above, below and adjacent on the same level) as required by SHTM 82 Section 3.

Derogation

IHSL Project Co Proposals (PCP) Section 4.12 Fire Strategy, developed for the project has a fire engineered solution that will provide Sprinkler Protection for Atrium only. Other areas referenced in the SHTM 82 guidance will not be provided with sprinkler protection.

Proposal

IHSL Project Co Proposals (PCP) Section 4.12 Fire Strategy, developed for the project has a fire engineered solution that will provide Sprinkler Protection for Atrium only. Other areas referenced in the SHTM 82 guidance will not be provided with sprinkler protection.

Reference Docts - Sketches, drawings, reference material extracts etc

Not Applicable

Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes MER	Reference
05/09/2014	03 Fibre Optic Cables	IHSL-MEP-011

BCR Clause

PART 6 (CONSTRUCTION MATTERS)
SECTION 3 (BOARD'S CONSTRUCTION REQUIREMENTS)
Page 140 Item 9.11.1 & Appendix B 3.4
Project Co shall provide two 24 core single mode fibre optic cables (Topology: - Diverse Star; Type: - OS1 - 9 micron; Cores: - 24 for each type with 100% expansion capacity to be provided in the cable tray runs), from the NHS Lothian Server Room in the Facilities to the RIE Facilities, following independent routes for resilience. The connection will be to the Communications Rooms 1 and 2 in the RIE Facilities.
It is the Board's understanding that within the Old Dalkeith Road / Little France Crescent cable duct, cables belonging to providers BT (Route 1-NHS), THUS (Route 1 – N3)) and VIRGIN (University), run into the two RIE Facilities Communication Rooms. If the Board are correct then Project Co shall provide a second ICT connection route from the Facilities to the RIE Facilities within the Old Dalkeith Road / Little France Crescent cable duct, cables belonging to providers BT (Route 1-NHS), THUS (Route 1 – N3)) and VIRGIN (University), run into the two RIE Facilities Communication Rooms.
Project Co shall provide two 200 pair copper (minimum) multi-core cables following independent resilient routes to support back up telephones linked from the Facilities Server Rooms to the RIE Facilities PBX.

Relevant Regulation - HBN, SHTM, Building Regulations etc

Not Applicable

Requirement

Project Co shall provide two 48 core single mode fibre optic cables (Topology: - Diverse Star; Type: - OS1 - 9 micron; Cores: - 24 for each type with 100% expansion capacity to be provided in the cable tray runs), from the NHS Lothian Server Room in the Facilities to the RIE Facilities, following independent routes for resilience. The connection will be to the Communications Rooms 1 and 2 in the RIE Facilities.
It is the Board's understanding that within the Old Dalkeith Road / Little France Crescent cable duct, cables belonging to providers BT (Route 1-NHS), THUS (Route 1 – N3)) and VIRGIN (University), run into the two RIE Facilities Communication Rooms. If the Board are correct then Project Co shall provide a second ICT connection route from the Facilities to the RIE Facilities within the Old Dalkeith Road / Little France Crescent cable duct, cables belonging to providers BT (Route 1-NHS), THUS (Route 1 – N3)) and VIRGIN (University), run into the two RIE Facilities Communication Rooms.
Project Co shall provide two 200 pair copper (minimum) multi-core cables following independent resilient routes to support back up telephones linked from the Facilities Server Rooms to the RIE Facilities PBX.

Derogation

Project Co will provide two 48 core Fibre connections. One to Comms Room 1 via the upper floor link building and one to Comms Room 2 via the ground floor of the link building.
Project Co will provide cable ducts within the service strip to Old Dalkeith Road . Project Co will provide 200 pair copper to Comms Room 2 through the first floor void of the link building.
Project Co will provide 200 pair copper to Comms Room 1 through the ground floor void of the link building.

Proposal

Project Co will provide two 48 core Fibre connections. One to Comms Room 1 via the upper floor link building and one to Comms Room 2 via the ground floor of the link building.
Project Co will provide cable ducts within the service strip to Old Dalkeith Road . Project Co will provide 200 pair copper to Comms Room 2 through the first floor void of the link building.
Project Co will provide 200 pair copper to Comms Room 1 through the ground floor void of the link building.

Reference Docts - Sketches, drawings, reference material extracts etc

All as ehealth signed off drawings

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN RHSC + DCN Edinburgh	**Derogation Request**		
	Date	**Notes MER**	**Reference**
	05/09/2014	*03 Environmental Matrix REWORDED 12.11.14*	IHSL-MEP-015

BCR Clause

8 Mechanical & Electrical Engineering Requirements

Project Co shall provide the Works to comply with the Environmental Matrix

Relevant Regulation - HBN, SHTM, Building Regulations etc

Not Applicable

Requirement

8 Mechanical & Electrical Engineering Requirements

Project Co shall provide the Works to comply with the Environmental Matrix

Derogation

Anomalies within the environmental matrix have been reviewed and proposals incorporated within the room data sheets (refer to schedule for proposed variations).

Proposal

Anomalies within the environmental matrix have been reviewed and proposals incorporated within the room data sheets (refer to schedule for proposed variations).This shall be further developed in conjunction with the board on the basis of the schedule of comments contained in Section 5 (RDD) Part IV.

Reference Docts - Sketches, drawings, reference material extracts etc

Room Data Sheets

Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

RHSC + DCN Edinburgh

Derogation Request

Date	Notes MER	Reference
05/09/2014	*02 Sustainability*	IHSL-MEP-016

BCR Clause

5.25 Sustainability

Item n Part 6
The Board's target of utilising some 20% of renewable energy sources shall be achieved by Project Co.

Relevant Regulation - HBN, SHTM, Building Regulations etc

Not Applicable.

Requirement

5.25 Sustainability

Item n Part 6
The Board's target of utilising some 20% of renewable energy sources shall be achieved by Project Co.

Derogation

As detailed in C30 Part 6 section3 The gas CHP is LZC but not a renewable fuel.

Proposal

As detailed in C30 Part 6 section3 The gas CHP is LZC but not a renewable fuel.

Reference Docts - Sketches, drawings, reference material extracts etc

Refer to Enegy Centre Ground Floor Plan drawing reference WW-EC-00-PL-500-001

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

RHSC + DCN Edinburgh

Derogation Request

Date	Notes MER	Reference
05/09/2014	02 Mech Vent / Air Con	IHSL-MEP-017

BCR Clause

8.7.8 Mechanical Ventilation & Air Conditioning

Project Co shall incorporate provision to include humidification to the AHU plant at a future date.

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM03-01 - Ventilation for healthcare premises.

Requirement

8.7.8 Mechanical Ventilation & Air Conditioning

Project Co shall incorporate provision to include humidification to the AHU plant at a future date.

Derogation

As discussed and agreed during the various workshops and confirmed by the Board Humidity Conrol is not required. However Air Handling Units for Theatres, Critical Care and High Dependency Unit areas to be fitted with space for future humidification. (In compliance with SHTM03-01)

Proposal

As discussed and agreed during the various workshops and confirmed by the Board Humidity Conrol is not required. However Air Handling Units for Theatres, Critical Care and High Dependency Unit areas to be fitted with space for future humidification. (In compliance with SHTM03-01)

Reference Docts - Sketches, drawings, reference material extracts etc

Not Applicable.

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes MER	Reference
04/11/2014	Fiscal Metering	IHSL-MEP-023

BCR Clause

8.7.1 Building Management Systems & Controls q) Application of energy metering, via the BMS, will allow Renewable Heat Incentive and energy saving schemes and to be implemented. This will require heat meters to be installed on each plate heat exchanger and heating circuit and connected into the BMS via MODBUS type interface. These meters may be used for fiscal purposes and would assist in providing information as to energy use.

Relevant Regulation - HBN, SHTM, Building Regulations etc

Not Applicable

Requirement

8.7.1 Building Management Systems & Controls q) Application of energy metering, via the BMS, will allow Renewable Heat Incentive and energy saving schemes and to be implemented. This will require heat meters to be installed on each plate heat exchanger and heating circuit and connected into the BMS via MODBUS type interface. These meters may be used for fiscal purposes and would assist in providing information as to energy use.

Derogation

The heat meters shall not be "fiscal" meters. However Utility company approved meters shall be provided to measure the output of the Photo Voltaic system.

Proposal

The heat meters shall not be "fiscal" meters. However Utility company approved meters shall be provided to measure the output of the Photo Voltaic system.

Reference Docts - Sketches, drawings, reference material extracts etc

Not Applicable

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	10/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
15/09/2014	01 Clinical Output Specifications 1/4	IHSL-ARC-001

BCR Clause

Section 3: Board's Construction Requirements
Sub-Section D - Specific Clinical Requirements clause 1.9 Design Guidance

Relevant Regulation - HBN, SHTM, Building Regulations etc

HBN 04-01

Requirement

Attention is drawn to the design guidance contained in the following documents:-HBN 04-01

Derogation

Delete reference to HBN 04-01 from clause 1.9 of the Clinical Output Based Specifications for the following departments:- A3, Q1, M1, I1, N1, L1, P1, L2, M3, M2, M4, N2, R2, and R1

Proposal

Clinicial output specs to be revised to account for anomalies.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
15/09/2014	01 Clinical Output Specifications 2/4	IHSL-ARC-001 (2)

BCR Clause

Section 3: Board's Construction Requirements
Sub-Section D - Specific Clinical Requirements clause 1.9 Design Guidance

Relevant Regulation - HBN, SHTM, Building Regulations etc

HBN 08

Requirement

Attention is drawn to the design guidance contained in the following documents:-HBN 08

Derogation

Delete reference to HBN 08 from clause 1.9 of the Clinical Output Based Specifications for the following departments:- M2

Proposal

SHPN 08 should substituted in clause 1.9 of the Clinical Output Based Specifications for the following departments:- M2

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
15/09/2014	01 Clinical Output Specifications 3/4	IHSL-ARC-001 (3)

BCR Clause

Section 3: Board's Construction Requirements
Sub-Section D - Specific Clinical Requirements clause 1.9 Design Guidance

Relevant Regulation - HBN, SHTM, Building Regulations etc

HBN 12

Requirement

Attention is drawn to the design guidance contained in the following documents:-HBN 12

Derogation

Delete reference to HBN 12 from clause 1.9 of the Clinical Output Based Specifications for the following departments:- D1, D5, M1, E1, D1, D7, D3, D4 and M2

Proposal

SHPN 12 should substituted in clause 1.9 of the Clinical Output Based Specifications for the following departments:- D1, D5, M1, E1, D1, D7, D3, D4, and M2.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
15/09/2014	01 Clinical Output Specifications 1/4	IHSL-ARC-001

BCR Clause

Section 3: Board's Construction Requirements
Sub-Section D - Specific Clinical Requirements clause 1.9 Design Guidance

Relevant Regulation - HBN, SHTM, Building Regulations etc

HBN 14

Requirement

Attention is drawn to the design guidance contained in the following documents:-HBN 14

Derogation

Delete reference to HBN 14 from clause 1.9 of the Clinical Output Based Specifications for the following departments:- A1,A2, F1, Q1, D1, D2, D5, M1, E1, L1, B1, H2, P1, D1, D7, D3, D4, L2, D9, C1.1, C1.2, C1.8, C1.3 and C1.4.

Proposal

HBN 14-01 should substituted in clause 1.9 of the Clinical Output Based Specifications for the following departments:- A1,A2, F1, Q1, D1, D2, D5, M1, E1, L1, B1, H2, P1, D1, D7, D3, D4, L2, D9, C1.1, C1.2, C1.8, C1.3 and C1.4.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	Derogation Request		
	Date	Notes	Reference
RHSC + DCN Edinburgh	15/09/2014	01 Single Bedroom Arrangement	IHSL-ARC-002

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ii, HBN

Relevant Regulation - HBN, SHTM, Building Regulations etc

HBN 23

Requirement

Hospital Accommodation for Children & Young People, Appendix 4 Sheet 1, shows a particular arrangement for a single bedroom with en-suite assisted shower room.

Derogation

Single bedroom layout shown in Appendix 4 sheet 1 not utilised

Proposal

Project Co propose a variant based on the HBN layout for the single bedroom but with an ensuite shower room design based on HBN 00-02 figure 60 proposal. This layout was signed off through the UGM process.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
15/09/2014	01 Multibed Room Bed Spaces	IHSL-ARC-003

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ii, HBN

Relevant Regulation - HBN, SHTM, Building Regulations etc

HBN 23

Requirement

Clause 3.117 The minimum size of each bed space in a multi-bed room is 3.4 x 3.5 m (see HBN 4). Clause 3.148 Multi-bed rooms should also incorporate a dedicated play area. The area should be large enough to accommodate a children's play table and seating, storage cupboards and shelving. This area can either be located as in Appendix 4 Sheet 3 or in a bay window.

Derogation

Delete Clause 3.117. Omit dedicated play area and storage cupoboards required by clause 3.148.

Proposal

Project Co propose a room layout which is a cruciform arrangement which includes an ensuite shower room and separate assisted WC without a dedicated play area and storage cupboards.
Requirement for play area superceded by room layouts signed off through UGM process.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	**Derogation Request**		
	Date	**Notes**	**Reference**
RHSC + DCN Edinburgh	15/09/2014	*02 Theatres Size WORDING AMENDED 07/11/14*	IHSL-ARC-004

BCR Clause

2.3 NHS Requirements

Relevant Regulation - HBN, SHTM, Building Regulations etc

HBN 26

Requirement

Facilities for Surgical Procedures: Vol 1, Operating Theatres, para 4.69 - A standard size of 55 sq.m.is recommended for all in-

Derogation

This HBN recommendation is based on providing maximum flexibility in use of theatres by opting for the largest space requirement for minimally invasive procedures. Project Co through design development with the agreement of the Board have reduced the size of two theatres in RHSC, one of which is used for day surgery and the other as a general theatre (including burns). This has enabled the introduction of a Preparation Room for the sixth RHSC theatre and four DCN Theatre suites.

Proposal

Theatre 6 (Day Surgery) 1-P-050 to be 47.5 sq.m. Theatre 5 (Burns) 1-P-140 to be 49.7 sq.m.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
15/09/2014	01 Sanitary Spaces - Alternative Layout	IHSL-ARC-005

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ii, HBN

Relevant Regulation - HBN, SHTM, Building Regulations etc

HBN 00-02

Requirement

Core Elements: Sanitary Spaces,

Derogation

Proposal

Project Co Proposals adopt a variant design for the en-suite shower room and separate assisted WC for the childrens multi-bed rooms in A2 PARU, C1.8 Surgical Short Stay and C1.1 Medical In-patients.
This layout was signed off through the UGM process.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
15/09/2014	01 Sanitary Spaces - Alternative Layout	IHSL-ARC-006

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ii, HBN

Relevant Regulation - HBN, SHTM, Building Regulations etc

HBN 00-02

Requirement

Core Elements: Sanitary Spaces,

Derogation

Proposal

Project Co Proposals adopt a variant design for the shared en-suite wet room and separate assisted WCs for the childrens multi-bed rooms in C1.2 Surgical Long Stay, and C1.3 Neuroscience In-patients wards.
This layout was signed off through the UGM process.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
15/09/2014	*01 Consult Exam Room Sizes*	IHSL-ARC-007

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ii, HBN

Relevant Regulation - HBN, SHTM, Building Regulations etc

HBN 00-03

Requirement

Core Elements: Clinical and Clinical Support Spaces.

Derogation

Consulting/ Exam rooms do not meet the minimum area specified within the HBN - i.e. 16.0sqm.

Proposal

Project Co Proposals are for Clinical Rooms such as Consulting / Exam Rooms in M1 DCN Out Patients sized at 15.0 sq m.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN RHSC + DCN Edinburgh	**Derogation Request**		
	Date	**Notes**	**Reference**
	15/09/2014	*01 Treatment Room areas*	IHSL-ARC-008

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ii, HBN

Relevant Regulation - HBN, SHTM, Building Regulations etc

HBN 00-03

Requirement

Core Elements: Clinical and Clinical Support Spaces,

Derogation

Consulting/ Exam rooms and Treatment Rooms do not meet the minimum area specified within the HBN - i.e. 16.0sqm and 16.5sqm respectively.

Proposal

Project Co Proposals are for generic Clinical Rooms such as Consulting / Exam Rooms and Treatment Rooms in D1 RHSC Out Patients sized at 15.5sqm and 16.0sqm respectively.
This proposal was signed off through the UGM process.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	Derogation Request		
	Date	Notes	Reference
RHSC + DCN Edinburgh	15/09/2014	*01 Infection Control*	IHSL-ARC-009

BCR Clause
2.3 NHS Requirements
Relevant Regulation - HBN, SHTM, Building Regulations etc
HBN 00-09
Requirement
Infection Control in the Built Environment
Derogation
HBN / SHFN conflict
Proposal
Substitute HBN 00-09 with SHFN 30 Version 3
Reference Docts - Sketches, drawings, reference material extracts etc
Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	**Derogation Request**		
	Date	**Notes**	**Reference**
RHSC + DCN Edinburgh	15/09/2014	*01 100% Single Bedrooms*	IHSL-ARC-010

BCR Clause
2.3 NHS Requirements
Relevant Regulation - HBN, SHTM, Building Regulations etc
SHPN 04-01
Requirement
Adult In-Patient Facilities, Paragraph 1.5, requires all new build hospital to provide 100% single bedrooms.
Derogation
The building does not provide 100% single bedrooms.
Proposal
Project Co have accommodated the substitution of 2 x 4 bed rooms within L1- DCN Acute Care in lieu of 8 single bedrooms. This proposal was signed off through the UGM process.
Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	Derogation Request		
	Date	Notes	Reference
RHSC + DCN Edinburgh	16/09/2014	03 Assisted Shower toom to multi-bed rooms	IHSL-ARC-013

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ix, SHPN

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHPN 04-01

Requirement

Adult In-patient Facilities, Paragraph 3.17, recommends for multi-bed rooms the provision of an assisted shower room (withWC, shower and whb) and a separate semi-ambulant WC (with hand-rinse basin).

Derogation

A separate semi-ambulant WC will not be provided in DCN multi-bed rooms.

Proposal

Project Co will provide an assisted shower room (with WC, Shower & whb) and a staff base base (services only, to allow for the future wc installation) in line with the NHSL requirements. This proposal was signed off through the UGM process.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
16/09/2014	*01 Open Linen Bays*	IHSL-ARC-014

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ix, SHPN

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHPN 04-01

Requirement

Adult In-patient Facilities, Paragraph 3.45, recommends that for infection control purposes linen should be kept in a closed store rather than on trolleys in an open bay.

Derogation

Linen will not be stored in closed bays.

Proposal

Project Co's proposals provides for open linen bays in line with NHSL requirements. Refer to project Co's Fire Strategy Proposals.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN RHSC + DCN Edinburgh	**Derogation Request**		
	Date	**Notes**	**Reference**
	16/09/2014	*03 4 bed layout*	IHSL-ARC-015

BCR Clause
2.3 NHS Requirements Sub-Section C, para 2.3ix, SHPN
Relevant Regulation - HBN, SHTM, Building Regulations etc
SHPN 04-01
Requirement
Adult In-patient Facilities, Appendix 1 Example bedroom layouts, figure 15, example layout for 4 bedded room, shows both the assisted shower room and the separate semi-ambulant WC located adjacent to the corridor wall.
Derogation
Project Co will not provide 4-bedded bays in line with figure 15.
Proposal
Project Co will provide a variant layout with the assisted shower room located on the outside wall and a staff base adjacent to the corridor wall at the entrance to the multi-bed room. This arrangement improves the visibility into and out of the room from the corridor while maintaining optimum natural light and external views. This proposal was signed off through the UGM process.
Reference Docts - Sketches, drawings, reference material extracts etc
Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	Derogation Request		
	Date	Notes	Reference
RHSC + DCN Edinburgh	16/09/2014	*01 Viewing Zones*	IHSL-ARC-016

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3v, HTM & SHTM

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 55:2.18

Requirement

The ideal viewing zone and ranges of eye levels for all types of occupants is shown in Figure 2.

Derogation

The viewing zones may not be as illustration contained in clause 2.18, figure 2

Proposal

Size of windows/ elevational treatment is detailed in Project Co's building elevation drawings. Project Co's proposals are compliant with clause 5.12 of the BCRs re: day lighting/ cill levels.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
16/09/2014	02 Georgian wired glass Pco revised confirmation	IHSL-ARC-017

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3v, HTM & SHTM

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 57: 2.8

Requirement

All glazing above 2,100mm, whether designated fire-resisting or not, should be glazed with 6mm Georgian wired or other fire-resisting glass to reduce the risk of breakage from raised temperatures in a fire.

Derogation

Georgian wired glass will not be used.
Glass above 2100mm will not be fire-resisting unless required by the fire strategy.

Proposal

Project Co shall not use georgian wired glass but shall use appropriately fire rated glass as required by the fire strategy and subject to full review and agreement with the Board.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
16/09/2014	*01 Georgian Wired Glass*	IHSL-ARC-018

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3v, HTM & SHTM

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 57: 2.12

Requirement

Where fire-resisting glass is required, panes of Georgian safety wired glass should be used, except where 'small panes' of ordinary wired glass are permitted. In other cases the glass may also be required to possess insulating properties.

Derogation

Georgian wired glass will not be used

Proposal

Due to advances in glazing technology where fire resisting glass is required – Georgian safety wired glass need not be used.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

Comments [NHSL]

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
16/09/2014	*01 Vision Panels*	IHSL-ARC-019

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3v, HTM & SHTM

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 57: 2.33

Requirement

Where through-vision is required for wheelchair users, the minimum zone of visibility should be between 500 mm and 1,500 mm from the finished floor level.

Derogation

Conflict between SHTM and BS8300. The viewing panel does not require to be continuous between 500 and 1500mm

Proposal

The vision panels as indicated in Project Co's Proposal's comply with BS8300 paragraph 6.4.3 and Figure 13.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

Comments [NHSL]

IHS LOTHIAN	**Derogation Request**		
	Date	**Notes**	**Reference**
RHSC + DCN Edinburgh	16/09/2014	*03 Georgian wired glass REWORDED 07/11/14*	IHSL-ARC-020

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3v, HTM & SHTM

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 57: 2.64

Requirement

Generally, where glass panels are not more than 900 mm wide, 6 mm Georgian
wired safety glass, which gives both fire resistance and Class C impact performance to BS 6206:1981, should be used. It is available at a slight additional cost. For 'small panes', 6 mm 'ordinary' Georgian wired glass may be used.

Derogation

Georgian glass shall not be used however appropriate FR glass shall be used where required by the Fire Strategy.

Proposal

Due to advances in glazing technology where fire resisting glass is required – Georgian safety wired glass need not be used. Non-wired glass is a more contemporary look in keeping with modern hospital environment.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	Derogation Request		
RHSC + DCN Edinburgh	**Date**	**Notes**	**Reference**
	16/09/2014	*01 Door widths*	IHSL-ARC-021

BCR Clause
2.3 NHS Requirements Sub-Section C, para 2.3v, HTM & SHTM
Relevant Regulation - HBN, SHTM, Building Regulations etc
SHTM 58: 2.10
Requirement
Door width requirements. Minimum width doors to multi bed areas and treatment areas to be min 1700mm.
Derogation
Conflict between SHTM and HBN. Multi bed areas and treatment areas not provided with 1700mm wide doors.
Proposal
Project Co will provide 1500mm wide doors to Multi-bed rooms and treatment rooms. 1500mm doorsets are consistent with HBN. Project Co will comply with HBN.
Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
16/09/2014	*05 Extent of Shielding*	IHSL-ARC-022

BCR Clause

5.14 Partitions
Project Co shall ensure partitions address special construction requirements including x-ray protection and gamma ray shielding i.e. concrete or lead. It is important that Project Co comply with the shielding requirements from the Board's Radiation Protection Advisor.
Partitions shall be designed to take account of following criteria:
a) Structural strength of overall partition, and adequacy of support for fittings, fixtures and equipment, both planned and future;
b) Sound reduction;
c) Fire resistance;
d) Moisture resistance;
e) Resistance to biological infection;
f) X-ray shielding;
g) Gamma ray shielding; and
h) Protection from damage.

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 58: 2.49

Requirement

as above

Derogation

As agreed during the Capex discussion, Project Co shall be providing radiation protection as per the completed schedule by the Board RPA, for the avoidance of doubt any lead lined doors shall be instructed as a change by the Board, and Faraday cages shall be provided by the Board.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	Derogation Request		
	Date	Notes	Reference
RHSC + DCN Edinburgh	17/09/2014	*01 Ironmongery*	IHSL-ARC-023

BCR Clause
2.3 NHS Requirements Sub-Section C, para 2.3v, HTM & SHTM
Relevant Regulation - HBN, SHTM, Building Regulations etc
SHTM 59
Requirement
Appendix: CL of latch spindle set at 800mm above FFL
Derogation
Door handles will not be provided at 800mm above FFL.
Proposal
Door spindle mounting height of 800mm above FFL considered too low. Lever handle heights will be consistant and compliant with BS8300 (900 and 1100mm)
Reference Docts - Sketches, drawings, reference material extracts etc
Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	Derogation Request		
	Date	Notes	Reference
RHSC + DCN Edinburgh	17/09/2014	*01 Equipment - Carcasses*	IHSL-ARC-024

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3v, HTM & SHTM

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 63: 2.7
SHTM 63: 3.37

Requirement

With the Corbel carcass type lower storage units are fitted 300 mm above floor level to permit the use of floor-cleaning machines and to reduce prolonged bending down.

Cantilever brackets may be used to support the 600 mm (as Figure 1) and 500 mm assemblies and the standing and sitting work-surface heights in each case.

Derogation

Units will not be mounted 300mm above floor.
Cantilever brackets will not be used.

Proposal

Base units will be floor mounted and not fitted 300mm above floor. Worktops will therefore be supported on base units.
This proposal was signed off through the UGM process.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	Derogation Request		
	Date	Notes	Reference
RHSC + DCN Edinburgh	17/09/2014	*01 Flexible Hoses-CAMHS*	IHSL-ARC-025

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3v, HTM & SHTM

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 64: 2.42

Requirement

Flexible hose to hand-held showerheads should be provided, and the design of the unit should be such that the head cannot become immersed in water, to accord with back-siphonage prevention requirements. It must be constrained to give a type AUK3 air gap above the spillover level of the bath or shower tray, and any other fluid Category 5 risk (for example a WC), by a robust means that cannot be removed without destroying the fitting.

Derogation

Flexible hoses will not be utlised in F1 CAMHS en-suites

Proposal

Anti Ligature showers with fixed heads will be utlised in F1 CAMHS

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
17/09/2014	02 Anti- Ligature	IHSL-ARC-026

BCR Clause

5.12 Windows
All windows and fittings shall be compliant with anti-ligature requirements.

Relevant Regulation - HBN, SHTM, Building Regulations etc

n/a

Requirement

All windows and fittings shall be compliant with anti-ligature requirements.

Derogation

As this is not a practical solution, the Board and IHSL have agreed the extent of anti-ligature provision and this is now identified on drawing HLM-SZ-00-PL-330-100 Rev 04 which will form part of the Part 4 Section 5 (RDD) Schedule Part 6 (Construction Matters) and associated comments.

Proposal

Reference Docts - Sketches, drawings, reference material extracts etc

as above

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

Comments [NHSL]

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
17/09/2014	01 Single Rooms - Bed Spacing 02 Proposal wording revised 22/09/14	IHSL-ARC-027

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3viii, Scottish Government Health Directorates Circulars (CEL and HDL)

Relevant Regulation - HBN, SHTM, Building Regulations etc

CEL 27 (2010)

Requirement

Provision of Single Room Accommodation and Bed Spacing - Para 5. Accordingly, the Chief Medical Officer has concluded that the guidance set out in the above CEL (CEL 48 2008) that there should be a presumption of 100% single rooms in future hospital developments, is confirmed as the policy for NHSScotland except for:

• existing accommodation which is being refurbished, where taking into account the constraints of the existing building, a minimum of 50% single room accommodation would be allowed but as close to 100% as possible would be expected; and

• in new developments where there are clinical reasons for not making 100% single room provision they should be clearly identified and articulated in the appropriate Business Case. However, each case would be subject to Scottish Government agreement as part of the Business Case approval process.

Derogation

The following wards / in-patient areas will be provided with less than 100% single rooms:- A2 PARU, B1 PICU,L1 DCN Acute Care, C1.1 Medical In-patients, C1.2 Surgical Long Stay, C1.3 Neurosciences In-patients, C1.4 Haematology & Oncology, C1.8 Surgical Short Stay and D9 Medical Day Care.

Proposal

Project Co have complied with the Boards Clinical Output Based Specifications for the following wards / in-patient areas which will be provided with approximate % single rooms as follows:- A2 (65%), B1(38%),L1(67%), C1.1(65%), C1.2 (47%), C1.3 (33%), C1.4 (67%), C1.8 (43%) and D9 (40%). Only F1 CAMHS and L2 DCN Adult In-Patients will have 100% single rooms. There are 149 single-bed rooms out of a total of 223 beds which is approximately 67% overall.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	Derogation Request		
	Date	Notes	Reference
RHSC + DCN Edinburgh	17/09/2014	04 Bed Spacing REWORDED	IHSL-ARC-028

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3viii, Scottish Government Health Directorates Circulars (CEL and HDL)

Relevant Regulation - HBN, SHTM, Building Regulations etc

CEL 27 (2010)

Requirement

Provision of Single Room Accommodation and Bed Spacing - Para 6. In relation to the issue of bed spacing for multi-bedded rooms, the current advice remains unchanged. That is, taking account of ergonomic criteria, primarily the space required for patient handling and other activities which take place in the immediate vicinity of the bed, it is recognised that the minimum bed space should not be less than 3.6m (wide) x 3.7m (deep).

Derogation

The multi-bedded rooms in RHSC Wards A2, B1, C1.1, C1.2, C1.3, C1.8 do not comply with this as the beds are not laid out in a parrallel configuration with rectangular bed spaces.

Proposal

Project Co's proposals have adopted NHSL reference design generic room layout which is a cruciform (St Andrew's Cross)arrangement with only one bed on each of the four walls. This room type is proposed for the following RHSC Wards :- A2, B1, C1.1, C1.2, C1.3, C1.8which were signed off during the UGM process.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
17/09/2014	*01 Single Room Accommodation*	IHSL-ARC-029

BCR Clause

3.5.6 Single Room Accommodation

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

DCN and CAMHS will have 100% of inpatient spaces in single rooms.

Derogation

The building does not provide 100% single bedrooms to DCN.

Proposal

Project Co have accommodated the substitution of 2 x 4 bed rooms within L1- DCN Acute Care in lieu of 8 single bedrooms.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	Derogation Request		
	Date	Notes	Reference
RHSC + DCN Edinburgh	17/09/2014	01 Car Parking	IHSL-ARC-030

BCR Clause

3.9.2 Emergency Department Parking

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Project Co shall provide as a minimum 24 free spaces for emergency visitors to the ED for the Facilities and the RIE Facilities. Of these spaces:
a) 50% must be of a size for disabled or parent and child parking, and marked as appropriate.
b) 50% must be non-disabled spaces for short term parking for emergency visitors to the ED facilities.

Derogation

Project Co propsoals do not provide 50% accessible spaces.

Proposal

Project co will provide 24 spaces at the ED entrance. 3no, of these spaces will sized as accessible spaces (14% of overall number) and appropriately marked in line with NHSL requirements.
This was agreed with NHSL during the pre-planning applciation dialogue process.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN RHSC + DCN Edinburgh	**Derogation Request**		
	Date	**Notes**	**Reference**
	17/09/2014	*01 Drop Off*	IHSL-ARC-031

BCR Clause
3.9.4 Drop-off / Pick-up Arrangements
Relevant Regulation - HBN, SHTM, Building Regulations etc
Requirement
Project Co shall provide designated, covered “drop-off / pick-up” area(s) directly adjacent to the principal entrances to the Facilities including the ED entrance. This shall allow direct access to the Facilities, for a wide range of vehicles including private cars, taxis, ambulances and patient transport vehicles. The design should discourage any other use other than dropoff in this area.
Derogation
Project Co are not providing cover to designated drop off / pick up areas
Proposal
Project Co will provide canopies to the main entrances at DCN, RHSC and Emergency Department ambulance drop off.
Reference Docts - Sketches, drawings, reference material extracts etc
Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
17/09/2014	*01 Building Envelope REDRAFTED 30/10/14*	IHSL-ARC-032

BCR Clause

5.7 Building Envelope

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

d) Any cladding systems chosen for use on this Project shall be designed and constructed to resist silently, without detriment to the required performance or appearance, the action of the elements including wind, rain, hail, snow, ice, solar radiation, temperature changes, moisture movement, structural movements, construction tolerances, thermal movements, the internal environment of the buildings and dead or imposed loads.

Derogation

Not all cladding systems may be able to resist silently, the action of the elements. Those which posed a problem - ETFE roof and standing seam metal roof over clinical areas - have had additional treatment agreed. There shall be a rain suppressant membrane over the ETFE roof and an integral anti drumming membrane to the standing seam.

Proposal

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN RHSC + DCN Edinburgh	**Derogation Request**		
	Date	**Notes**	**Reference**
	17/09/2014	01 Corridor WidthsREDRAFTED 30/10/14	IHSL-ARC-033

BCR Clause

5.10 Corridor Widths and Heights

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

The hospital streets are to have a minimum unobstructed width of 3 metres.
Minimum widths and heights shall apply along the whole length of the corridor.

Derogation

Hospital street does not have an unobstructed width of 3m along its whole length.

Proposal

Localised widths below 3m will occur at agreed seating/ resting points for DCN patients along the Hospital Street as agreed with the Board.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	**Derogation Request**		
	Date	**Notes**	**Reference**
RHSC + DCN Edinburgh	17/09/2014	*02 Windows redrafted 10.11.14*	IHSL-ARC-034

BCR Clause

5.12 Windows

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Project Co shall ensure all windows required for ventilation shall be provided with controllable trickle ventilators within the head of the frame or with two stage key lockable handles giving 5 – 10mm ventilation gap.

Derogation

Project Co will not provide tricke vents to the head of all windows required for ventilation.

Proposal

Project Co will provide controllable trickle ventilators within window frames. Locations of vents within frames subject to appointment of specialist supplier/ manufacturer and also to Board agreement/sign off of sample/mock up of actual window system proposed.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	10/11/2014

IHS LOTHIAN	Derogation Request		
	Date	Notes	Reference
RHSC + DCN Edinburgh	17/09/2014	01 Flooring	IHSL-ARC-035

BCR Clause

5.13.2 Flooring

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHS Safety Action
Notice SAN(SC)05/08

Requirement

Project Co shall ensure that all entrances to the Facilities incorporate sufficient length of appropriate floor matting designed to remove contaminants including water, dirt and leaves from footwear, trolley wheels etc. A water evaporation system such as a hot air curtain shall be provided at each entrance.

Derogation

Project Co will not provide the recommended 6m of barrier matting at the ambulant emergency department entrance.

Proposal

Project Co will provide a maximum of 3.7m length barrier matting to the ambulant emergency department entrance due to limited entrance lobby depth.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	Derogation Request		
	Date	Notes	Reference
RHSC + DCN Edinburgh	17/09/2014	02 Gas Cylinder Storage REWORDED	IHSL-ARC-036

BCR Clause

5.28 Storage of Gas Cylinders

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 2023

Requirement

Project Co shall ensure that all gas cylinders, whether they are connected to external supplies or not, are stored in accordance with SHTM 2023.

Derogation

Gas cyclinder storage does not comply with SHTM 2023

Proposal

A number of gas cylinder stores are located within departments and not on external walls in accordance with NHSL requirements as per user request during UGM and subsequent sign off. This relates only to a number of gas cylinder stores where no external wall is present.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
17/09/2014	01 Heated External Spaces	IHSL-ARC-037

BCR Clause

7.2 Therapy Gardens

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Attention shall also be paid to providing covered / heated areas to allow the external environment to be enjoyed in different weather conditions.

Derogation

Project Co's Proposals do not include heated areas externally.

Proposal

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
17/09/2014	*01 Escalators*	IHSL-ARC-038

BCR Clause

8.8.12 Escalators

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Where Project Co provides escalators within the buildings they shall adhere to the requirements of all relevant British Standards and in particular with BS EN 115 Safety of escalators and moving walks.

Derogation

No escalators are provided as part of Project Co's Proposals

Proposal

No escalators are provided as part of Project Co's Proposals as accepted by the Board.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
22/09/2014	*03 Handrails REVISED WORDING*	IHSL-ARC-039

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ii, HBN

Relevant Regulation - HBN, SHTM, Building Regulations etc

HBN 00-04

Requirement

Core Elements: Circulation & Communication Spaces

7.10 The top of the handrail should be:
• 900–1000 mm above the surface of a ramp, ramp landing or pitch line of a flight of steps or along a corridor;
• 900–1100 mm from the surface of a stair
landing.

7.11 A second lower rail at a height of 600 mm should be provided in corridors, stairs and landings in children's healthcare facilities and on ramps (for wheelchair users). They should also be provided on
stairs and landings in healthcare premises where there are likely to be a significant number of semi- ambulant users.

Derogation

Project Co shall provide 2 handrails to stairs.

Proposal

Project Co shall provide 2 handrails to stairs per NHSL request.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN RHSC + DCN Edinburgh	**Derogation Request**		
	Date	**Notes**	**Reference**
	15/10/2014	01 Helipad Ramp Gradient	IHSL-ARC-040

BCR Clause

2.3 NHS Requirements

Relevant Regulation - HBN, SHTM, Building Regulations etc

HTM 15-03

Requirement

Ramp gradient suggested at 1:20.

Derogation

Project Co propose a ramp gradient of 1:12 for the patient helipad access. Patient transfers times would be improved by adopting the design proposal as this would substantially decrease the travel distance from the helipad to the hot core lift thus improving patient care. A ramp of similar gradient was inspected (at the New Southern General Hospital, Glasgow) by the NHSL team including Jon McCormack and Mark Dunn of the helicopter operations team on 30th June 2014 and no issues with the ramp gradient were noted. Further discussed at meeting 15.10.14.

Proposal

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN RHSC + DCN Edinburgh	**Derogation Request**		
	Date	**Notes**	**Reference**
	31/10/2014	01 Drainage Life Expectancy	IHSL-ARC-041

BCR Clause
Section 5. General Construction Requirements 5.1 d
Relevant Regulation - HBN, SHTM, Building Regulations etc
N/A
Requirement
Life expectancy of drainage and below ground civil engineering infrastructure - 70 years
Derogation
To reduce the requirement period from 70 years to 50 years
Proposal
Project Co are unable to source a material supply for drainage pipework and fittings whose manufacturer is prepared to provide a warranty on their products for a 70 year period. Project Co therefore propose to offer a specification compliant product with a 50 year life expectancy
Reference Docts - Sketches, drawings, reference material extracts etc
Marley Products BBA certificate
Approvals

	Organisation	**Title**	**Signature**	**Date**
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014
NHSL				

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
12/11/2014	01 Lift Door Widths	IHSL-ARC-042

BCR Clause

5.18 Any passenger or bed / passenger lifts required for vertical transportation shall have a minimum clear entrance of 1300 mm.

Relevant Regulation - HBN, SHTM, Building Regulations etc

n/a

Requirement

As noted above

Derogation

Not all lift doors provide 1300mm clear.

Proposal

1275kg capacity lifts provide 1100mm clear door widths. This is as agreed and detailed in PCP 4.15 Vertical Transportation.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
12/11/2014	01 (Submitted C30) Single bedroom/ensuite layout HBN 23	DER Arch 02

BCR Clause

HBN 23

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Hospital Accommodation for Children & Young People, Appendix 4 Sheet 1, shows a particular arrangement for a single bedroom with en-suite assisted shower room

Derogation

Ignore single bedroom layout shown in Appendix 4 sheet 1.

Proposal

Project Co propose a variant based on the HBN layout for the single bedroom but with an ensuite shower room design based on HBN 00-02 figure 60 proposal. This layout was signed off through the UGM process.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
12/11/2014	(Submitted C30) Critical care layout HBN 57	DER Arch 04

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ii, HBN

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Derogation

Proposal

HBN 57 Facilities for Critical Care: This document is referred to in the Clinical OBS for B1 Critical Care, PICU, HDU and NICU. We have based our design on your reference design and HBN 04-02 Critical Care Units

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
12/11/2014	Submitted C30) Clinical support spaces layout HBN 00-03	DER Arch 07

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ii, HBN

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

The HBN requirement is 16.0sq m for clinical rooms.

Derogation

Rooms shall be provided at less than the required area.

Proposal

HBN 00-03 Core Elements: Clinical and Clinical Support Spaces, we propose to adopt your reference design for Clinical Rooms such as Consulting / Exam Rooms in a number of departments which are scheduled at 15.5 sq m and drawn at 15.0 sq m. The HBN equivalent is 16.0sq m.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN	Derogation Request		
RHSC + DCN Edinburgh	**Date**	**Notes**	**Reference**
		Submitted C30 Clinical support spaces layout HBN 00-04	DER Arch 09

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ii, HBN

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Derogation

Some department corridors may result in reduced compliancy in terms of clear widths.

Proposal

HBN 00-04 Core Elements: Circulation & Communication Spaces, minimum corridor widths were adopted in line with the reference design and then were fully reviewed during the UGM process. Final setting out will be provided during the RDD process to confirm.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

Comments [NHSL]

IHS LOTHIAN	Derogation Request		
	Date	Notes	Reference
RHSC + DCN Edinburgh		Submitted C30 Adult in-patient assisted shower rooms HBN 04-01	DER Arch 12

BCR Clause

2.3 NHS Requirements
Sub-Section C, para 2.3ii, HBN

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Derogation

Proposal

SHPN 04-01 Adut In-patient Facilities, Paragraph 3.17, recommends for multi-bed rooms the provision of an assited shower room (withWC, shower and whb) and a separate semi-ambulant WC (with hand-rinse basin). We have provided a separate accessible WC (with hand-rinse basin) in lieu of the semi-anmbulant WC in line with the NHSL requirements.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

Comments [NHSL]

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
12/11/2014	Submitted C30 Ceilings	DER/Aco/01

BCR Clause

2.7

Relevant Regulation - HBN, SHTM, Building Regulations etc

SHTM 08-01

Requirement

Derogation

Proposal

SHTM 08-01 Ceilings - We would suggest that there may be a conflict between SHTM 08-01 - Acoustics and any infection control requirements.SHTM 08-01 notes that room acoustics are to be considered:It recommends that all rooms be treated with acoustically absorptive surfaces with exception for acoustically non-important rooms (such as store rooms) and rooms where there are over-riding factors such as cleaning, infection control, patient safety, and clinical and maintenance requirements.2.106 Sound-absorbent treatment should be provided in all areas (including all corridors), except acoustically unimportant rooms (for example storerooms etc), where cleaning, infection-control, patient-safety, clinical and maintenance requirements allow. (underlined by me). 2.110 Acoustically-absorbent materials should have a minimum absorption area equivalent to a Class C absorber (as defined in BS EN ISO 11654:1997) covering at least 80% of the area of the floor, in addition to the absorption that may be provided by the building materials normally used. If a Class A or B absorbent material is used, less surface area is needed. (See Appendix B for an example of how to calculate the absorption area required for materials with different absorption class.) In rooms / corridors / streets provided with lay in grid tiles Clause 2.110 is achieved by the specification of tiles (Armstrong Bioguard Acoustic would suffice). However the following rooms may have solid plasterboard ceilings (which do not provide the sound-absorbent requirements as Clause 2.110) but due to infection control issues may not require additional absorption:

- Theatre suites
- Isolation rooms and lobbies
- Interventional Radiology / Cardiac Cath Lab
- Food preparation areas
- Decontamination suite
- Treatment rooms
- Plaster rooms
- DCFP
- Operating Theatres

- Anaesthetic Rooms
- Prep Rooms
- Scrub
- Interventional Radiology
- DCFP(We believe that this covers all clinical areas)

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
15/10/2014	*Rev 02 07/11/14 Helicopter Weights*	As/Hel/02

BCR Clause

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Derogation

Proposal

As noted in PCP appendix A it has been established that the Sikorsky S92 does not have a current approved vertical procedure for operations in PC1 to allow it to operate from an elevated helipad. There are no initiatives to establish one. The design weight of the helicopter has been agreed as AW189 operating at a gross weight of 8.3t.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
13/11/2014	*01 Submitted C30 VIE Equipment*	1

BCR Clause

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Derogation

Proposal

IHSL have assumed that the provision of VIE Equipment (Oxygen Tanks/Evaporators/control panels and the like) will be provided by the Boards chosen supplier. IHSL have allowed for a suitable base, security fencing, gates etc to allow the installation by others (final details to be confirmed).

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
12/11/2014	*03 (Submitted C30) Blinds/Curtain/Shower Curtain Tracks- C*	3

BCR Clause

5.16.2 Blinds & Curtains

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Derogation

BCR's do not clearly state where curtains are required, the matter was clarified below.

Proposal

IHSL have allowed either Blinds or Curtain tracks to windows and shower cubicles within the facility. No provision for any curtains have been included.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
12/11/2014	03 (Submitted C30) Planting Maturity REDRAFTED	18

BCR Clause

7.1 Landscaping Requirements

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

The soft landscaping shall be easy to maintain, and plants and shrubs shall reach a state of maturity within three years of Actual Completion Date.

Derogation

The Boards requirement that external planting should reach full maturity within 3 years of PC of the construction contract may not be achievable in all instances.

Proposal

Project Co shall continue to monitor against programme/planting season and advise the Board accordingly. Project co shall use reasonable endeavours to meet the requirements.

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
12/11/2014	01 (Submitted C30) 25% extra capacity	23

BCR Clause

8.7.10 Medical Gases, 8.7.13 Non-Medical Gases, 8.8.1 Main and Sub-Main Distribution, 8.8.2 Standby Generation, 8.13 Services Capacity Reserve, 8.14 Service Routes, 9.6.1 Cabling & 9.7 NHS Lothian Server and NHS Lothian Node Rooms

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Derogation

25% increased capacity for future services installations within services voids/ risers; this has been provided where possible but may not be available in all risers/ service voids due to the space constraints of the building footprint/ storey heights.

Proposal

Project Co shall continue to review during the RDD process in conjunction with the Board

Reference Docts - Sketches, drawings, reference material extracts etc

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

IHS LOTHIAN

RHSC + DCN Edinburgh

Derogation Request

Date	Notes	Reference
12/11/2014	02 (Submitted C30) FFE to external works	33

BCR Clause

7 External Works

Relevant Regulation - HBN, SHTM, Building Regulations etc

Requirement

Hard and soft landscaping - FF&E

Derogation

Cost allowances for external works FF&E

Proposal

FF&E to External Works - Project Co have indicated within the drawings / plans the position of FF&E within the external works. The specifications for the FF&E items will be within the cost allowances contained within the Cost Plan. For clarity, project Cowill provide the requisite external FF&E in the positions indicated on the drawings / plans but within the constraints of the cost allowances within the Cost Plan.

Reference Docts - Sketches, drawings, reference material extracts etc

HLM External Works Drawings - Hard & Soft Landscaping

Approvals

	Organisation	Title	Signature	Date
Project Co	BMCE	Design Manager	Liane Edwards-Scott	11/11/2014
	BMCE	Commercial	Graham Coupe	13/11/2014
	BYES	FM	Panya Upama	13/11/2014
NHSL			Brian Currie	14/11/2014

NHS National Services Scotland

Scottish Health Technical Memorandum 03-01

Ventilation for healthcare premises
Part A – Design and validation

Health Facilities Scotland
Engineering and Environment

February 2014

Contents

Disclaimer

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HTM 03-01 Part A has been updated and amended by Health Facilities Scotland for use in NHSScotland as SHTM 03-01 Part A and the contribution from the National Heating & Ventilation Advisory Group is gratefully acknowledged.

Preface

About Scottish Health Technical Memoranda

Engineering Scottish Health Technical Memoranda (SHTMs) give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare.

The focus of Scottish Health Technical Memorandum guidance remains on healthcare-specific elements of standards, policies and up-to-date established best practice. They are applicable to new and existing sites, and are for use at various stages during the whole building lifecycle.

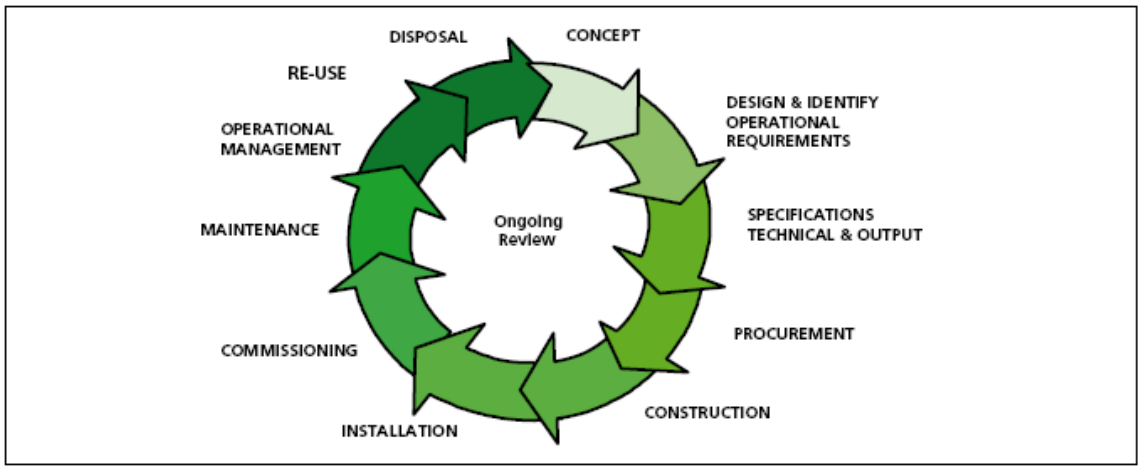
Healthcare providers have a duty of care to ensure that appropriate engineering governance arrangements are in place and are managed effectively. The Engineering Scottish Health Technical Memorandum series provides best practice engineering standards and policy to enable management of this duty of care.

It is not the intention within this suite of documents to repeat unnecessarily international or European standards, industry standards or UK Government legislation. Where appropriate, these will be referenced.

Healthcare-specific technical engineering guidance is a vital tool in the safe and efficient operation of healthcare facilities. Scottish Health Technical Memorandum guidance is the main source of specific healthcare-related guidance for estates and facilities professionals.

The core suite of eight subject areas provides access to guidance which:

- is more streamlined and accessible;
- encapsulates the latest standards and best practice in healthcare engineering;
- provides a structured reference for healthcare engineering.



Healthcare building lifecycle

Structure of the Scottish Health Technical Memorandum suite

The series of engineering-specific guidance contains a suite of eight core subjects:

Scottish Health Technical Memorandum 00: Policies and principles (applicable to all Scottish Health Technical Memoranda in this series).

Scottish Health Technical Memorandum 01: Decontamination.

Scottish Health Technical Memorandum 02: Medical gases.

Scottish Health Technical Memorandum 03: Heating and ventilation systems.

Scottish Health Technical Memorandum 04: Water systems.

Scottish Health Technical Memorandum 05: Reserved for future use.

Scottish Health Technical Memorandum 06: Electrical services.

Scottish Health Technical Memorandum 07: Environment and sustainability.

Scottish Health Technical Memorandum 08: Specialist services.

Some subject areas may be further developed into topics shown as -01, -02 etc and further referenced into Parts A, B etc.

Example: Scottish Health Technical Memorandum 06-02 Part A will represent: Electrical Services – Electrical safety guidance for low voltage systems.

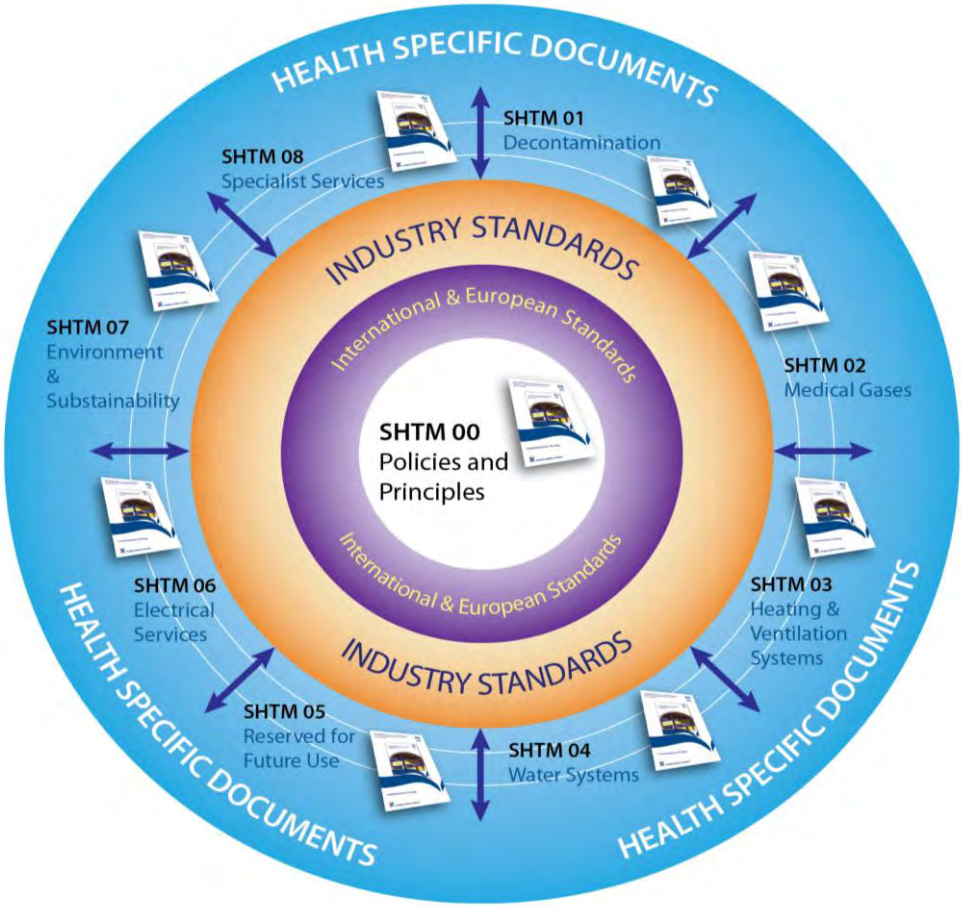
In a similar way Scottish Health Technical Memorandum 07-02 will simply represent:

Environment and Sustainability – EnCO_2de.

All Scottish Health Technical Memoranda are supported by the initial document Scottish Health Technical Memorandum 00 which embraces the management

and operational policies from previous documents and explores risk management issues.

Some variation in style and structure is reflected by the topic and approach of the different review working groups.



Engineering guidance

1. Introduction

1.1 Ventilation is used extensively in healthcare premises or primary patient treatment in operating departments, high dependency units and isolation facilities. It is also installed to ensure compliance with quality assurance of processed items in pharmacy and sterile supply departments and to protect staff from harmful organisms and toxic substances, for example, in laboratories.

1.2 This edition of Scottish Health Technical Memorandum 03 'Ventilation in healthcare premises' is published in two sections. It is equally applicable to both new and existing sites. It gives comprehensive advice and guidance to healthcare management, design engineers, estate managers and operations managers on the legal requirements, design implications, maintenance and operation of general and specialised ventilation in all types of healthcare premises.

1.3 Current statutory legislation requires both 'management' and 'staff' to be aware of their collective responsibility.

1.4 'Ventilation' is also provided in healthcare premises for the comfort of the occupants of buildings. More specialised ventilation will also provide comfort but its prime function will be to control closely the environment and air movement of the space that it serves in order to contain, control and reduce hazards to patients and staff from airborne contaminants, dust and harmful micro-organisms.

1.5 Ventilation systems in themselves present little danger to patients or staff. However, they do possess the ability to transmit hazards arising from other sources to large numbers of people. The danger may not become apparent until many patients and staff have been affected.

1.6 The sophistication of ventilation systems in healthcare premises is increasing. Patients and staff have a right to expect that it will be designed, installed, operated and maintained to standards that will enable it to fulfil its desired functions reliably and safely.

1.7 The Health and Safety at Work etc Act 1974 (HSW Act 1974) is the core legislation that applies to ventilation installations and these installations are intended to prevent contamination, control closely the environment, dilute contaminants or contain hazards. Their very presence indicates that risks to health have been identified.

Statutory requirements

1.8 The Control of Substances Hazardous to Health (COSHH) regulations place upon management an obligation to ensure that suitable measures are in place to protect their staff and others affected by the work activity. These methods may include both safe systems of work and the provision of a specialised

ventilation system. In laboratories the requirements are often met by the provision of fume cupboards and safety cabinets.

1.9 The existing requirements to provide ventilation, implicit under HSW Act 1974 and COSHH, have been made explicit by the Management of Health and Safety at Work Regulations 1999, the Workplace (Health, Safety and Welfare) Regulations 1992 and the Provision and Use of Work Equipment Regulations 1998, all issued as a result of European Directives.

1.10 Where specialised ventilation plant is provided as part of the protection measures there is a statutory requirement that it be correctly designed, installed, commissioned, operated and maintained. The local exhaust ventilation (LEV) section of the COSHH regulations requires that the plant be inspected and tested at least every 14 months by an independent organisation and that management maintain comprehensive records of its performance, repair and maintenance.

1.11 Certain substances have Occupational Exposure Limits (OEL) set out in Guidance Note EH 40 published annually by the Health and Safety Executive. If special ventilation systems are provided in order to achieve these standards they will be subject to the COSHH regulations as above.

1.12 All ventilation systems should conform to the principles set out in the Approved Code of Practice and guidance document entitled “Legionnaires’ disease: the control of *Legionella* bacteria in water systems” (commonly known as ‘L8’) published by the Health and Safety Executive and Scottish Health Technical Memorandum SHTM 04-01: The control of *Legionella*, hygiene, “safe” hot water, cold water and drinking water systems.

1.13 Special ventilation plants installed in laboratories dealing with research, development or testing, whether involving drugs, animals or genetically modified organisms, may be subject to particular legislation with regard to their operation in addition to that mentioned above. Further information is given by the Health and Safety Executive Health Services Advisory Committee in:

- safe working and prevention of infection in clinical laboratories;
- safe working and prevention of infection in clinical laboratories: model rules for staff and visitors;
- safe working and prevention of infection in clinical laboratories in the mortuary and post-mortem room.

1.14 Plants installed in units manufacturing medicinal products to the standards set out in the current European Guide to Good Manufacturing Practice may also be subject to particular legislation with regard to their operation in addition to that mentioned above.

1.15 Records should be kept of equipment design and commissioning information. The Health and Safety Executive, Medicines Inspectorate and other interested bodies have a statutory right to inspect them at any time. All records should be kept for at least five years.

1.16 The fire regulations require that if ventilation ductwork penetrates the fabric of a building it should be designed and installed so as to contain the spread of fire. (for further information refer to Firecode Series SHTMs 81, 83 and 85)

1.17 Increased health risks to patients will occur if the more specialised ventilation systems installed to supply high quality air to operating departments do not achieve and maintain the required standards. The link between post-operative infection and theatre air quality has been well established. Plants serving conventional operating departments, for instance, will be required to ensure the separation of areas within the suite by maintaining a specific direction of air flow between rooms, even when doors are opened. They will also maintain the selected operating department environmental conditions regardless of changes in the outside air conditions or activities within the space. In addition ultra-clean operating ventilation systems that are designed to provide an effectively particle-free zone around the patient while the operation is in progress, have been shown to reduce significantly post-operative infection in patients undergoing deep wound surgery. Their use for other forms of surgery may well be required.

1.18 Ventilation systems that can be shown to be inappropriate, inadequate or ineffective and that give rise to proven failures can result in a civil suit by the patient against the operators.

1.19 If the plant has been installed to dilute, extract or contain harmful substances (the definition of which now includes microorganisms) its failure may expose people to unacceptable levels of hazard. Proven failures can give rise to a civil suit against the designers and operators by the individuals who have been affected. This would be in addition to the actions brought as a result of breaching the statutory requirements.

1.20 There is a statutory requirement to provide ventilation in all enclosed workspaces. It may be provided by either natural or mechanical means. The following are some of the factors that determine the ventilation requirements of a workspace:

- human habitation (minimum fresh air requirement);
- the activities of the department, that is, extraction of odours, aerosols, gases, vapours, fumes and dust – some of which may be toxic, infectious, corrosive, flammable, or otherwise hazardous (see Control of Substances Hazardous to Health (COSHH) regulations;
- dilution and control of airborne pathogenic material;
- thermal comfort;
- the removal of heat generated by equipment (e.g. catering, wash-up, sterilising areas, electrical switch rooms, uninterruptible power supply (UPS) cupboards and some laboratory areas);
- the reduction of the effects of solar heat gains where other forms of reducing the solar effect is not available or practical, i.e. solar blinds;
- the reduction of excessive moisture levels to prevent condensation (for

example Hydrotherapy pools);

- combustion requirements for fuel burning appliances (see BS5376, BS5410 and BS5440);
- 'make-up' supply air where local exhaust ventilation (LEV) etc., is installed.

Mechanical ventilation systems are expensive in terms of capital and running costs, and planning solutions should be sought which take advantage of natural ventilation either where the use of the area in question is not critical to airflow patterns or pressures, or where backup systems are available when natural ventilation cannot be achieved.

1.21 When new ventilation systems are accepted for use, full information as to their designed mode of operation together with recommended maintenance procedures should be provided as part of the handover procedure.

Requirement	Reason	Application
Statutory	Health and Safety at Work etc Act	Operating department Laboratories Pharmacy
	COSHH regulations	Areas containing identified biological or chemical hazards Areas containing oxygen displacing gases
	Local Exhaust Ventilation (LEV)	Enclosed work-spaces Workshops
Functional	Comfort	Situations where the quality of the environment for staff and patients is critical to their general performance and well-being
Clinical	Post-operative infection reduction	Operating suites used for general surgery, casualty, obstetrics/gynaecological and maternity procedures
	Reduction of deep wound sepsis	Ultra-clean operating suites for transplant, deep wound surgery, hip replacement, bone grafting and bone marrow transplant procedures
	Isolation from contact with bio hazards	Isolation units for patients who present a biological, chemical or radiation hazard to others. Isolation units for patients with a reduced immune system

Table 1: Reasons for providing ventilation

Functional overview – Terms in use

1.22 The terms 'ventilation' and 'air-conditioning' are often incorrectly used to describe the same equipment. A general explanation of the terms is given below.

Ventilation

1.23 Ventilation is a means of removing and replacing the air in a space. In its simplest form this may be achieved by opening windows and doors. Mechanical ventilation systems provide a more controllable method. Basic systems consist of a fan and either collection, (extraction) or distribution (supply) ductwork. More complex systems may include the ability to heat and filter the air passing through them. Ventilating equipment may be required in order to remove smells, dilute contaminants and ensure that a supply of 'fresh' air enters a space.

Air-conditioning and mechanical cooling

1.24 Air-conditioning is the ability to heat, cool, dehumidify and filter air. For full air-conditioning, humidification may also be provided. This means that the climate within a space being supplied by an air-conditioning plant can be maintained at a specific level regardless of changes in the outside air conditions or the activities within the space. Mechanical cooling may be provided where close control of 'comfort conditions' within a space is required but humidity control is not needed.

Special ventilation

1.25 In healthcare premises, certain activities will necessitate the provision of ventilation equipment with additional special features in order to achieve and maintain specific conditions. These may be needed in order to assist with the treatment of patients or maintain the health and safety of staff. The precise reason for providing special ventilation will depend upon the intended application. The list below indicates some of the more typical reasons:

- to remove, contain or dilute specific contaminants and fumes;
- to ensure the isolation of one space from another;
- to preserve a desired air flow path from a 'clean' to a 'less clean' area;
- to provide control of the cleanliness of a space;
- to provide 'close' control of temperature;
- to provide 'close' control of humidity.

1.26 The following departments will usually have specialised ventilation requirements, either for a single room or throughout a suite of rooms:

- operating department;
- laser surgery unit;
- intensive treatment unit;
- infectious diseases isolation unit;
- manufacturing pharmacy;
- specialised imaging, X-ray and scanning unit;

- pathology containment laboratories;
- mortuary and dissection suite;
- research laboratory;
- sterilising and disinfecting unit (SDU);
- endoscopy unit;
- renal dialysis suite;
- ultrasound facilities;
- audiology room.

1.27 Ventilation may be provided in a wide variety of ways. These will include:

- extensive purpose-built air-conditioning units housed in their own plant rooms;
- proprietary 'packaged' systems often sited outside on a roof or;
- wall-mounted electric fans located at the point of use.

1.28 A fixed volume of air may be supplied, often expressed in terms of the resulting number of air changes per hour (ac/h) within the space being ventilated. It may also be expressed in terms of litres/second/person. Alternatively the volume of air supplied may be varied in order to maintain a specific pressure relationship between the area supplied and other surrounding areas. In some situations a combination of both methods may be adopted.

1.29 Modern plants are fitted with the means to recover energy from the extract air where this can be justified without causing contamination of the incoming supply air.

1.30 Ultra-clean systems use the same basic plant and equipment as standard air-conditioning but are in addition fitted with a terminal device that supplies the air in a unidirectional manner to the working area. Their standard of filtration will be capable of delivering air with a very low particle count to the space that they serve.

Local exhaust ventilation

1.31 Local exhaust ventilation (LEV) is a term used to describe systems installed to prevent hazardous substances from entering the general atmosphere of the room in which they are being used. Their primary function is to protect staff from the effects of their work activity.

1.32 Simple LEV systems comprise a capture hood, extract ductwork and fan. These are used to contain industrial types of hazard such as fumes from welding processes, gas discharges from standby battery banks and dust from woodworking machinery. The vapour given off when large quantities of chemicals are decanted into ready-use containers and fumes from X-ray film processing units are further examples of chemical hazards often controlled by LEV systems.

1.33 In laboratories, pharmaceutical manufacturing facilities and operating suites, LEV systems usually take the form of semi-open fronted cabinets within which the hazardous substance is manipulated. These cabinets either have their own filtered air supply or are fed with air from the room. The air extracted from the cabinet is passed through a high-efficiency filter before being discharged either to the atmosphere or back into the room. Microbiological safety cabinets, laboratory fume cupboards, cytotoxic drug cabinets and fixed or mobile disinfection enclosures are all examples of this type of facility.

1.34 Mortuaries and dissection suites may have LEV systems incorporated within the dissection table, specimen bench and bone saw.

Management action

1.35 The guidance contained in this SHTM should be applied in full to new installations and major refurbishments of existing installations.

1.36 Ventilation will need to be provided:

- as a requirement for patient care;
- in order to fulfil a statutory duty.

1.37 In assessing the need for more specialised ventilation and the standards desired for patient care, managers will need to be guided by their medical colleagues and by information published by Health Facilities Scotland.

1.38 The statutory need for ventilation falls into two categories:

- in the first, the need for specialised ventilation and the standards to be adopted are clearly set out in specific pieces of legislation. An excellent example of this is the current legislation surrounding the manufacture of medicinal products in the European Community. The managers of the departments affected by this type of legislative requirement should be aware of their needs and be able to advise on the standards to be achieved;
- the second type of statutory requirement arises due to the interpretation of both the Health and Safety at Work etc Act and the Control of Substances Hazardous to Health (COSHH) regulations. The person tasked with conducting COSHH assessments will be able to advise as to the need for, and standard of, ventilation in each particular case.

Design and validation process

1.39 It is essential when undertaking the design of a specialised ventilation system that the project be considered as a whole. The process model set out below should ensure that all relevant factors are considered.

Step	Question	Design statement and information required	Comment
1	Why is the system required?	Healthcare applications Statutory elements Non-healthcare applications	
2	What is the required system performance?	Room air flow pattern Air change rate Differential pressures Air quality Room air condition Noise limits	
3	What are the constraints on the distribution system?	Location, Size, Materials Dampers, Access, Insulation Fire considerations Room terminals	
4	What are the minimum requirements for the AHU(s)?	Intake / Discharge positions *Legionella*, Health and Safety Access, Fire, Electrical safety Leaks, Insulation, Cleanliness Filtration, Drainage	
5	What control functions are required?	User control requirements Estates control functions Energy management Environmental conditions Control sequence logic Run, Set back, Off philosophy	
6	How will the system performance be validated?	Validation methodology Instruments used Design information required [*Design air flow rates* *Design air velocities* *Pressure differentials* *Noise levels* *Air quality* *Installation standard*]	
7	The system will only be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life.		
8	Handover to client	Basic design information Commissioning results Validation report	

Table 2: Design and Validation process model

Use and function of typical equipment used in ventilation plant

1.40 Typical equipment used in ventilation systems is listed below together with a brief description of both function and use.

General

1.41 The equipment built into the ventilation system and its ductwork should be of a type that will neither cause nor sustain combustion. No materials that could sustain biological activity should be used in the construction or assembly of the system.

Air Intake

1.42 An uncontaminated air supply to the system is essential. In order to achieve this, the air intake will be positioned so that air discharged from extract systems or other dubious sources cannot be drawn in. Exhaust fumes from vehicles can present particular problems. The area surrounding the intake will need to be kept clean and free of vegetation and waste material in order to reduce the possibility of biohazards or fire. The intake itself will be protected by a louvre and mesh screen to prevent rainwater, vermin and insects etc from entering the system.

Damper

1.43 Several types may be fitted:

- automatic dampers fitted immediately behind the air intake and extract louvres. They will automatically close when the system is shut down in order to prevent an uncontrolled circulation of air;
- balancing dampers are fitted into each branch of the air distribution ductwork system so that the design air flow rate can be set during the commissioning process;
- where ductwork passes through a fire compartment wall, ceiling or floor a fire and/or smoke damper may be required;
- plant isolating dampers are fitted so that the main plant can be isolated from its air distribution duct system. They are manually operated and enable cleaning and maintenance of the air-conditioning equipment to be carried out.

Ducting

1.44 The means by which air is conveyed from the intake to its point of use. Ducting is usually constructed of galvanised steel and will normally be insulated to reduce noise and conserve energy. Ducts can also be formed in concrete, brickwork, stainless steel or plastic and may be rigid or flexible.

Fan

1.45 A series of rotating blades that move the air in the direction required. Fans are usually powered by electric motors either directly connected to them or driven through belts and pulleys. A fan may be arranged either to force air into or draw air from a ductwork system.

Attenuator / silencer

1.46 A device that will contain and absorb the noise emitted by a fan. They may be required to reduce disturbance caused by noise breaking out through the air intake and also noise transmitted along the ductwork to the conditioned space.

Filter

1.47 A filter consists of a labyrinth of fibrous material contained in a frame. It is designed to capture and hold particles being carried in the airstream. Because of the size range and number of particles that exist in air no filter can remove them all. The purpose of filtration is to reduce their number and size range to an acceptable level. Filters of progressively higher grades are fitted through the ventilation system:

- primary filters (coarse) are designed to collect the larger particles and are intended to keep the air-conditioning plant clean;
- secondary filters (fine) will remove the staining particles from air and keep the conditioned space visibly clean;
- high efficiency particulate air filters (HEPA/absolute) will remove virtually all particles from air. These may be required in order to reduce contamination in the working area either biologically or in terms of particle count.

Filters may be fitted to extract systems to protect energy recovery devices. They may also be fitted to remove biological, radiation or chemical hazards and if so, are often contained in a 'safe change' facility in order to protect those carrying out maintenance.

Activated carbon filters will reduce odours in extracted or recirculated air.

Heater battery / heater coils

1.48 A series of heater batteries or heating coils with or without fins through which steam or hot water is circulated. Heat is given up to the air passing over the battery thus increasing its temperature. Heating is usually carried out in stages, the final battery being controlled by the end user. Small batteries may be electric.

Humidifier

1.49 A device for increasing the humidity of air by adding moisture. For ventilation in healthcare premises this is normally achieved by releasing 'clean' steam into an air supply duct. The steam will be completely absorbed into the air, increasing its humidity. The level of humidity may be preset or controlled by the end user.

Cooler battery / cooling coil

1.50 A series of finned coils mounted in the air supply duct. Either chilled water or refrigerant is circulated through the coils causing heat to be removed from the air. This will reduce its temperature and may also condense moisture out of the

air. As free moisture in a duct can be a source of contamination the coil will be fitted with an eliminator and drainage system.

Eliminator

1.51 A device for catching and removing water droplets from an air stream. It may form part of a cooling coil or be a separate device.

Drainage system

1.52 A means of removing water from ductwork and disposing of it safely. Typically it will consist of a tray mounted in the duct to catch moisture, a glass water seal trap, continuously falling drainage pipework and an air break in the drain run to prevent waste water returning and contaminating the duct.

Access doors and observation ports

1.53 Doors and removable panels providing access for routine maintenance and cleaning. The doors should be fitted with glazed ports and suitable lighting provided so that the correct operation of devices such as cooling coils, humidifiers and filters can be easily observed without needing to switch off the plant.

Energy recovery

1.54 Many plants are fitted with the means to recover energy from the extract air without causing contamination of the incoming supply air. These devices will be fitted with a drainage system and may incorporate an eliminator. Several types of energy recovery systems are available.

1.55 Precise definitions of ventilation and air-conditioning terms are given in the Chartered Institution of Building Services Engineers (CIBSE) Guide B.

Typical plant

1.56 The layout of a typical plant that conforms to the requirements for healthcare applications is shown in Figure 1 overleaf. It contains most of the equipment described above.

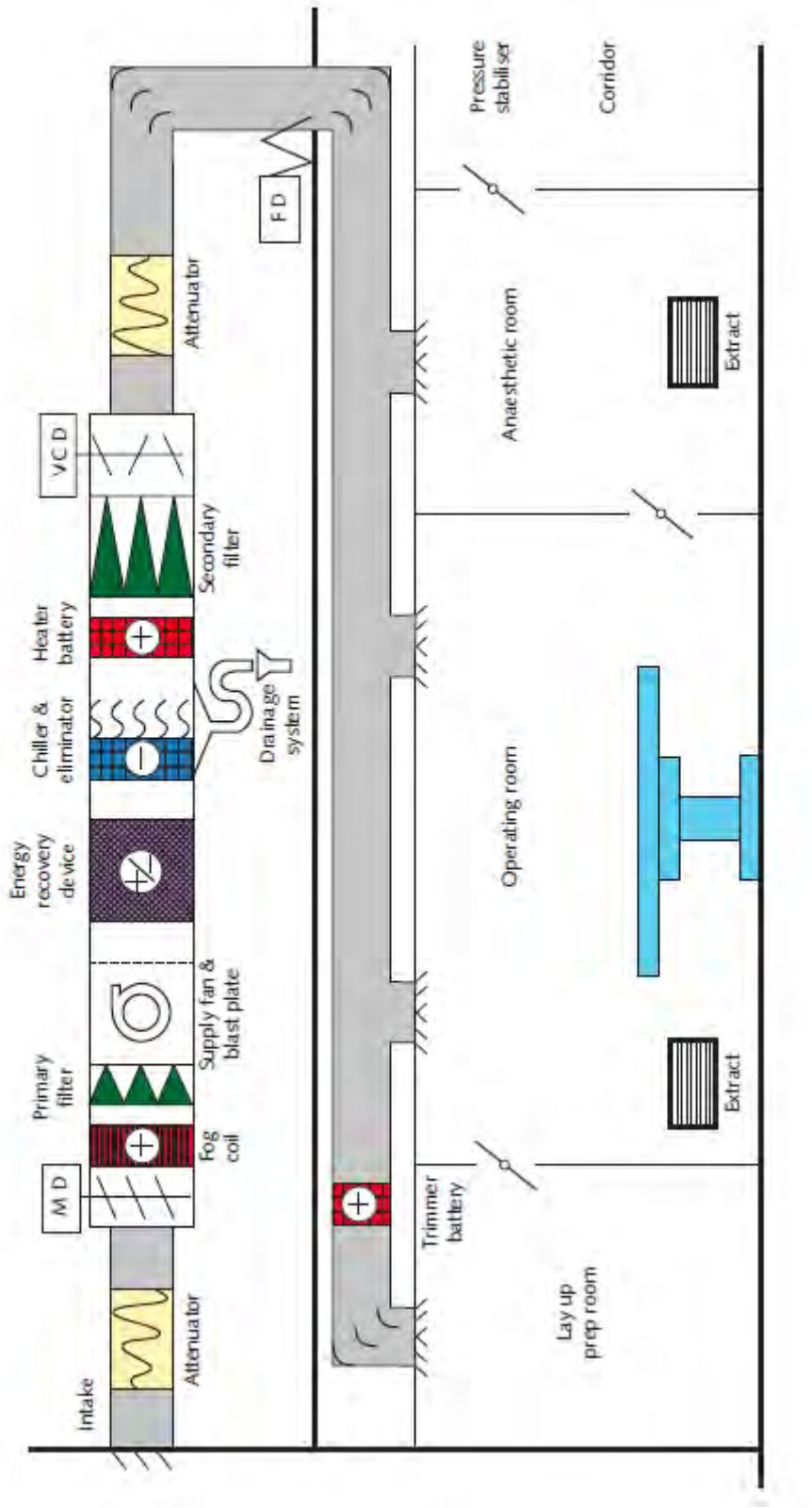


Figure 1: Design and Validation process model

2. Provision of ventilation in healthcare buildings

2.1 It is acknowledged that planning constraints imposed by the building shape and/or functional relationships of specific areas will invariably result in some measure of deep planning thus reducing the opportunity for natural ventilation. However, ventilation costs can be minimised by ensuring that where practicable, core areas are reserved for rooms that have a functional requirement for mechanical ventilation. Examples are sanitary facilities, dirty utilities and those rooms where clinical or functional requirements have specific environmental needs; and where for reasons of privacy, absence of solar gain etc., windowless accommodation is acceptable. Other spaces appropriate to core areas are those that have only transient occupation and therefore require little or no mechanical ventilation, for example circulation and storage areas.

Natural ventilation

2.2 Natural ventilation is usually created by the effects of wind pressure. It will also occur if there is a temperature difference between the inside and the outside of the building. The thermo-convective effect frequently predominates when the wind speed is low and will be enhanced if there is a difference in height between inlet and outlet openings. Ventilation induced by wind pressures can induce high air change rates through a building provided air is allowed to move freely within the space from the windward to the leeward side.

2.3 As the motivating influences of natural ventilation are variable, it is almost impossible to maintain consistent flow rates and ensure that minimum ventilation rates will be achieved at all times. This variability is normally acceptable for general areas including office accommodation, general wards, staff areas, libraries rooms, dining rooms and similar areas which should, where possible, be provided with opening windows of a design that facilitates natural ventilation.

2.4 Current guidance restricts the amount windows can be opened for safety reasons and as many designs are top-hung, their ability to permit natural ventilation is limited. It may therefore be necessary to provide dedicated ventilation openings in the fabric of the building to allow a sufficient natural flow of air into and out of the space. Paragraph 2.20 also refers.

2.5 In all cases, excessive heat gain, indoor air quality requirements or external noise may limit or preclude the use of natural ventilation.

Extract ventilation systems

2.6 Separate extract ventilation will be required for sanitary facilities, lavage areas, dirty utilities and in rooms where odorous, but non-toxic fumes are likely, in order to ensure air movement into the space. 10 air changes per hour have been found necessary, particularly in geriatric and psychogeriatric accommodation. This will assist with infection control procedures. A single

fan/motor unit can be suitable for individual rooms, but multi-room systems should be provided with duty and standby fans or motors to meet this need.

2.7 Toilets should have an extract ventilation rate as set out in the building regulations. Where WC's are located in shower and bathroom spaces, the ventilation required for the WC will normally be adequate for the whole space.

Supply only ventilation

2.8 Mechanical supply ventilation will be required in areas where it is important to maintain a positive pressure in order to prevent the ingress of less clean air, e.g. in pharmacy aseptic suites, sterile supply packing rooms, operating theatres and their preparation rooms (air change rates are given in Table A1).

Supply and extract ventilation

2.9 Mechanical supply and extract ventilation should be provided in rooms where there is a need to control room pressure in relation to adjacent spaces. Intensive Care Units, (ICU), isolation suites and treatment areas are typical applications.

Mechanical or comfort cooling

2.10 Cooling is very expensive in terms of energy costs and should be provided only where necessary to maintain a comfortable environment for staff and patient, or to ensure satisfactory operation of equipment. The imaging department in particular may require cooling to offset the equipment load.

2.11 Calculations and thermal modelling should be undertaken to ensure that during the summertime, internal temperatures in patient areas do not exceed 28ºC (dry bulb) for more than 50 hours per year taking into account the level of design risk for the application.

2.12 Certain non-patient areas may also require cooling and will typically include some laboratories, central wash-up and other areas that are subject to high equipment heat gains.

2.13 Where deep planning of other continuously occupied spaces, for example offices, is unavoidable, there will also be occasions when acceptable levels of comfort can only be maintained by cooling. Planning solutions of this type however will be exceptional.

2.14 Refrigeration plant should be of sufficient capacity to offset heat gains and maintain areas at a temperature that does not exceed the external design shade temperatures by more than about 3ºC taking into account the level of design risk for the application.

Air-conditioning

2.15 Full air-conditioning is only required in a very small number of areas within healthcare buildings and due to the capital and running cost its inclusion should be kept to a minimum. Paragraphs 3.14 - 3.15 and 4.91 - 4.93 also refer.

2.16 Areas whose functions may warrant the installation of air-conditioning include operating departments, intensive therapy units, manufacturing pharmacies and areas with particularly sensitive equipment.

Specialised ventilation

2.17 Due to the nature and extent of activities carried out in healthcare buildings, there will be a need for a wide range of specialised ventilation systems. The types of system which are generally required in individual departments and typical arrangements are given in Section 7.

2.18 The activities within some departments will require the provision of local exhaust ventilation (LEV). This is a statutory requirement under COSHH wherever the escape of chemicals, toxic fumes, biological material or quantities of dust into the general area would present a hazard to the occupants.

Ventilation for general areas

2.19 Table A1 provides recommended air change rates, temperatures and pressures for general areas that require mechanical ventilation in healthcare buildings.

Use of natural ventilation

2.20 The air tightness of new buildings has improved to the point that infiltration through building leakage can no longer be relied upon to provide sufficient air-flow. Attention must therefore be given to the provision of purpose-made ventilation openings to achieve the necessary flow rates. The air entering the openings may need to be controlled by motorised dampers linked to temperature and / or occupancy sensors in the ventilated space.

2.21 Internal partitions, fire compartment walls and closed doorways can often impede the flow path, and when this happens, the process will be more dependent on single-sided ventilation. Nevertheless, even with this degree of compartmentation, acceptable ventilation may still be achieved without window openings that would prejudice safety, security or comfort.

2.22 Some types of window, for example, vertical sliding, can enhance single sided air change by temperature difference, and these will improve the overall rate of natural ventilation in protected or sheltered areas where the effect of wind pressure is likely to be minimal.

2.23 It is generally considered that natural cross-flow ventilation is able to give reasonable air distribution for a distance of up to 6 metres inwards from the external façade, provided that reasonably clear air paths are maintained. Beyond this distance in areas where clear air paths cannot be maintained and in areas where high minimum air change rates are specified, mechanical ventilation should be provided.

2.24 Further information can be found in SHTM 55 ‘Windows’, BS5925 ‘Code of practice for ventilation principles and designing for natural ventilation’ and

CIBSE Applications Manual AM10: 'Natural ventilation in non-domestic buildings'.

Mixed mode ventilation

2.25 This comprises an assisted form of natural ventilation. Fans are fitted in the purpose made damper-controlled ventilation openings. Alternatively a separate ventilation unit may be installed. In both cases the dampers and fans are controlled under the dictates of temperature and occupancy sensors to ensure a minimum air flow rate while taking advantage of natural ventilation effects when present.

2.26 Where natural or mixed mode ventilation is adopted with complex air paths, the designer should produce an air flow diagram in order to ensure correct provision of air transfer devices. CIBSE Applications Manual AM13: 'Mixed mode ventilation in non-domestic buildings' gives guidance.

Mechanical extract ventilation

2.27 General extract systems can vary in complexity from a single wall-mounted fan to a ducted air system with dual extract fans.

2.28 Replacement air is generally provided by a central supply system (as described below). Unless special precautions are taken, the latter may result in an unacceptable level of draughts occurring in winter, and possible risk of unacceptable levels of noise transmission.

2.29 If individual systems are used, the ventilation can be operated intermittently, provided it continues to run for at least 15 minutes after the room is vacated, as with light switch-operated fans in individual toilets.

2.30 If general exhaust systems are used; it is recommended that filtered and tempered replacement air is provided via a central supply plant to adjoining lobbies or corridors, to prevent the risk of discomfort caused by the ingress of cold air. Fire compartmentation requirements must be maintained.

2.31 Information on specialised extract systems is given in Section 7.

Mechanical supply systems

2.32 Where mechanical supply systems are required, the fresh air should be tempered and filtered before being delivered to the space, to avoid discomfort.

2.33 The air should be heated using a constant or variable temperature source, but generally only to the space air temperature. In most instances, the low-pressure hot water heating (LPHW) should offset any fabric loss, so that setback room temperatures can be maintained during unoccupied periods without the need for the ventilation system to operate.

Balanced ventilation

2.34 Balanced ventilation systems are merely a combination of a supply and extract systems of equal volume; and either a single space or a whole building may be considered to be balanced. A balanced system is necessary in instances where it is essential to maintain consistent air movement within an area, for example, treatment rooms.

Cascade ventilation

2.35 In operating departments it is normal practice to supply air to the operating room, and allow it to pass through less clean areas – corridors, utility rooms etc. (from where it is eventually extracted).

Recirculation systems

2.36 Due to the nature of the use of mechanical ventilation systems within healthcare buildings, there are few opportunities for the application of recirculation air systems. They are however normally used for HEPA filtered clean room applications where the extract air is significantly cleaner than the outside supply. Recirculation is also routinely used in the canopy section of Ultra Clean Operating theatre ventilation systems.

2.37 Where the designer is considering the installation of a recirculation air system, due account must be taken of:

- minimum fresh air supply volume required by the Building (Scotland) Regulations 2004 (currently 20%);
- prevention of contamination of supply air from vitiated air in extract systems;
- prevention of stratification occurring within plenum chambers and mixing boxes which may result in freezing of downstream coils;
- ensuring sufficient velocities through control dampers (ideally 5-6m/s) to provide suitable authority; and good shut-off;
- modulating control of mixing to provide optimum on-plant conditions;
- use of ‘free cooling’ by cycling the dampers to minimum fresh air when the enthalpy of the outside air is above that of the extract air under conditions when cooling is required.

Chilled beams

2.38 The use of chilled beams for the provision of heating, cooling and ventilation is increasingly common in healthcare premises. The use of Active Chilled Beams providing tempered filtered air to a heating / cooling device within the room can provide effective local control of environmental conditions.

2.39 Care should be taken in positioning chilled beams to ensure the avoidance of cold draughts particularly when used in the cooling mode. The control settings should ensure that the external elements of the beam are always above dewpoint.

2.40 Consideration should be given to the ease with which specific types of chilled beam units can be accessed for cleaning having regard to the need to control the infection risk. The impact of maintenance requirements on room availability should also be considered.

Split comfort air-conditioners

2.41 Split comfort air-conditioners, room conditioners or cassette units are used increasingly where there is a small local requirement for cooling for operational purposes. They can provide an effective economic solution to cooling needs, where a central refrigeration system is not practicable.

2.42 The units re-circulate room air so provision for a fresh air make up, either by natural or mechanical means, to the standard required by the Building (Scotland) Regulations must be provided.

2.43 The recirculation of room air presents problems with indoor air quality (IAQ) and may increase the risk of healthcare associated infection (HAI). Split units should not therefore be used in critical patient areas.

2.44 Split units may be used for single room applications or as multiple linked units that can independently provide either heating or cooling, all served by a single outdoor unit. These systems enable good temperature control of a number of rooms with maximum energy efficiency.

2.45 Whether single or multiple systems are used, it is essential that the designer gives due consideration to the source of electrical supply, location of the heat rejection unit, environmental effects to the refrigerant used and drainage provision for the cooling coil condensate.

2.46 The units will require routine maintenance for filter change and cleaning; they should therefore be installed in an accessible position.

Dilution ventilation and clean air flow paths

2.47 Dilution ventilation has in the past been used to control levels of hazardous substances in a space. This approach is no longer considered acceptable. The COSHH Regulations require that known hazardous substances should be substituted by safe alternatives. If this is not possible then they should be controlled at source by the use of closed systems such as anaesthetic gas scavenging units or exhaust protective enclosures such as fume cupboards.

2.48 The exposure of staff to casual spillages of substances such as medical gases in anaesthetic rooms should in the first instance be dealt with by establishing a clean airflow path. Air should be supplied at high level and extracted at low level directly behind the anaesthetic equipment position. The philosophy of establishing a clean air-flow path from the supply point; to the staff; on to the patient and out via a low level extract would also apply in recovery rooms and maternity delivery rooms including labour, delivery, recovery & post partum (LDRP) Rooms. A suitable air change rate will provide dilution ventilation as an additional safeguard; see Table A1, Table A2 and Note c.

2.49 In operating theatres the patient will be on a closed breathing circuit in a room with a high air change rate. Under these circumstances the dilution effect would be considered sufficient to control any casual exposure to anaesthetic gases.

Mechanical ventilation systems

System selection

2.50 Natural ventilation is always the preferred solution for a space, provided that the quantity and quality of air required, and the consistency of control of ventilation to suit the requirements of the space, are achievable with this method. If this is not the case, a mechanical ventilation system will be required.

Choice of central/local plant

2.51 Mechanical ventilation is expensive to operate, and as such, should be controlled to operate when the space being served requires to be ventilated. In addition, loads on refrigeration plant are rarely constant owing to changes in solar gain, occupancy and use of heat-generating equipment and lights, therefore control of temperature is critical.

2.53 If the ventilation loads throughout a department or building are in phase, or are not significant, a central plant with single zone control can be adopted. However, this is rarely the case, and elsewhere, the condition or quantity of supply air to different areas or zones of the building must be varied accordingly. This can be done by providing either individual plants to each zone, or separate zone terminal control. Where there is a high density of rooms with similar ventilation requirements in an area of a building or department, it is usually economical to combine them into a central system.

2.54 In large buildings, a choice between a single distribution system and multiple smaller systems may arise. Large distribution systems and their plant can have the advantage of lower operating costs, but require more space for vertical shafts and horizontal distribution. In general, very long runs of ducting should be avoided to prevent undue heat losses or gains, excessive leakage, and difficulties in balancing during commissioning. As the pressure losses in the long runs will be greater and a higher initial static pressure will be required, this will lead to a more expensive class of ductwork. Multiple smaller distribution systems may be more expensive in capital and operating costs but they avoid long runs, large ducts and vertical shafts, and this may reduce overall building costs. They also provide a more robust service as the failure of an individual system does not prevent the use of the rest of the building.

Zoning of the building

2.55 The efficiency and effectiveness of any ventilation or air-conditioning installation depends largely on the zoning and control of the installation. The factors to consider when determining the zoning of a ventilation system for a building or department are:

- periods of occupancy;

- fresh air/ventilation requirements;
- smoke control.

2.56 Where the ventilation system is not merely tempering the air, but also providing the heating and/or cooling requirements, the following additional factors will need to be considered:

- internal or peripheral location;
- orientation of windows;
- variation in internal loads;
- level of control required.

2.57 For single zone plant in staff areas, local control (with a run-on timer if required) is recommended, as this can be turned off when the space is not in use, thus saving both thermal and electrical energy. Most supply and extract systems, conversely, are required to operate continuously while the department is occupied, thus some form of time or use control is necessary.

2.58 The control of individual plant items is covered in Section 4, with examples of typical control strategies in Section 6. For control of particular specialised ventilation and air-conditioning systems refer to Section 7 of this document.

2.59 On very rare occasions a duplicate standby air handling plant may be justified. If installed it must be provided with a gas-tight damper at its junction with the supply distribution duct, so that no back-flow can occur. Standby plants can become sources of contamination if warm moist air is allowed to dwell within them. Their design and control system must ensure that this cannot happen.

Specific requirements for hospital departments

2.60 Specific requirements for individual spaces and departments are included in the Health Building Notes (HBNs) and Activity Database (ADB) A-Sheets, or Scottish Health Planning Notes (SHPNs).

3. Assessment of service requirement

Selection of design criteria

External design conditions

3.1 The most accurate data that is available for the summer and winter conditions at the site should be used. The Metrological office can supply data for the United Kingdom.

3.2 Healthcare mechanical ventilation systems will normally be 'full fresh air'.

3.3 Local adjustments such as for height above sea level, exposure factor, or other climate peculiarities, should be made as appropriate.

Internal design conditions

3.4 The design conditions selected within patient areas must strike a balance between the comfort requirements of staff and patients, who often have very different levels of clothing and activity.

3.5 Recommendations for the dry resultant temperature and humidity of individual spaces are shown on Activity Database (ADB) A-Sheets. Table A1 gives a summary.

Minimum fresh air requirements

3.6 For most applications involving human occupancy, the dilution of body odours is the critical factor in determining ventilation requirements. Where natural ventilation or mechanical full fresh-air systems are used, all ventilation air will be fresh.

3.7 Where odour dilution is the overriding factor, it is recommended that 10 litres/second/person should be taken as the minimum ventilation rate.

3.8 Smoking is not permitted in healthcare premises. If permitted for example in residential care, it will be confined to designated areas. It therefore follows that these areas will contain a high percentage of smokers so the ventilation rate would be at least 36 litres/second/person for these applications (CIBSE Guide A; Table 1.10 refers).

3.9 In non-standard applications such as laboratories, aseptic suites, operating departments, etc., the particular requirements for each area should be considered independently in order to determine the overriding minimum requirement for ventilation.

Limiting supply air conditions

3.10 For most applications in healthcare buildings, it is the temperature differential between the supply and room air, rather than the actual temperature of the

supply air which is the critical factor. The maximum recommended supply-to-room air temperature differential is:

summer cooling: - 7K

winter heating: + 10K

3.11 It is also necessary to keep supply air humidity below 70% during winter in order to minimise risks associated with condensation.

Air purity

3.12 In healthcare premises, the standard of filtration will depend on the activities within the occupied spaces. With the exception of special areas, (for example manufacturing pharmacies), the requirement for aerobiological needs is not stringent and filtration is only required to:

- maintain hygienic conditions for the health and welfare of occupants, or for processes such as food preparation;
- protect finishes, fabrics and furnishings; to reduce redecoration costs;
- protect equipment either within the supply air system; that is, to prevent blocking of coils, or in the space itself to prevent dust collection.

3.13 Given that almost all viable particles will originate from the occupants of a space and not from the incoming air, dilution is the more important factor aerobiologically. Therefore, for general areas a G4 filter will be suitable. More critical areas will require a F7 filter. HEPA filters will only be required in Ultra Clean systems.

Humidity control requirements

3.14 Providing humidification is expensive in terms of plant, running costs and maintenance, and therefore its use should be restricted to where it is necessary for physiological or operational reasons.

3.15 Humidification was originally required for some healthcare applications, e.g. operating theatres, in order to control the risk associated with the use of flammable anaesthetic gases. The use of such gases has now ceased. Humidification is therefore no longer required unless there is a very specific application requirement.

Maximum noise levels

3.16 Noise will be generated in an air distribution system by the fan, ductwork fittings, dampers and grilles. The specified maximum noise level will depend on the activities within the occupied spaces.

3.17 The overall noise levels should not exceed the values given in Scottish Health Technical Memorandum 08-01: ‘Acoustics’, although general requirements are given in Table 3.

3.18 Attenuation should be incorporated into the ductwork system or plant arrangement as necessary to reduce noise from fans and plant items in order to achieve the acceptable limits within the rooms at the design air flows.

3.19 Plant noise should not be greater than 80dB(A) within the plant room from the fans, coolers, heaters, humidifiers etc. when starting up or running, and should be reduced to lower noise levels where the plant is near to departments sensitive to noise.

3.20 Attention must be given to the reduction of tonal components. High tonal components from air diffusers etc. can seriously disturb concentration over longer periods even when the overall noise level is low. Broadband noise causes less annoyance. Reference should be made to SHTM 08-01: 'Acoustics'.

3.21 The designer requires knowledge of the total hospital layout and operational policies, to assign acceptance magnitudes to all the possible noise sources, in order to arrive at the correct rating.

Room	Overall noise level - NR	Ventilation plant commissioning - NR	Ventilation plant design - NR
Operating department	50 (55)	45	40
Ward areas	33	30	30
Sanitary facilities	45	40	35
Industrial areas	50	45	40
Circulation areas	50	45	40

Table 3: Interior noise level

3.22 In Table 3, above, the overall noise level takes account of all internal and external noise sources. The commissioning noise level is the level measured with a sound level meter in the unoccupied room, taking account of the external noise together with the noise generated by the ventilation system. When occupied and in use, this commissioning level will constitute a continuous background noise which will allow the overall noise level to be achieved. The ventilation plant design noise level is that generated by the plant alone with no other noise source being considered. The levels suggested make recognised allowance for the ingress of environmental noise that must be considered in the overall design, that is, in specifying the attenuation of walls, partitions, ceilings, etc.

3.23 The recommended criterion is measured as the "A" weighted sound pressure level expressed in decibels, which should not be exceeded for more than 10% of the time.

3.24 The designer must also consider noise escaping to the external environment and this must not be unacceptable to occupants of adjacent buildings.

Calculation of building loads

Air infiltration

3.25 Air infiltration occurs due to a complex combination of wind pressure, thermal effects, location relative to other features and the construction standard of the building. The infiltration rate is governed by the size and number of openings in the building envelope and the complexity of internal air paths.

3.26 CIBSE Guide A (2006) Section 4 provides information and formulae for the calculation of air infiltration and natural ventilation of buildings. In all cases the requirements of the appropriate section of the Building (Scotland) Regulations must be met.

Summertime temperatures

3.27 The calculation method for determining the summertime temperature is described CIBSE Guide A (2006) Section 5. However, it is very important to select the time of day and time of year of peak loadings for the calculations. These will be dependent on the orientation and proportion of solar to total heat gain. In establishing outside design values, the design risk having regard to the function and occupancy of the building should be considered.

3.28 Where calculations indicate that internal temperatures will frequently exceed the selected design external shade temperature by more than 3K for a period that exceeds the building design risk, methods of reducing temperature rise should be implemented. Options include: - reducing solar and casual gains, the use of chilled beams or ceilings, increasing ventilation rates or providing mechanical cooling. In some situations it may be possible to alter the thermal mass of the structure to 'move' the peak temperature event time so that it occurs outside of the occupancy period. Calculations and thermal modelling should be undertaken to ensure that during the summertime internal temperatures in patient areas do not exceed 28°C dry bulb for more than 50 hours per year. It has been found that there is a relationship between preferred indoor temperatures and mean outside temperature. Fig A2 in CIBSE Guide A indicates this relationship.

Peak heating load

3.29 Peak heating local calculations are necessary on all mechanical supply systems to establish the size of heater batteries and subsequently the central plant.

3.30 Where ventilation systems provide tempered air to spaces that have supplementary LPHW to offset the building fabric losses, the plant heating load should be calculated based on the external winter design temperature, the design internal air temperature, and the calculated total air volume (including a suitable allowance for leakage).

3.31 Where the ventilation system is the only means of heating a space, an increase in load equivalent to the calculated fabric heat losses from the space should be added to the ventilation load. A check of supply temperature difference should

be made. If it exceeds 10K the ventilation supply volume should be increased to suit.

Condensation risk

3.32 A check should be made to ensure that the selected air condition will not lead to surface condensation on low-temperature elements of the ventilated space.

3.33 Where there are local sources of moisture that would require excessive levels of ventilation to avoid condensation, the designer should consider the capture and removal of moisture at the source of the evaporation via an exhaust hood or similar device.

3.34 In intermittently heated buildings, it is necessary to consider the condensation risk at night setback conditions as well as during normal operation. Calculation methods for this assessment are given in CIBSE Guide A.

Peak cooling load

3.35 In addition to the base data of airflow rates and temperatures, when calculating cooling loads, the designer must take into account:

- solar cooling loads;
- surface conduction cooling loads;
- internal gain cooling loads;
- cooling loads due to high-level humidity control;
- method of control of internal conditions;
- fluctuations in internal temperatures.

3.36 When the peak internal loads have been assessed and a suitable allowance made for non-coincidence, the supply temperature can be calculated.

3.37 Once the lowest required supply temperature of the air handling unit has been established, and an allowance made for temperature rise through the fan and ductwork (usually 1K for low pressure systems), the off-plant enthalpy can be established from a psychrometric chart or table.

3.38 The cooling loads for all plants on the chilled water system should be calculated at each of the individual peak times in order to establish accurately the required (diversified) capacity of the chiller.

Annual energy consumption

3.39 Annual energy consumptions of heating-only ventilation systems are simple to calculate based on supply-to-external air temperature rise, and frequency of occurrence of external temperatures as given in CIBSE Guide A.

3.40 Minimum air volumes are usually fixed by the room loads or fresh air requirements. However, the designer may increase airflow to some rooms or

zones in order to balance loads, as detailed in the following paragraphs on "Calculation of plant requirements."

3.41 The method of zoning and control can significantly influence energy consumption.

3.42 The nature of air-conditioning operation, comprising cooling and reheating for humidity or zonal temperature control, makes prediction of energy consumption very complex. It is imperative that these calculations are performed to ensure optimum energy efficiency.

3.43 The concept of load and plant operation charts is outlined in the CIBSE Guide A. The method requires the designer to establish the minimum and maximum loads on all zones across the range of external temperatures between winter and summer design conditions. Once the load chart is complete, the plant chart converts the loads to supply temperatures, which are then superimposed on external air temperatures.

3.44 When all temperatures for all zones are plotted on the plant operation chart, set points and resetting schedules can be established. From this information, the outputs of individual heaters, coolers and humidifiers can be established at any given external temperature. When those loads are computed against annual frequency of occurrence of external temperatures as given in CIBSE Guide A, the annual energy consumption of individual elements, and thus the air-conditioning system, can be established.

3.45 In order to prevent surface condensation occurring, it is necessary to provide sufficient ventilation to maintain the maximum and ambient dew-point temperature below the lowest surface temperature, the coldest usually being the glazing. Paragraphs 3.33 and 3.34 also refer.

Calculation of plant requirements

Air supply volumes

3.46 The minimum air supply volume for a room is determined by the greatest of these three criteria:

- the minimum fresh-air requirement;
- the minimum supply volume for the room load as determined by the maximum heating or cooling supply temperature differential;
- the desired/required air change rate.

Plant sizing

3.47 Once the design airflow has been established the cross-sectional area of the air-handling unit can be calculated based on a maximum coil face velocity of 2.0 m/s.

3.48 In order to establish the length of the air-handling unit, it will be necessary to refer to manufacturers' literature, ensuring all necessary access panels and components are included as detailed in Section 4.

3.49 The fan duty should be calculated by adding the resistances of all elements that contribute to the pressure drop of the index circuit.

3.50 The main elements that must be considered are:

- inlet or discharge louvres;
- plant entry and discharge;
- attenuators;
- components within the air-handling unit;
- duct-mounted heaters and filters (including a dust allowance);
- ductwork distribution;
- ductwork fittings, including: fire dampers, volume control dampers, bends and sets, tees, changes of section;
- air terminal device;
- discharge velocity.

3.51 Where packaged air-handling units are installed, the fan pressure drop is usually quoted as external plant resistance, and thus the designer does not need to calculate the resistances of individual plant items. The designer should, however, ensure that an allowance has been made for filter clogging; and confirm whether the fan pressure quoted is fan total or static pressure.

3.52 Resistances of ductwork and fittings may be obtained from the CIBSE Guide A. However, the designer should exercise some care when using tabulated pressure loss information for fittings that are relatively close together.

3.53 Upon completion of the resistance calculation exercise, the designer should make allowances for calculation and construction tolerances as indicated in Table 4.

Criteria	Low pressure systems	Medium/high pressure systems
Volume flow rate margin for leaking and balancing requirements	+5%	+5%
Total pressure loss margin A. for increase in volume flow rate (above)	+5%	+5%
B. for uncertainties in calculation	+5%	+10%
Combined total pressure loss margin	+10%	+15%

Table 4: Typical fan volume and pressure margins

Plantroom size and location

3.54 The ventilation plant and associated equipment should be positioned to give maximum reduction of noise and vibration transmitted to sensitive departments; while at the same time, achieve an economic solution for the distribution of services.

3.55 It is not recommended that noise and vibration generating plant be housed either directly above or below sensitive areas (for example, operating or anaesthetic rooms) unless there is no alternative, in which case, additional care and attention must be given to the control measures.

3.56 The plant must also be located so that it is remote from possible sources of contamination, heat gains and adverse weather conditions. The design should ensure that wind speed and direction have a minimal effect on plant throughput.

3.57 Safe access to and around plant is essential to facilitate inspection, routine maintenance, repair and plant replacement.

Provision of primary services

3.58 Where more than one air-handling plant requires cooling, remote central cooling plants with piped chilled water are preferred. In the case of a single plant, a multi-stage direct-expansion cooling coil with refrigerant piped from an adjacent compressor/condensing plant could be considered. If this option is selected, a refrigerant gas detector mounted in the base of the duct and an alarm system audible to the end-user will also need to be provided (as dictated by COSHH Regulations).

3.59 Clean dry steam is preferred for humidification, provided that the boiler water treatment does not render the steam unusable for direct humidification.

3.60 If a suitable supply of steam cannot be obtained from the steam main, a steam generator should be provided locally, or a self-generating humidifier installed. Electric humidifiers require considerable electrical loads and if a gas supply can be derived, this would be preferable. The location of a local steam generator is critical if condensate is to drain back into it.

Inlet and discharge sizing and location

3.61 Air intakes and discharge points should preferably be located at high level, to minimise the risks of noise nuisance to surrounding buildings, contamination and vandalism.

3.62 Intakes and discharges should be designed and located so that wind speed and direction have a minimal effect on the plant throughput.

3.63 Helicopter landing pads in the vicinity of ventilation intakes and discharges can result in large short-term pressure changes. This can cause pressure surges in supply systems and reverse airflows in extracts. Exhaust fumes from the helicopter may also be drawn into intakes. For general information, refer to Health Building Note (HBN) 15-03 – Hospital helipads.

3.64 Intake points should also be situated away from cooling towers, boiler flues, vents from oil storage tanks, fume cupboards and other discharges of contaminated air, vapours and gases, and places where vehicle exhaust gases may be drawn in.

3.65 Where intakes have necessarily to be sited at or near ground level, the area around them should be paved or concreted to prevent soil or vegetation being drawn in. They should also be caged or located within a compound to prevent rubbish being left in the vicinity. The likely proximity of vehicle exhausts should also be taken into account when determining the protected area around the intake.

3.66 The discharge from an extract system must be located so that vitiated air cannot be drawn back into the supply air intake or any other fresh-air inlet. Ideally, the extract discharge will be located on a different face of the building from the supply intake(s). In any event, there must be a minimum separation of 4 metres between them, with the discharge mounted at a higher level than the intake.

3.67 Discharges from LEV systems should preferably be vertical and usually not less than 3m above roof level. They should not be fitted with a cowl that could cause the discharge to be deflected downwards.

3.68 Each intake and discharge point should be fitted with corrosion-resistant weatherproof louvres or cowls to protect the system from driving rain. Louvres should be sized based on a maximum face velocity of 2 m/s in order to prevent excessive noise generation and pressure loss.

3.69 The inside of the louvres should be fitted with a mesh of not less than 6mm and not more than 12mm to prevent leaves being drawn in and infestation by vermin.

3.70 The duct behind louvres should be self-draining. If this is not practicable, it should be tanked and provided with a drainage system.

3.71 Cleaning access must be provided either from the outside via hinged louvres or by access doors in the plenum behind the louvre. Where a common plenum is provided, cleaning access should be via a walk-in door.

Heat rejection devices

3.72 The design conditions given in Section 2 make no allowance for the elevated temperatures that can occur on the roof of buildings. Refrigeration condensers should, if practicable, be shaded from direct solar radiation, or the design adjusted to take account of the gain.

3.73 Air-cooled condensers must always be the first choice for heat rejection from any refrigeration plant. Evaporative cooling systems must not be used in healthcare premises.

3.74 Reference should be made to Scottish Health Technical Memorandum 04-01: 'The Control of *Legionella*, hygiene, 'Safe' hot water, cold water and drinking

water systems, Part A: Design, Installation and Testing, and Part B: Operational Management, published by Health Facilities Scotland, 2011.

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4. Air handling unit design and specification guidance

General requirements

Location and access

4.1 Air-handling units should be located in an accessible area secured from unauthorised entry. Siting units in ceiling voids above occupied spaces is not appropriate.

4.2 Units located on roofs must have a safe means of access together with suitable precautions to prevent personnel or equipment falling or being blown off during maintenance activities.

4.3 Units located at ground level should be secured within a locked compound to prevent unauthorised access. Measures should be taken to exclude vehicles from the vicinity to ensure that exhaust fumes will not be drawn into intakes.

4.4 Units may have a working life of approximately 20 years. It can be anticipated that over this period there will be a need to access every element within the unit for deep cleaning. It is also quite possible that the main fan and individual heater and chiller batteries will need replacement. Suitably positioned service connection joints and adequate spacing should permit these items to be withdrawn without the need to dismantle other installed plant or equipment. Batteries significantly wider than 1 metre should be split to permit withdrawal from both sides.

4.5 It is essential that air-handling units are positioned so that all parts are easily and safely accessible for routine inspection and service. If a unit is located against a wall or backs onto another unit then access to all parts must be available from the front. Units greater than 1 metre wide should preferably have access from both sides or access doors large enough to permit the full and safe entry of maintenance personnel.

4.6 Water may be used during routine cleaning or spilt when maintenance is being undertaken. The area around the unit should be tanked to prevent water penetration to adjacent areas and adequately drained.

4.7 Fire precautions should be incorporated in accordance with Firecode. Guidance is available in BS5588: Part 9 and Sections 5 and 6 of this document.

4.8 Combustion equipment must not be located in a fire compartment that houses air-handling equipment.

Technical requirements

4.9 The basic technical requirements of the whole of the ventilation system should meet the relevant clauses of the Model Engineering Specification. It should be noted that the Specification contains a menu of clauses that cover a wide range

of applications, so it is important to select only those that are relevant to the specific application.

Note 1: At the time of writing, Model Engineering Specification C04 was listed for revision in order to bring it into line with the revised standards as set out in this Scottish Health Technical Memorandum. Where conflicts in specification arise, the Scottish Health Technical Memorandum takes precedence.

4.10 It is essential that the main plant/ductwork is located far enough above the floor to permit the correct installation of drainage systems for cooling coils, humidifiers and heat recovery systems. Easy access for maintenance of drainage systems and their associated pipework must be provided.

4.11 Organic materials or substances that can support the growth of microorganisms must not be used in the construction of the plant or its distribution system. The water fittings and materials directory lists suitable materials for sealants and gaskets.

4.12 The plant and its distribution system must not contain any material or substance that could cause or support combustion.

4.13 Plants should have a high standard of air-tightness. The double-skin method of construction with insulation sandwiched between two metal faces is recommended. The panels may be available in a variety of colours at no additional cost. This can aid identification by colour coding of units in a plant room (for example green for general ventilation; blue for theatres; red for laboratories and isolation facilities; grey for extract etc).

4.14 The inside of the plant should be as smooth as possible. Channels, rolled angles or formed sections that could trap or hold moisture should be kept to a minimum. If stiffeners are required, they should be fitted externally. If internal bracing has to be fitted it must be of a design that will not trap or hold moisture.

4.15 Airflow across air treatment components such as filters, heat exchangers and humidifiers will be influenced by the pattern of the approaching airstream. If unsatisfactory conditions are created, the performance of the component will be reduced.

4.16 Access to items that require routine service such as filters, frost batteries and chiller batteries should be via hinged doors. The doors should be large enough (for example 500mm minimum) to allow easy access. Items requiring infrequent access such as attenuators may be via bolted-on, lift-off panels. All doors and panels should be close-fitting and without leaks.

4.17 Care should be taken during installation to ensure that electrical and mechanical services are not installed in positions that will reduce or impede access.

4.18 It can be difficult to turn off AHUs in order to inspect filters and drainage trays. Viewing ports and internal illumination will therefore facilitate routine inspection of such items. Viewing ports should be at a convenient height so that temporary ladders are not required. Internal illumination should be provided by

fittings to at least IP55 rating. Fittings should be positioned so that they provide both illumination for inspection and task lighting. All of the lights in a unit should be operated by a single switch.

4.19 Access to AHUs and items in the distribution system such as filters or heater / chiller batteries should be via fixed ladders and platforms or pulpit-style moveable steps. The installation of distribution ductwork and other electrical or mechanical services should provide sufficient clearance to allow the pulpit steps to be easily wheeled into position.

AHU drainage system

4.20 All items of plant that could produce moisture must be provided with a drainage system. The system will comprise a drip tray, glass trap, air break and associated drainage pipework.

4.21 The drip-tray should be constructed of a corrosion-resistant material (stainless steel is preferred) and be so arranged that it will completely drain. To prevent 'pooling', it is essential that the drain connection should not have an upstand; and that a slope of approximately 1 in 20 in all directions should be incorporated to the drain outlet position. The tray must be completely accessible or, for smaller units, easily removable for inspection and cleaning.

4.22 Each drip tray should be provided with its own drain trap. The drain trap should be of the clear (borosilicate) glass type. This permits the colour of the water seal to be observed thus giving an early indication of corrosion, biological activity or contamination within the duct. The trap should have a means for filling and incorporate couplings to facilitate removal for cleaning. It should be located in an easily visible position where it will not be subject to casual knocks. The pipework connecting it to the drainage tray should have a continuous fall of not less that 1 in 20.

4.23 Traps fitted to plant located outside or in unheated plant rooms may need to be trace-heated in winter. The trace-heating must not raise the temperature of water in the trap above 5°C.

4.24 Water from each trap must discharge via a clear air gap of at least 15mm above the unrestricted spill-over level of either an open tundish connected to a foul drainage stack via a second trap, or a floor gully (or channel). A support should be provided to ensure that the air gap cannot be reduced. More than one drain trap may discharge into the tundish providing each has its own air break.

4.25 Drainage pipework may be thermoplastic, copper or stainless steel. Glass should not be used. The pipework should be a minimum diameter of 22mm and a fall of at least 1 in 60 in the direction of flow. It should be well supported and located so as not to inhibit access to the AHU.

Layout of air handling unit

4.26 The AHU should be arranged so that the majority of items are under positive pressure. Any item of plant requiring a drain should be on the positive pressure side of the fan. A recommended layout is given in schematic from in Figure 3.

4.27 A separate extract unit will generally be required for the area served by each supply unit.

4.28 An energy recovery system will normally be fitted between the supply and extract units.

Provision of dampers

4.29 Fire- or smoke-actuated dampers shall be provided at the locations required by Firecode. (See Paragraphs 5.17 - 5.21).

4.30 Motorised low-leakage shut-off dampers should be located immediately behind the intake and discharge of each supply and extract system respectively. They should be of the opposed-blade type, opening through a full 90° and must close automatically in the event of power failure or plant shutdown to prevent any reversal of the system airflow.

4.31 The quality of motorised dampers is critical. They should be rigid, with square connections fitted with end and edge seals of a flexible material and with minimal play in linkages. The leakage on shut-off should be less than 2%.

4.32 A manually operated isolating damper should be installed between the main AHU and its distribution system to enable the unit to be isolated when cleaning is in progress.

4.33 Good practice will require the fitting of a main volume control damper so that the design airflow rate can be set at commissioning. The damper should be lockable in any position. If it will also be used for plant isolation, it should be capable of being reset to give the design airflow without the need for re-measurement.

4.34 Internal plant isolating dampers or provision for the fitting of shut-off plates between items within a unit are not required.

Vibration

4.35 Vibration from a remote plantroom can be transmitted by the structure of the building, may be regenerated and may sometimes be magnified many times. Units should be selected to have the minimum vibration generation and installed on suitable anti-vibration mounts. Pipe and ductwork should incorporate anti-vibration couplings, preferably in two planes at right angles, as close to the vibration source as possible. Consideration should be given to the use of anti-vibration pipe hangers and supports.

Sequence of components

4.36 The following arrangement of plant components is typical although in many instances not all elements will be required:

- fresh air intake;
- motorised isolation damper;

- frost / fog coil;
- pre-filter;
- energy-recovery device;
- attenuator;
- fan;
- blast plate;
- attenuator;
- chiller battery;
- eliminator;
- heater battery;
- humidifier;
- final filter;
- isolation / volume control damper.

Note 2: Attenuators may be located in the intake and discharge duct if they are of a suitable type (See Paragraphs 4.159 - 4.162)

There may be instances where the above arrangement is not appropriate and the plant arrangement should be planned accordingly.

Fans

General requirements

4.37 The fan should be selected for good efficiency and minimum noise level, but the overriding factor should be the selection of a fan characteristic such that the air quantity is not greatly affected by system pressure changes due to filters becoming dirty or external wind effects.

Acceptable types

4.38 Fans can be of the axial, centrifugal, cross-flow, mixed-flow or propeller type, depending upon the requirements of the system.

4.39 Where used, centrifugal fans should preferably be of the backward-blade type. Alternatively, where noise levels are more critical and pressure requirements are lower, forward-curved blade fans are acceptable. For high-power applications, aerofoil-blade fans may be appropriate.

Selection

4.40 Generally, large ventilation systems will use centrifugal fans due to their efficiency, non-overloading characteristics, and developed pressures.

4.41 Forward curved centrifugal fans can overload if allowed to handle more air than they are designed for.

4.42 Alternatively, it may be appropriate to use mixed flow fans in high-pressure systems.

4.43 Axial flow or propeller fans are generally only used in local through-the-wall systems, or systems with very low pressure requirements.

4.44 Cross-flow fans have very low operating efficiencies, and thus their use is restricted to applications such as fan coil units.

Location and connection

4.45 Fans are normally positioned to 'blow through' the central plant so that the cooling coil and humidifier drains will be under positive pressure.

4.46 The fan performance figures given by manufacturers in their catalogue data are based on tests carried out under ideal conditions, which include long uniform ducts on the fan inlet/outlet. These standard test connections are unlikely to occur in practice, the designer should therefore ensure as far as is practical that the fan performance will not be significantly de-rated by the system. This objective can be approached by ensuring that the fan inlet flow conditions comprise uniform axial flow velocities with low levels of turbulence.

4.47 Where the outlet duct is larger than the fan discharge connections, there should be a gradual transition, with a following section of straight duct, having a length equivalent to three duct diameters.

4.48 The design of the fan intake connection must be carefully considered to avoid swirl in the airstream. When the air spins in the same direction as the impeller, the performance and power consumption of the fan are reduced. When the air spins in the opposite direction to the impeller the power consumption and noise will increase with hardly any pressure increase. Airstream swirl is usually induced by large variations across the fan intake caused by the air passing round a tight bend immediately before the intake.

4.49 Where a centrifugal fan is located with an open intake, the clear distance between the suction opening and the nearest wall should be not less than half the diameter of the inlet. If two fans with free inlets are positioned within the same chamber, their adjacent suction openings should be at least 1 diameter apart.

4.50 Airtight flexible joints should be provided at fan inlet and outlet connections. They should be equal in cross-section to the points of connection and be neither longer than 200mm nor shorter than 100mm.

4.51 For centrifugal fans, a diffuser screen / blast plate should be fitted immediately downstream of their discharge.

Supply fan drive arrangements

4.52 Where the fan drive is via a motor-driven belt and pulley, it should be external to the air stream. This arrangement has the following advantages:

- the fire risk is reduced;
- the drive is visible so it is simple to check that the belt is still there;
- particles shed from the drive belt are outside of the air stream;
- if the belt slips, the “burning rubber smell” is not transmitted down into occupied areas of the premises;
- noise generated by the motor and drive will not be transmitted along the ductwork;
- waste heat is excluded from the system;
- the drive may be through a vee or toothed belt and pulley. The latter have the advantage of eliminating belt squeal on start up and have a longer service life. They are particularly suitable where the fan drive motor is fitted with a soft start and should be located external to the air stream.

4.53 The drive train should be easily visible without the need to remove access covers. Protecting the drive train with a mesh guard is the preferred option. For weatherproof units designed to be located outside, the fan drive will be external to the duct but enclosed. It should be easily visible through a viewing port with internal illumination and access via a lockable hinged door.

4.54 For direct-coupled fan and motor units, the motor should be out of the air stream.

4.55 For induction drive ‘plug’ motor arrangements (where the motor is fitted within the fan and is integral to it) and in line axial fans with a pod motor; the fan / motor combination may be within the air stream provided the motor windings are protected from over temperature by a thermister and lockout relay.

Extract fan drive arrangements

4.56 The preferred method where the fan drive is via a motor driven belt and pulley arrangement will be to locate it external to the air stream.

4.57 The fan drive and motor may be located inside the duct within the air stream provided the motor windings are protected from over-temperature by a thermister and lockout. The drive train should be easily visible through a viewing port, have internal illumination and access via a lockable hinged door.

4.58 Where the system air is explosive, aggressive or has high moisture content, the extract fan motor must be located outside the air stream. This is generally achieved with axial fans by using a bifurcated unit.

Control

4.59 Fans in healthcare applications are normally either single or two-speed. Where there is a requirement for two-speed operation, this is generally via a local user control (for example, in a hood extract system to provide a boost facility) or via a time schedule for energy saving during unoccupied periods.

4.60 Normally only a single motor is required with a standby motor available for fitting as necessary or fitted but not belted. Twin, run and standby motors - with the standby being jockeyed around - are not required.

4.61 Where there is a specified requirement for standby fans, the system should incorporate an automatic changeover facility activated via an airflow sensor. Fault indication should be provided.

4.62 The control of fans in terms of start-up and run is increasingly being vested in computer software. Inverter-drive, variable-speed, soft-start systems are becoming a standard approach. It should be remembered that most healthcare applications require known amounts of air to be delivered while the system is in use. Constant volume systems that deliver specified air-change rates are therefore the norm. Duct- or room-pressure-controlled, variable-speed systems have a very limited application in healthcare.

4.63 It is necessary to ensure that - should the computer control system or its software develop a fault - then the fan can be switched to a direct-start, fixed-speed, manual operation. This is particularly important for critical care systems serving operating suites, high-dependency care units of any type, patient isolation facilities, laboratories and pharmaceutical production suites. Off-site software support is no substitute for the ability of on site staff to override the automatic control and keep the system operating in an emergency. Under these circumstances actions that may shorten the life of the plant are considered of secondary importance to that of preserving the health and safety of patients and staff.

Heater batteries / heater coils

General requirements

4.64 Frost batteries are installed to protect the downstream filters from low-temperature, high-humidity intake air conditions. As they handle unfiltered air they should be constructed of plain tubing without fins and be as near to the outside as possible to minimise condensation during cold weather. Access for cleaning will need to be provided to both sides of the coil.

4.65 Where steam coils are used for a frost battery, they may be constructed using spiral-finned copper tube. As they will be prone to fouling the tube layout and spacing should permit easy access for regular cleaning.

4.66 Main and branch heater-batteries should be constructed of solid-drawn copper-tube coils with copper fins, generally connected in parallel.

4.67 Where there is a wet heating system in the areas served, the main heater-battery should be sized for the ventilation requirements only, and not for the fabric loss.

4.68 Access for cleaning must be provided to both sides of all frost batteries and heater-batteries.

Acceptable types

4.69 Electric, water or steam heater-batteries may be considered. However, electric heater-batteries are expensive to operate and where there are alternatives, their use should be restricted to low-power use (for example trimming control).

4.70 Where steam-supplied heater-batteries are used, their control, venting and trapping systems should be designed so that a vacuum cannot occur within the coil. The condensate drainage arrangements should not allow pressure to build in the main resulting in a back-up of condensate in the coil.

Location

4.71 Where possible, wet-trimmer heater-batteries should be located in plant areas.

4.72 Where it is necessary to locate heater-batteries in false ceilings etc, consideration should be given to the use of electric heaters. If this is not practicable, drip-trays should be installed under both the battery and the control valve assembly to protect the ceiling. A moisture sensor and alarm should be fitted in the tray. In any event, to facilitate maintenance access, they should be located above corridors or other non-critical areas and never above patient occupied spaces.

4.73 Auxiliary fan coil units should not be installed in the ceiling above an occupied space. They should be accessible for routine maintenance and cleaning without the need to cause significant disruption to the operation of the department that they serve.

Control

4.74 LPHW frost coils should be controlled by an off-coil temperature sensor operating a motorised valve to provide a minimum plant “on temperature” of between 2°C and 5°C. The off-coil temperature of the frost coil is generally sensed by a serpentine thermostat downstream of the coil or upstream of the next plant item. This thermostat will shut the fan down if any part of the air stream is below the minimum set-point.

4.75 Steam-supplied frost coils should be fitted with an on/off control operated by a temperature sensor mounted upstream of the battery. These are normally set to open the control valve fully when the outside temperature drops to +1°C. This will ensure that there is no standing condensate in the base of the coil.

4.76 The main heater-battery should be controlled in the same manner under the dictates of either an off-coil temperature sensor, or a room temperature sensor, depending on the plant configuration and method of control. Trimmer heater-

batteries are generally controlled by one or more averaging temperature sensors within the room or rooms in the zone.

4.77 Heater-battery control valves should drive to a closed position on system shutdown or fan failure. The control system should then automatically set to provide frost protection.

Cooling coils

General requirements

4.78 Cooling coils will need to be decontaminated periodically. They must have good access both up and downstream. Hinged access doors with viewing ports and illumination inside the duct should be provided both sides of the coil.

4.79 An eliminator will be required downstream of all cooling coils. The eliminator may take the form of an extension of the coil fins or be a separate device. If a separate device it should be removable as a unit to permit cleaning of the coil face.

4.81 4.80 All cooling coils must be fitted with their own independent drainage system as specified above. A baffle or similar device must be provided in the drip tray to prevent air bypassing the coil. The tray should be large enough to capture the moisture from the eliminator, bends and headers. Where coils are greater than 1m high, intermediate drip-trays will be required.

4.82 Condensate traps manufactured from Borosilicate Glass will allow easy visual inspection and incorporate a self-cleaning smooth non-porous internal surface, complying with ISO 3585 and BS2589 Part 1.

Selection

4.83 Cooling coils supplied with chilled water are the preferred option. For small loads or where chilled water is not available, direct expansion coils may be used.

4.84 Care must be taken in selection to minimise electrolytic action resulting from condensation on the airside. Coils constructed from copper tubes with copper fins extended on the downstream side in the form of an eliminator and electro-tinned after manufacture are preferred. Aluminium fins should only be used if vinyl-coated.

4.85 All parts of the coil and its associated ductwork in contact with moisture must be manufactured from corrosion-resistant materials. Pressed steel coil headers, even if treated, have been shown to be prone to corrosion over time and should not be used. Steel mounting frames and casings present similar problems hence stainless steel is preferred.

Location

4.86 Microorganisms that multiply in moisture cannot be avoided when the coil is dehumidifying. However, locating the final filter downstream of the coils will reduce the risk of infection.

4.87 Cooling coils in AHUs should be located upstream of the final filter.

4.88 Where any cooling coil has to be located above a ceiling, drip-trays should be installed under both the coil and the control valve assembly to protect the ceiling. A moisture sensor and alarm should be fitted in the tray. To facilitate maintenance access, they should be located above corridors or other non-critical areas and never above patient occupied spaces.

Control

4.89 There are two basic methods of control for cooling coils:

- off-coil control – used in multi-zone systems or single-zone systems where close humidity control is required, to provide a constant maximum off-plant condition which satisfies the temperature and high humidity requirements of the zone with the highest load;
- sequential control – used in single-zone systems, or multi-zone systems with averaging sensors where close control is not required. A room or duct temperature sensor controls the cooling coil and heater battery in sequence to maintain constant room conditions.

4.90 The advantage of off-coil control is that accurate humidity control can be provided without relying on humidity sensors, which are prone to inaccuracy and drift. Off-coil control is however, expensive to operate in terms of energy consumption, due to the fact that there is no feedback of room loads, and thus at low loads and in systems where there are large zonal variations, significant over-cooling and reheating will occur.

4.91 On systems with two-speed operating, it is usual to isolate the cooling coil upon selection of low speed. In addition, on system shutdown, low airflow or fan failure, the cooling coil must be isolated.

Humidifiers

Design need

4.92 Humidification was originally required for some healthcare applications in order to control the risk associated with the use of flammable anaesthetic gases. The use of such gases has now ceased. Humidification is therefore no longer required unless there is a very specific application requirement.

4.93 Operating-theatre AHUs do not generally require humidifiers but provision for their retrofitting in terms of space provision and a capped drainage system should be provided.

4.94 Where humidification is required, it will be subject to the specific requirements set out below. These are intended to ensure that the unit will operate safely and not become a source of contamination.

General requirements

4.95 The most important requirement for a humidifier is to create complete mixing of the steam with the air. The manufacturers' instructions should be followed regarding minimum distances which should be allowed before bends or other components. This is particularly important with respect to a filter mounted downstream. If it becomes saturated by the humidifier, organisms can grow through the filter and be released into the duct. These may then be carried on the airstream into an occupied space.

4.96 The section of ductwork containing the humidifier may need to be periodically decontaminated. Hinged access doors with viewing ports and internal illumination should be provided. A label warning that the device emits live steam and should be isolated prior to opening should be affixed to the access door.

4.97 All parts of the humidifier and its associated ductwork in contact with moisture must be manufactured from corrosion-resistant materials. Stainless steel is preferred.

4.98 The electrodes of self-generating electrode-boiler type humidifiers should be stainless steel.

4.99 All humidifiers must be fitted with their own independent drainage systems as detailed in Paragraphs 4.20 - 4.25 or 4.72 and 4.87.

4.100 For self- and locally-generated steam humidifiers, the cleanliness of the water supply is essential for their safe operation. Provision should be made for draining down supply pipework and break tanks for periodic disinfection and cleaning during periods when they are not required in service.

4.101 The addition of treatment chemicals for continuous control of water quality for humidifier/air handling units should be avoided. Consideration could be given to installing a UV system to control microbiological growth. Given the limitations of UV systems, however, this will require filtration to high quality to ensure the effectiveness of exposure of organisms to the UV irradiation. As with all water treatment systems the unit should be of proven efficacy and incorporate UV monitors so that any loss of transmission can be detected.

Acceptable types

4.102 Only steam-injection manifold-type humidifiers are considered suitable for use in health building air-conditioning systems. Water humidifiers of any type should not be used.

4.103 Steam may be derived from the central steam supply provided that it does not contain any treatment carry-over, or generated locally either within or adjacent to the humidifier.

4.104 The introduction of steam should be by an appliance specially designed to discharge dry steam into the air-conditioning system without objectionable noise or carry-over of moisture.

4.105 During the design stage, consideration should be given to the proposed methods for the regular cleansing of the humidifier(s) and their components.

Selection

4.106 The number and length of steam-injection manifolds to be used is dependent on various factors such as duct cross-sectional area, air velocity, dry-bulb temperature and manifold design. Guidance from the manufacturer should be followed closely.

4.107 A mains steam humidifier can be noisy and will be difficult to control if it is operated at an excessive steam pressure. It should be sized for an operating pressure of approximately 1 bar. The pipework supplying it should be provided with a dirt pocket, pressure reducing valve and steam trap installed as close as practicable to the humidifier, so that the steam condition at entry is as dry as possible. A temperature switch on the condensate line (or equivalent design provision by the humidifier manufacturer) should be incorporated to prevent 'spitting' on start-up.

4.108 Most operational problems with mains steam humidifiers arise because of back-pressure in the condensate discharge line which will result in flooding into the duct. Unless the condensate from the device can be discharged and collected at atmospheric pressure, it should be discharged directly to drain.

4.109 A local steam generator, where used, must be fed with potable quality water. Additional water treatment to the standard set out above may be required. If the humidifier is unused for a period exceeding 48 hours, it must automatically drain its water content, including that contained in the supply pipework, right back to the running main and leave itself empty.

4.110 Some steam generators are of a type that requires regular cleaning and descaling. The design must allow for them to be installed such that they can be physically isolated from the air duct in order to prevent contamination of the supply by cleaning agents while this is taking place.

Location

4.111 Careful siting of the humidifier injection manifold is required to prevent the steam impinging onto the side(s) of the duct, condensing and generating excess moisture.

Control

4.112 Accurate humidity control can only be provided on single-zone systems, or multi-zone systems with zonal humidifiers. In the above systems, humidity sensors control the humidifier for low-level humidity control, and override the temperature controls to open the cooling coil valve for high-limit humidity control.

4.113 Multi-zone systems are more usually controlled by a minimum humidity sensor located in the supply duct(s) following the last heater-battery.

4.114 Overriding controls separate from the normal plant humidistat should be installed. Their purpose is to prevent excessive condensation in the conditioned space when starting up. A time delay should be incorporated into the humidifier control system such that the humidifier does not start until 30 minutes after the ventilation/plant start-up. In addition, a high-limit humidistat should be installed to limit the output of the humidifier so that the saturation in the duct does not exceed 70%. This humidistat is to control the added moisture. It is not necessary to install a de-humidifier to reduce the humidity of the incoming air if it already exceeds 70%. The humidifier control system should ensure that the humidifier is switched off when the fan is not running.

4.115 On systems with two-speed operating, it is usual to isolate the humidifier upon selection of low speed. In addition, on system shutdown, low airflow or fan failure, the humidifier should be isolated.

Filtration

General requirements

4.116 The purpose of filtration is to reduce the level of airborne contamination in an air stream. It is generally carried out in stages.

4.117 Filters must be securely housed and sealed in well-fitting frames that minimise air by pass. Air by pass significantly reduces filter efficiency, the higher the filter grade the greater the effect. Mounting frames should be designed so that the air flow pushes the filter into its housing to help minimise air bypass. Mounting frames that withdraw so that the filter can be changed without having to reach into the unit are preferred.

4.118 Neither the filter media, nor any material used in the construction of the filters, should be capable of sustaining combustion. The filter media should be such that particles of it do not detach and become carried away by the airflow.

4.119 Filters need to be readily accessible for replacement so a hinged access door should be provided. The upstream side of the filter should be visible for inspection through a viewing port with internal illumination.

4.120 All filters should be provided with a means of visually checking the differential pressure across them. Direct-reading dial-type gauges marked with clean and dirty sectors are preferred.

4.121 A complete spare set of filters must be provided at handover.

Definition of filter terms

4.122 Particulate air filters are divided into four categories:

- general ventilation filters grades G1 to G4;

- fine filters grades F5 to F9;
- high efficiency particulate filters (HEPA) graded H10 to H14;
- ultra-low particulate air filters (ULPA) graded U15 to U17.

4.123 General filters are graded in terms of their 'Synthetic dust weight 'Arrestance'. This represents the percentage of a test dust captured by a filter. 'Arrestance' provides a good indication of a filter's ability to remove the larger, heavier particles found in outdoor air. These are of a size to block finned batteries and large enough to settle out in the air distribution system.

BS EN 779 grade (Eurovent grade)	% Arrestance	Notes and typical healthcare application
G1 - (EU1)	< 65	Metal mesh grease filter
G2 - (EU2)	65 to < 80	Coarse primary filter
G3 - (EU3)	80 to < 90	Primary air intake; return air; energy recovery device protection
G4 - (EU4)	> 90	General purpose tempered air supply

Table 4: General Filters

4.124 Fine filters are graded in terms of their 'Atmospheric dust spot Efficiency'. This is a measure of the filter's ability to remove the very fine staining particles found in outdoor air. It will indicate how 'visibly' clean a filter will keep a ventilated space. The staining particles are approximately the same size as most common bacteria so it is also a rough measure of the filter's ability to remove microorganisms.

BS EN 779 grade (Eurovent grade)	% Efficiency	Notes and typical healthcare applications
F5 - (EU5)	40 to 60	General purpose panel / bag filter
F6 - (EU6)	60 to < 80	Basic grade bag filter
F7 - (EU7)	80 to < 90	Medium grade bag or pleated paper Conventional operating theatre supply air
F8 - (EU8)	90 to < 95	High grade bag or pleated paper
F9 - (EU9)	> 95	Basic HEPA filter – Level 8 clean rooms

Table 5: Fine Filters

4.125 High efficiency filters (HEPA and ULPA) are graded in terms of their ability to capture their 'Most Penetrating Particle Size' (MPPS). High-efficiency filters self-select the particle that they are least able to trap, hence the MPPS. They are then tested against that size of particle. These filters are designed to provide very high-efficiency filtration of particles in the sub-micron size range.

BS EN 1822 grade (Eurovent grade)	% Efficiency @ MPPS	Notes and typical healthcare application
H10 - (EU10)	85	Ultra-clean theatre terminal
H11 - (EU11)	95	
H12 - (EU12)	99.5	
H13 - (EU13)	99.95	
H14 - (EU14)	99.995	Pharmacy aseptic suite Category 3 room extract
U15 – U17	-	Not generally used in healthcare

Table 6: High Efficiency (HEPA) Particulate Filters

Selection primary filters

4.126 All filters should be of the dry type. Panel filters are cheap and disposable with relatively low dust-holding capacity. They are generally used as pre-filters to eliminate large particles that would otherwise clog or cause damage to the fan and finned heating and cooling batteries. Stainless steel frames that hold disposable pre-cut filter pads are preferred.

4.127 General ventilation supply plant should incorporate primary air filters of grade G3, sized for a maximum face velocity of 2.0 m/s. Additional coarse pre-filters may be justified where the intake air is exceptionally polluted. They are sometimes fitted as a temporary measure when building work is being carried out in the vicinity of the air intake.

Secondary filters

4.128 Where a higher standard of filtration is required, secondary bag or pleated paper panel filters would be used. Rigid frame filters incorporating pleated paper elements are preferred over bag filters for critical care applications such as operating theatres.

4.129 In urban or other areas of high atmospheric pollution, a higher standard of filtration may be justified to reduce the level of staining to internal finishes.

Extract air filters

4.130 Extract filtration will generally only be required where heat-recovery devices are installed. There are a very limited number of specialised applications (microbiological safety cabinets and similar LEV systems) where contaminated air is required to be filtered prior to discharge to atmosphere. If it is safe for staff to work in a room without wearing respiratory protective equipment, it is safe to discharge the room air to atmosphere without filtration.

Return-air filters

4.131 They are used to reduce the load on HEPA filters in recirculating applications such as Ultra Clean operating suite ventilation canopies and pharmacy aseptic suites.

High-efficiency filters – HEPA and ULPA

4.132 HEPA filters are expensive so their use should be kept to a minimum. Applications requiring HEPA filters include the air supply to aseptic suites in manufacturing pharmacies, the discharges from microbiological safety cabinets and isolation facilities.

4.133 If used, HEPA filters should be of the replaceable panel type with leak-proof seals. They should be installed in a manner that permits on-site validation of the filter and its housing. This may involve the release of a Dispersed Oil Particle (DOP) challenge smoke through an injection point upstream of the filter and a measurement of the DOP penetration across the downstream face. Alternatively a particle-counting method may be used.

4.134 HEPA filters are sometimes fitted in extract systems to capture hazardous substances or organisms. Design provision must be made for the subsequent safe handling of contaminated filters by maintenance staff. This may be achieved by:

- sealing the hazardous substance into the filter before it is removed;
- providing a system to fumigate the filter to kill any organisms;
- housing it in a ”safe change” unit that permits the filter to be ejected into a bag and sealed without staff having to come into direct contact with it.

4.135 In view of the costs and problems associated with placing HEPA filters in extracts, it is recommended that a full risk assessment be carried out at the design stage. This should include defining the true need for HEPA filters in an extract; validation of its performance at installation; the method of safely changing a contaminated filter; and its subsequent disposal.

4.136 ULPA filters are very expensive and are designed to remove particles below a size that are either surgically or aerobiologically significant. There would have to be exceptional circumstances in order to justify their use in healthcare ventilation systems.

Activated carbon filters

4.137 Activated carbon filters are able to remove gases and vapours from an air stream and are graded according to the range of substances they can remove. They are not normally fitted in air-conditioning supply systems.

4.138 They are occasionally fitted retrospectively because the main air intake has been poorly sited and is drawing in traffic fumes. Where used they must be protected by a particulate air filter.

4.139 Activated carbon filters are more commonly used in specialised fume extraction systems when the location of the discharge means that dilution cannot be relied upon to disperse noxious fumes.

Location

4.140 The primary filter should be positioned on the inlet side of the supply fan, downstream of the frost coil. The secondary filter, when fitted, should be on the positive-pressure side of the fan. This will prevent air being drawn into the system after the filter and capture any particles shed by items of equipment within the AHU.

4.141 The filter installation must be arranged to provide easy access to filter media for cleaning, removal or replacement, with side or front withdrawal as required.

Control

4.142 Differential-pressure transducers should be provided to monitor and alarm remotely on excessive filter pressure drop. In critical areas dirty-filter indication lights should be provided at the point-of-use.

Energy-recovery

General requirements

4.143 Energy recovery will normally be fitted to all healthcare ventilation systems. It may be omitted only where it would clearly be uneconomic. Where the economic case is marginal, space should be allowed for the retrofitting of an energy recovery system.

4.144 For systems in healthcare premises, a plate heat exchanger or 'run-around coil' system is suitable. Thermal wheels may be used providing they are fitted with a purge sector. The small amounts of air leakage across those devices are not considered significant. Other systems such as heat pumps or heat pipes are also suitable. Selection should be based on relative locations of the supply and extract units, ease of maintenance and practicality. Cleaning access will be required to both sides of any energy-recovery device.

4.145 The following are the minimum energy transfer efficiencies required for devices handling equal air volumes:

- run-around coil – 45%;
- plate heat exchanger – 50%;
- thermal wheel – 65%;
- any other energy-recovery device – 50%.

4.146 If a plate heat exchanger is chosen, the plates should be constructed of metal. Plastic should not be used for internal bypass dampers and drive gears.

4.147 Whichever energy-recovery device is chosen the extract side will need to be protected by a G3 filter and provided with a drainage system as described in Paragraphs 4.20 - 4.25, to remove condensate.

Location

4.148 Energy-recovery devices should be located downstream of the frost battery and pre-filter, prior to the cooling coil or main heater battery on the supply side.

Control

4.149 It is essential to consider the control of both the energy recovery device and the frost battery when assessing the economics of recovery, as all energy provided by the frost battery will directly reduce the heat exchange of the recovery device. To this end, the off-coil setting of the frost coil should be the minimum possible to protect the primary filter (for example +2°C).

4.150 The energy-recovery device should be controlled in sequence with the main heater battery, and should incorporate a control to prevent the transfer of unwanted heat when the air-on condition rises above the required plant set point.

4.151 In instances where the plant is cooling the air, it may be possible to remove heat from the supply air at high ambient conditions, under the dictates of enthalpy sensors in the intake and extract ducts.

Attenuation

General requirements

4.152 Noise will be generated in an air distribution system by the fan, plant items and airflow. The ductwork is a very effective transmitter of this noise hence there is generally a need to limit the noise transmission to meet the requirements of the building. This normally involves the provision of sound attenuation treatment as part of the overall ductwork system design.

4.153 A thorough assessment of the design should be made to assess the noise impact. This should take into account the following primary factors:

- fan- and plant-noise generation;
- air-flow generated noise in ductwork fittings and dampers;
- noise generated at grilles, diffusers and other terminals;
- noise break-in and break-out of ductwork;
- cross-talk and similar interference;
- the noise limitations for the building and surrounding areas;
- external noise generation.

4.154 A method of assessment of these factors and the sound attenuation requirements of ductwork systems is given in CIBSE Guide B.

4.155 The fan is usually the main source of system noise. The sound power that it generates varies as the square of the fan pressure, and thus to limit the fan noise level the system resistance should be kept as low as economically

possible. As a general rule the selected fan should operate close to its point of maximum efficiency to minimise its noise generation. Where there is disturbance to the airflow at the fan inlet, the manufacturer's stated fan noise levels should be increased by up to 5 dB(A). More precise guidance on this aspect may be available from the manufacturers.

4.156 Fans radiate noise through both the inlet and outlet connections and it may be necessary to provide attenuation to limit the noise from both of these connections. It is always preferable and more economic to control noise and vibration at source, or as close to source as possible. It should be noted that attenuators offer a resistance to airflow. The resistance must be included in the fan and ductwork calculations.

4.157 Provided care is taken in the design and construction of low-pressure systems to avoid significant noise generation in the ductwork, attenuation should only be needed to absorb fan noise.

4.158 Noise breakout from all equipment housed in the plantroom must be taken into consideration if control is to be satisfactory. Any ductwork within the plantroom after the silencer should be acoustically insulated to prevent noise break-in or the silencer relocated at the point of entry or exit of ductwork to and from the plant room.

4.159 There is no complete means of control over external noise generation from such as road traffic, aircraft, factory and community noise. Consideration must be given to this at the design and planning stage.

Acceptable types and location

4.160 The noise levels produced by ventilation and other plant should be reduced by either lining the inside of the duct with sound-absorbing material or fitting bespoke attenuator units.

4.161 In supply systems, sound-absorbing material should not be applied to the inside surface of a duct system downstream of the final filter, owing to the risk of mechanical damage and the subsequent dispersal of the media into the ventilation system.

4.162 In supply and extract systems, sound-absorbing material must not be applied to the inside of a duct within 1 metre of a fire damper. The material should be non-particle-shedding and fire-resistant (further guidance can be found in SHTM Firecode suite of documents). Where sound-absorbing material is applied in a section of duct that will be routinely exposed during maintenance activities it should be protected from mechanical damage.

4.163 Bespoke attenuator units with a sound-absorbing infill suitable for the quality of air being handled and protected by a perforated sheet metal casing are the preferred option for critical systems. Absorption of moisture, dirt and corrosive substances into the 'in-fill' and the release of fibrous particles into the airstream should be prevented by the use of a membrane. The membrane material should have a declared service life of at least 25 years. If these conditions can be met then the attenuator may be located in the supply ductwork downstream

of the final filter. When so located, cleaning access should be provided at both ends of the attenuator unit.

5. Air distribution system

Air distribution arrangements

Ductwork distribution systems

5.1 Ductwork systems for ventilating and air-conditioning applications are referred to by their velocity or pressure category, that is, as low, medium or high velocity (or pressure) systems. Heating & Ventilating Contractors Association (HVCA) limits are up to 10 m/s or 1,000 Pa; 20 m/s or 1,750 Pa: and 40 m/s or 3,250 Pa in the case of conventional low, medium and high pressure systems respectively. High-pressure systems are disappearing because of the constraints of the Building Regulations but existing systems may sometimes need to be altered or extended.

5.2 For normal applications in healthcare buildings, low velocity systems are recommended. The use of higher velocities than those recommended is not likely to be economical. Future trends are likely to be towards even lower optimum duct velocities; however, velocities below 2 m/s are unlikely to be justified.

5.3 The site will often dictate the main routing of ductwork systems, but in general, the design should seek to make the layout as symmetrical as possible; that is, the pressure loss in each branch should be as nearly equal as possible. This will aid regulation and may reduce the number and variety of duct fittings that are needed.

5.4 Main distribution ductwork should not be routed above sleeping areas. Where there is no alternative route, additional acoustic insulation will be required.

5.5 Where auxiliary cooling units, fans, filters or trimming devices are installed in the distribution system, they must be independently supported and fitted with a suitable drainage system where appropriate. If they are a source of vibration they should be linked to the distribution ductwork via flexible connections.

5.6 The fan of a Local Exhaust Ventilation (LEV) system provided under the COSHH Regulations should be located outside of the building so that all of the ductwork within the building is under negative pressure. Where the fan has to be within the building it should be located as close as practicable to the outside with an absolute minimum run of discharge ductwork within the building. The discharge ductwork within the building will be under positive pressure so it must not be penetrated by test holes or inspection hatches.

Ductwork materials and construction

5.7 The choice of duct material should take account of the nature of the air or gas being conveyed and the environment in which the duct will be placed.

5.8 Galvanised-sheet-steel is generally suitable and most economical for normal ventilating and air-conditioning applications. Its inherent mechanical strength

renders it resistant to casual damage both during the construction phase and throughout its service life when mechanical and electrical services around it are altered. It also readily withstands the impacts sustained when rotary equipment is used to for internal cleaning.

5.9 In instances where moisture levels and/or corrosive elements in the air being conveyed are very high, aluminium, stainless steel, PVC or GRP (glass-reinforced plastic) ducts should be used. Stainless or black steel are the only suitable materials for high-temperature ductwork.

5.10 In inherently wet areas, such as the base of fresh air inlet ducts and some extract systems, the ductwork may require draining to prevent a build-up of standing water. The layout of the drains should be as specified in Paragraphs 4.20 - 4.25.

5.11 Where builderwork plenum chambers or ducts are used, these may be constructed of various materials. However all such ducts must be rendered and sealed to prevent dust shedding. A greater allowance may need to be made for leakage.

5.12 Galvanised, black and stainless steel ductwork should be manufactured and installed to the current HVCA specification for sheet metal ductwork DW144, but excluding the use of bolt-through supports.

5.13 GRP and PVC ductwork should be manufactured and installed to the current HVCA specification for plastic ductwork DW154.

5.14 Where phenolic-board ductwork is considered, care should be taken to ensure that it is fabricated to a quality standard and installed strictly in accordance with the manufacturers' instructions. Its pressure rating and degree of support should be suitable for the application and ducts should be fitted with mechanical protection where required. Designers should be fully conversant with installation techniques and Installers should be experienced having received training in the techniques required and certified to this effect by the manufacturers. Due consideration should be given to the impact on ductwork pressures created by the closing of dampers. Phenolic-board ducting should not be installed in plant rooms or any other areas where it could be vulnerable to impact damage. Internal cleaning using mechanical (rotary) means is also liable to cause damage to the integrity of surfaces.

5.15 Flexible ductwork is unsuitable for air distribution in healthcare applications. It should only be used to make the final connection to a terminal (See Paragraphs 5.54 and 5.55).

5.16 The inside of the ductwork should be free from structural projections and as smooth as possible. Flanged, gasketed joints are preferred.

Fire aspects, damper types and locations

5.17 It is essential that all relevant fire aspects of ducting systems are agreed with the fire officer before the design is finalised.

5.18 Ductwork must be fire-stopped where it penetrates fire compartment walls, floors and enclosures, cavity barriers and sub-compartment walls or enclosures, and provided with weatherproof collars where roofs or external walls are penetrated.

5.19 Fire/smoke dampers shall be provided at the locations required by SHTM Firecode. The fire-damper mounting frame must be securely attached to the building fabric. Where a fire-damper is not mounted directly in a fire compartment wall, it must be correctly supported and the ductwork between it and the firewall must posses the same fire rating as the firewall that it penetrates. The fire-rated portion of ductwork must not be penetrated by test holes or inspection hatches. All fire/smoke dampers shall be capable of remote re-setting via the Building and Energy Management System (BEMS) or equivalent, after periodic testing procedures.

5.20 An access hatch shall be provided adjacent to each fire damper so that its correct operation can be directly observed.

5.21 Smoke-diverting dampers must be provided on recirculation air systems to divert automatically any smoke-contaminated return air to the outside of the building in the event of a fire; and arranged so that the normally open smoke-diverting damper on the return-air branch to the input unit closes and all the return air is exhausted through the extract fan. Guidance is available in SHTM 81 and BS5588: Part 9.

Duct sections

5.22 Ducting is generally available in rectangular, circular and flat oval sections, although other sections may be made for special situations.

5.23 Rectangular ducting is most common on low-pressure systems, for the following reasons:

- it can readily be adapted to fit into the space available;
- fittings are cheaper than those for circular or flat oval ductwork;
- it can readily be joined to such component items as heating and cooling coils, and filters.

5.24 When sizing ductwork, the designer should take into account:

- both installation and operating costs;
- space limitations imposed by the structure and other services;
- operating noise levels;
- requirements of regulation at the commissioning stage.

5.25 For overall economy and performance, the aspect ratio should be close to 1:1, since high aspect ratios increase the pressure loss, heat gains or losses and overall cost (for example, changing the aspect ratio from 1:1 to 1:4 can typically

increase the installed cost of the ductwork by 40% and add 25% to the heat gains or losses).

5.26 Rectangular ducting should not be the first choice for high pressure systems, and should be avoided in systems operating at high negative pressures, because the strengthening of the flat sides and the sealing requirements necessary to make rectangular ducts suitable for these high pressures are costly.

5.27 Circular ducting is preferable for high-pressure systems, and for systems operating at high negative pressures. In the case of the latter, additional stiffening rings may be necessary. Machine-formed spirally-wound ducting and a standard range of pressed and fabricated fittings can sometimes make circular ducting more economical, particularly in low pressure systems having a relatively low proportion of fittings.

5.28 Flat oval ducting provides an alternative to circular ducting, principally where there is a limitation on one of the dimensions in the space available for the duct run.

5.29 Other sections may be used, such as triangular sections to pass through roof trusses. Such sections present difficulties in the provision of fittings, and connections to standard plant items, and are likely to be more expensive than traditional sections.

Standard ductwork fittings

5.30 All fittings should conform to current HVCA specification DW144. Wherever possible, long radius bends, large radius main branches, not more than 45° angle sub-branches and long-taper transformations should be used.

5.31 Fittings should be arranged with vanes in sub-branches connected directly to grilles and diffusers, and turning vanes in square bends (when used). When vanes are used, additional cleaning access will be required.

5.32 The number of duct fittings should be kept to a minimum and there should be a conscious attempt to achieve some standardisation of types and sizes. Increasing the number and variety of fittings in a system can markedly raise its overall cost.

5.33 Bad design in relation to air flow can lead to vibration of flat duct surfaces, increases duct-generated noise and pressure loss, unpredictable behaviour in branch fittings and terminals, and adverse effects on the performance of installed plant items (such as trimmer batteries).

Branches

5.34 There are many designs of branches and junctions in use. The important features are that the flow should be divided (or combined) with the minimum interference and disturbance. Changes in duct sizes should not be made at the branch but a short distance downstream (or upstream). A good dividing branch

design cannot be effective if the flow entering the branch is not uniform across the section.

Changes of section

5.35 The expansion of a duct section should be formed with sides having a total included angle of no more than 30°, and preferably less than 20°. If the angle of expansion is greater, the flow is not likely to remain attached to the walls of the duct and large eddies will be formed with flow reversal at the walls. This leads not only to a high-pressure loss, but also to non-uniform velocity pattern at the outlet. Where there is insufficient space for a gentle expansion and a greater angle is necessary, internal splitters should be used.

5.36 A contraction in a duct section is less critical, but the total included angle of the taper should not exceed 40° (or 20° where the contraction is made on one side of the duct only)

5.37 The most economical way to change the section of a rectangular duct is to restrict the change of duct size to one side only. If the calculated reduction or increase to the side dimension is 50mm or less, it is usually not economical to change the size at the position. The minimum size of a rectangular duct should usually be 150mm x 100mm.

Other fittings

5.38 As a general rule, fittings should avoid abrupt changes in direction and also sharp edges that cause the flow to separate and form eddies, thus limiting pressure loss and causing noise generation. If the fitting leads to the flow preferentially attaching to one side of the outlet, then a significant length of straight downstream duct is necessary before the next branch or fitting; this length should be greater than five equivalent diameters.

Thermal insulation

5.39 Thermal insulation is applied to ductwork to reduce heat exchange, and to prevent condensation.

5.40 In a duct system, the air temperature changes can be significant, especially when passing through untreated space, and these have the effect of reducing the heating or cooling capacity of the air and of increasing the energy input to the system. The heat transmission to and from the surrounding space can be reduced by effective insulation of the ducts. Extract ductwork conveying air from which heat recovery will be derived should be thermally insulated to the same standard as with associated supply ventilation ductwork.

5.41 Condensation can arise in ductwork systems conveying cooled air and, apart from creating conditions conducive to corrosion of ductwork, condensation affects the heat and vapour-resisting properties of insulating materials themselves which may induce further condensation.

5.42 In normal circumstances, the insulation thickness for heat resistance is sufficient to prevent surface condensation, but in extreme conditions the

insulation thickness for vapour resistance may be greater than that for heat resistance. When cold ducts pass through areas of high dew-point, carefully selected vapour barriers should be applied externally to the insulation.

Noise generation within the ductwork

5.43 Noise is generated in ductwork at sharp edges, by tie rods, damper blades, duct obstructions and sharp bends etc. This air-flow-generated noise becomes an important factor if it is about the same or greater level than the upstream noise level. (Air-flow-generated noise is often referred to as “regenerated noise”).

5.44 The noise level generated by airflow in ductwork is very sensitive to the velocity. The sound power of this noise is approximately proportional to the sixth power of the velocity; that is, a doubling of the duct velocity will increase the sound power by a factor of 64. The duct velocities should therefore be kept as low as possible. In general, duct fittings that have lower pressure loss factors in similar flow conditions will generate less noise.

5.45 Ductwork serving quiet areas should not be routed through noisy areas where noise break-in can occur and increase the noise level in the ductwork.

5.46 Grille, register and louvre noise should be kept to the minimum by selecting types having low noise-producing characteristics, without high tonal noise, and should be fitted with acoustically treated external inlet and outlet louvres.

5.47 Cross-talk attenuators may be necessary where noise intrusion between adjacent spaces can arise and where individual room confidentiality is required. They will normally be of the ‘through-the-ceiling, ‘up-and-over’ type and may include a fire damper if required.

Volume control damper locations

5.48 Manually operated balancing dampers are needed generally:

- in the main duct downstream of the fan;
- in branches of zone ducts;
- in sub-branch ducts serving four or more terminals;
- at terminals not covered by the previous item.

5.49 Dampers integral with terminals should only be used for final trimming of air volumes, otherwise noise and air distribution problems may ensue.

5.50 Dampers in rectangular ducts should be single-bladed when the longer side is up to 450mm but be of the opposed-blade multi-leaf type above this size. In circular ducts, iris-type dampers are recommended. Dampers must be accessible, incorporate a position indicator and means of locking in the commissioned position. Dampers should be located as far away as possible from adjacent branches or plant items.

Cleaning and access door locations

5.51 Cleaning and access doors are required to facilitate access to plant items and ductwork components for inspection, maintenance, cleaning and replacement, and must be of sufficient size to permit safe access for the required functions. Consideration should also be given to the number of doors to be provided. Older installations may be deficient in the provision of access doors and consideration will be necessary to have these incorporated in the course of any refurbishment in the accommodation served.

5.52 Recommended locations for access doors are given in the current HVCA specification DW144 and are generally provided to give access to:

- every regulating damper;
- every fire and motorised damper;
- filter (to facilitate filter withdrawal);
- both sides of cooling/heating coils;
- humidifiers;
- fans; and
- motors and impellers.

5.53 Care should be taken when siting access doors to ensure that no other services to be installed will prevent reasonable access.

Flexible ducting

5.54 Flexible ductwork may be used for final connections to grilles and diffusers provided it is constructed to meet the fire precautions recommended in BS8313. It must not pass through fire compartment walls, floors or enclosures of sub-compartment walls or enclosures, or through cavity barriers.

5.55 Flexible ducting will cause a significant frictional loss and may be difficult to clean and should never be used in lieu of a bend. Where installed it should take the most direct route and be as short as possible, never exceeding 1 metre in length.

Diffuser and grille selection and sizing

5.56 The effectiveness of all ventilation and air-conditioning systems depends on the methods by which air is introduced to, and vitiated air is removed from, the space. The usual results of poor air-terminal selection and/or positioning are: draughts, stagnation, poor air quality, large temperature gradients and excessive noise.

5.57 Air can be supplied to a space in a number of ways, although any device can be broadly placed into one of two categories: that producing a diffused supply, or that producing a perpendicular jet. Diffusers may be radial or linear, and normally utilise the Coanda effect (that is, adhesion of the air stream to an adjacent surface), to reduce the risk of excessive room-air movement. A

perpendicular jet is formed by discharging air through grilles, louvres or nozzles, which are generally adjustable.

5.58 Air-flow patterns produced by both types of terminal are dependent to a large extent on the presence of the Coanda effect.

5.59 Supply air terminals can be incorporated into any room surface, for example, floors, walls (high or low level), desktop etc.

5.60 As they operate on the jet principle, the use of sidewall and linear grilles is restricted to areas where air change rates are low, that is, less than 10 per hour. Perforated rectangular diffusers can provide acceptable conditions within the occupied zone at up to 15 air changes per hour. In areas where a higher air change rate is required, square or circular ceiling mounted diffusers should be used.

5.61 The performance of supply air terminal devices is provided, based on three criteria: throw, spread and drop.

- **throw** is defined as perpendicular or parallel distance from the terminal to the point at which the air velocity is 0.5 m/s isovel;
- **spread** is defined as the width of the 0.5 m/s isovel; and
- **drop** is defined as the vertical distance from the centre line of the terminal to the bottom edge of the 0.25 m/s isovel.

5.62 It is necessary to consider each of these parameters in both summer and winter conditions to ensure satisfactory operation of the air-terminal device, as warm jets behave very differently from cold jets.

5.63 A warm jet tends to rise until it attaches itself to a horizontal surface, while a cold jet falls. Care must be taken to ensure that this does not lead to unacceptable temperature gradients in winter or excessive air velocities in the occupied zone in summer.

5.64 In order to ensure satisfactory air movement within a space, it is necessary to consider interaction between air movement from adjacent terminals, and ceiling mounted fixtures (light fittings etc), as well as interaction between air movement and room surfaces.

5.65 If the supply and extract terminals are too close, short-circuiting may occur, while if they are too far apart, stagnant zones may be formed. Where two opposing air streams meet, the individual velocities must not be greater than 0.25 m/s.

5.66 Supply and extract grilles and diffusers should be fitted with opposed-blade dampers for fine balancing purposes.

5.67 Further guidance on the selection of grilles and diffusers is given in the CIBSE Guide B.

5.68 In operating theatres, the supply terminals must be able to produce a down-flow movement of air in the operating zone 1 metre above floor level. Ceiling mounted diffusers with fixed directional vanes that provide a downward turbulent airflow are the preferred option. Plenum boxes fitted with perforated screens to produce a parallel downward flow are also acceptable. Nozzles or jets of any type are not acceptable. Sidewall-mounted linear diffusers that utilise the Coanda effect to send air across the ceiling and 'drop' it into the operating zone are also not suitable. However linear ceiling mounted diffusers that provide a direct downward airflow around the operating zone may be used.

Transfer grille - size and location

5.69 Air-transfer grilles in walls, partitions or doors form an integral part of the building's air distribution system. Modern doorsets have very low leakage rates so cannot be relied upon to permit even quite small airflows. Failure to make adequate provision for air to move from room to room will result in excessive pressure differentials and 'door whistle'.

5.70 Transfer grilles are required in locations where there is a significant imbalance between the supply and extract rates in a room. They will relieve any pressure differentials that may affect the operation of the spaces and/or the ventilation system and permit airflow in a known direction. However, transfer grilles are vulnerable to damage and, in many instances, as long as the equivalent free area is provided, they can be substituted with undercut door.

5.71 Care needs to be taken to ensure that the positioning of transfer grilles does not interfere with the fire or smoke integrity of the building. In general, the air-transfer grilles should not be installed within fire-resisting boundaries, although if this is unavoidable, they should be fitted with fire- or smoke-dampers.

5.72 Where installed, transfer grilles should be of the non-vision type, sized for a maximum face velocity of 1.5 m/s.

5.73 In photographic dark rooms, lightproof transfer grilles will be required.

5.74 Cross-talk attenuators may be necessary where noise intrusion between adjacent spaces can arise and where individual room confidentiality is required. (See also Paragraphs 5.43 - 5.47).

Pressure stabilisers - size and location

5.75 Pressure stabilisers are required in lieu of air-transfer grilles in areas where it is necessary to maintain pressure differentials between adjacent rooms to prevent reversal of airflows for example, in operating suites, isolation facilities and clean rooms. (See also Paragraphs 7.24 - 7.28).

5.76 Fire precautions for pressure stabilisers are the same as for transfer grilles. For sizing criteria, refer to Paragraph 7.23

5.77 Pressure stabilisers should be of the balanced-blade type, with the facility to make fine adjustment of the pressure setting. They should be silent in

operation and give a seal as tight as practicable when closed. The materials of construction and method of assembly should allow for cleaning and disinfection.

5.78 Pressure stabilisers should be installed in a visible location so that their operation can be readily observed.

5.79 Cross-talk attenuators may be necessary where noise intrusion between adjacent spaces can arise and where confidentiality is required. In these cases, the pressure stabiliser and cross-talk attenuator should be mounted in a short length of ductwork within the ceiling void.

5.80 Pressure stabilisers may need to be fitted with a stand-off baffle on their discharge side to prevent a sight line in situations where a laser will be used. Baffles may also be required to preserve privacy or prevent discharge air causing draughts or disturbing the air distribution pattern in the adjoining room. They are also useful in low-level locations to prevent the airflow path being obstructed by portable equipment.

6. Automatic controls

6.1 Various options for control of single and multi-zone air-conditioning systems are given in CIBSE Guide B.

General requirements

6.2 The basic requirements for an automatic control system are as follows:

- facilities to start, set-back and stop the plant;
- facilities to control the volumetric air-flow;
- facilities to control the system or room pressure;
- temperature control and indication;
- humidity control and indication;
- devices to monitor and indicate the plant's operating state;
- alarms to indicate plant failure, low air-flow, and filter state.

The control functions actually provided will depend on the purpose of the ventilation system.

6.3 There will also be a need to determine the control strategy in the event of a fire either within the zone being served or within an adjoining zone.

6.4 The designer should consider whether it is necessary for the supply and extract fans to be interlocked, either so that the supply fan will not operate unless air-flow is established within the extract system, or vice-versa depending on the required pressures within the rooms being served.

6.5 The sequence switching of units in order to prevent transient reverse airflows will be particularly important in laboratory and pharmacy areas that also contain fume cupboards, safety cabinets and other LEV systems.

6.6 Alarms should be provided to show 'filter fault' and 'low air-flow'. The "filter fault" alarm should be initiated by a predetermined increase of pressure differentials across the filter. The 'low air-flow' alarm should be initiated when the supply air quantity falls to 80% of the design value.

Objectives of control system

6.7 The primary objective of ventilation plant control system is to maintain the space served within the required environmental control limits, at the appropriate times, regardless of external conditions or internal loads and with the minimum energy consumption.

6.8 Often, it is not possible to predict accurately building load variation at the design stage, and thus optimum set points cannot be assessed. Information provided by monitoring the operation of the plant via a Building and Energy Management

System (BEMS) will enable optimum set points to be established and energy consumption reduced. Control of most systems will be via a BEMS. This will enable the operating conditions and control tolerances to be set and monitored. The BEMS may also be set to log the actual energy consumed by the system together with that recovered by the energy-recovery device. This will provide a useful check on overall operating efficiency and provide evidence that energy targets are being achieved.

6.9 BEMS incorporating self-adaptive control algorithms that automatically adjust the set-point to the suit the usage and load are preferred. The provision of movement sensors within the controlled space in order to determine the actual occupancy will facilitate this process.

6.10 The failure of specialised ventilation systems can have grave consequences for the delivery of healthcare. Control systems should therefore be simple, robust and reliable.

6.11 Computer-software-driven control systems are becoming the norm in building services. However, it should be remembered that healthcare ventilation systems need to be available to operate outside of normal working periods when software support is not available. Should the software fail, it will be left to site staff, who may have little knowledge of the control algorithms to restart the ventilation system. It is therefore essential to ensure that a simple means of re-starting critical systems in the event of a software failure is provided (see also Paragraphs 4.62 - 4.63)

Location of controls

6.12 Whether within the plant, duct or room, sensors should be located to provide accurate measurement of the condition of the air being monitored.

6.13 Sensors and control items such as control valves should be located close to the element being sensed or plant item being controlled, in order to minimise time lags within the system which may create over-shoot of conditions beyond the design envelope and result in additional energy consumption.

6.14 There are practical advantages in locating all control valves for an air-handling unit in a bank (at a convenient height) at one end of the unit. (This will not normally result in an undue additional control lag.)

6.15 Some applications require intermittent mechanical ventilation, frequently at a high air-change rate, (for example, in bathrooms and treatment rooms.) Local controls to facilitate this mode of operation should be placed in a prominent position to encourage economical use.

6.16 Local controls that enable the user to select more than one mode of operation should be clearly labelled to identify the particular mode selected. Where the system allows different room pressures to be selected then a direct-reading pressure gauge should be fitted within the eye line of the users to provide an independent confirmation of the resultant mode of operation. A clear

description of the selectable modes of operation should be mounted adjacent to the control switch.

Fire aspects

6.17 A fire control panel should be mounted at the entrance of the area that the ventilation serves. The panel should have restricted access for the fire officer and include independent on/off controls and indication of the supply and extract systems.

6.18 In certain critical care departments it is preferable to maintain the supply ventilation in case of a fire within the area. For example, in an operating department, while undergoing surgery, the patient cannot always be easily moved without significant risk. In the event of a fire in a staff or support area of the department, or adjoining zone, the continued supply of air to a theatre will maintain it at a positive pressure and protect the patient and staff from the effects of smoke. This will allow time for the patient to be stabilised so that he/she can be safely evacuated if necessary. A similar situation occurs for patients in ITU and other critical care units. In all of these cases the ventilation to the critical area should continue to operate unless the AHU starts to draw in smoke. For these departments, a notice should be affixed to the fire control panel drawing attention for the need to liaise with departmental staff before switching off fan units.

6.19 All supply AHUs should have a smoke sensor mounted in the main supply duct immediately downstream of the AHU. In the event of a fire in the AHU or smoke being drawn into the system from an outside source, it should cause the supply air fire damper to close and shut down the AHU.

Time switching

6.20 Facilities to start, set-back and stop the plant should be provided in the plantroom. Remote start and set-back control and indication, if required, should be provided at a manned staff location, for example, at the reception or staff base or, in theatres, within the Surgeon's Panel.

6.21 Many ventilation systems may be completely shut down when the area served is not in active use. Alternatively, where there is a need to maintain a background condition, the ventilation output can be reduced by "setting back" the system. This will significantly reduce energy consumption and extend the life of filters and other system components.

Start-up control

6.22 The plant's start control should contain a control logic that will start the plant in the sequence set out in the following algorithms, Figures 2 - 5

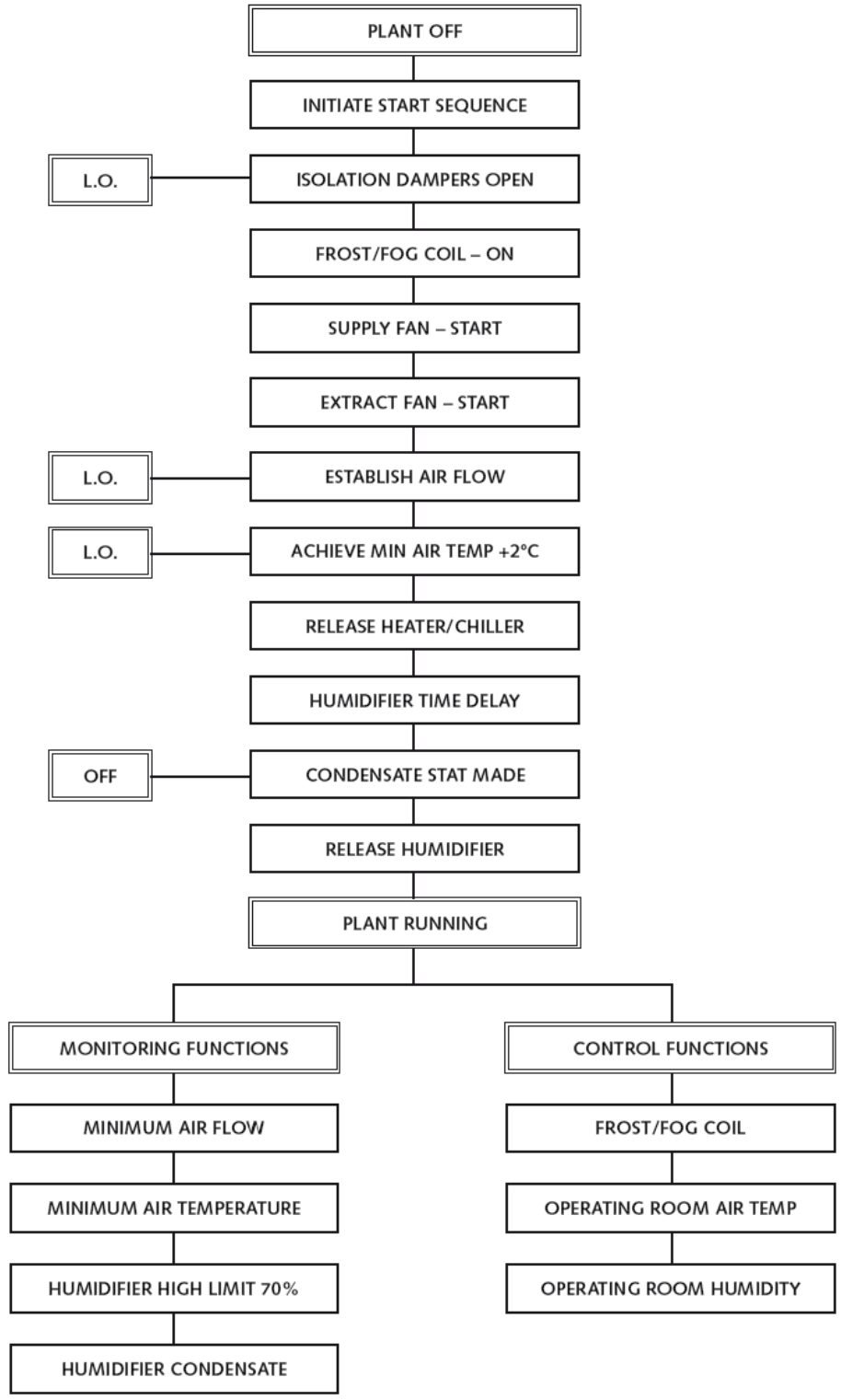


Figure 2: Typical plant control algorithm – normal start-up sequence

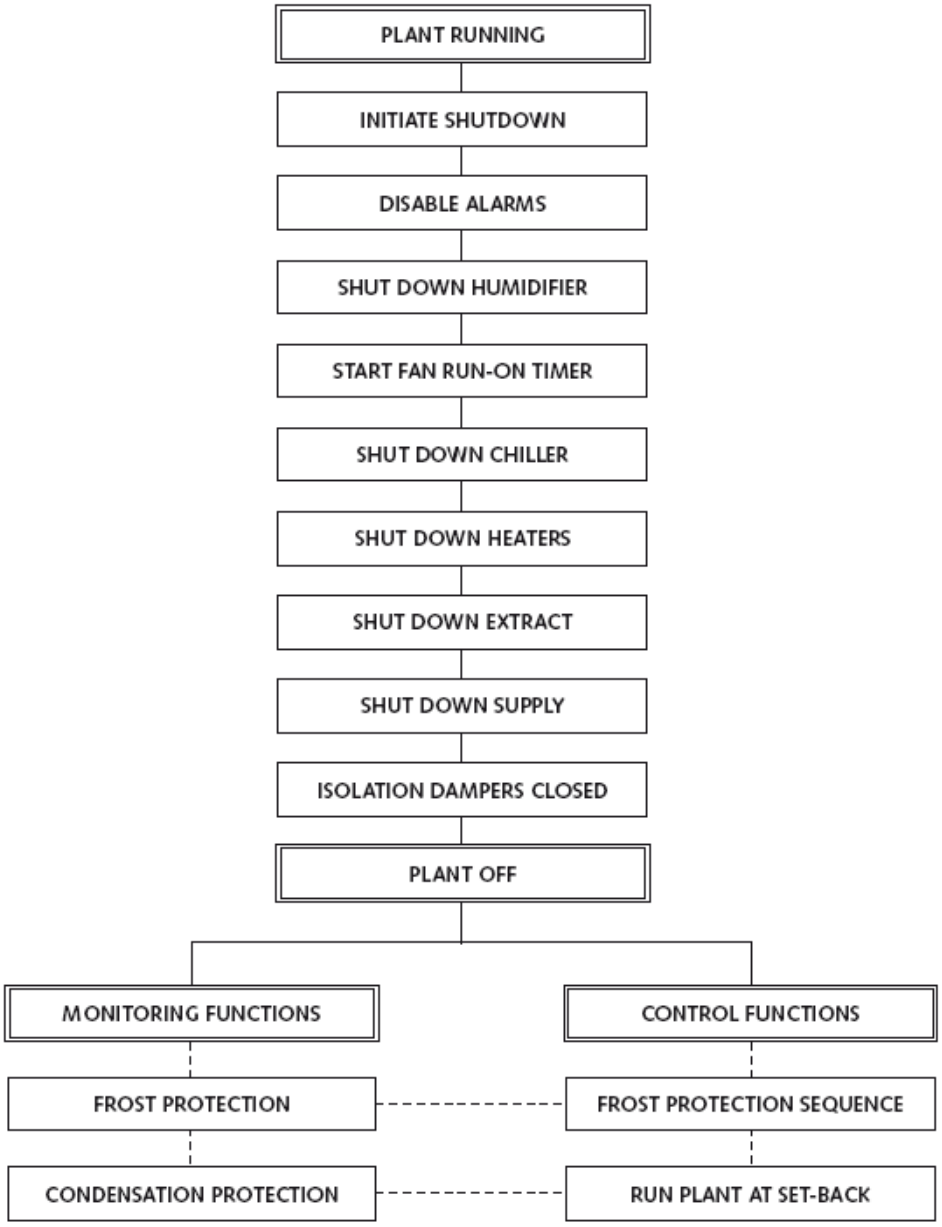


Figure 3: Plant control algorithm – normal shutdown sequence

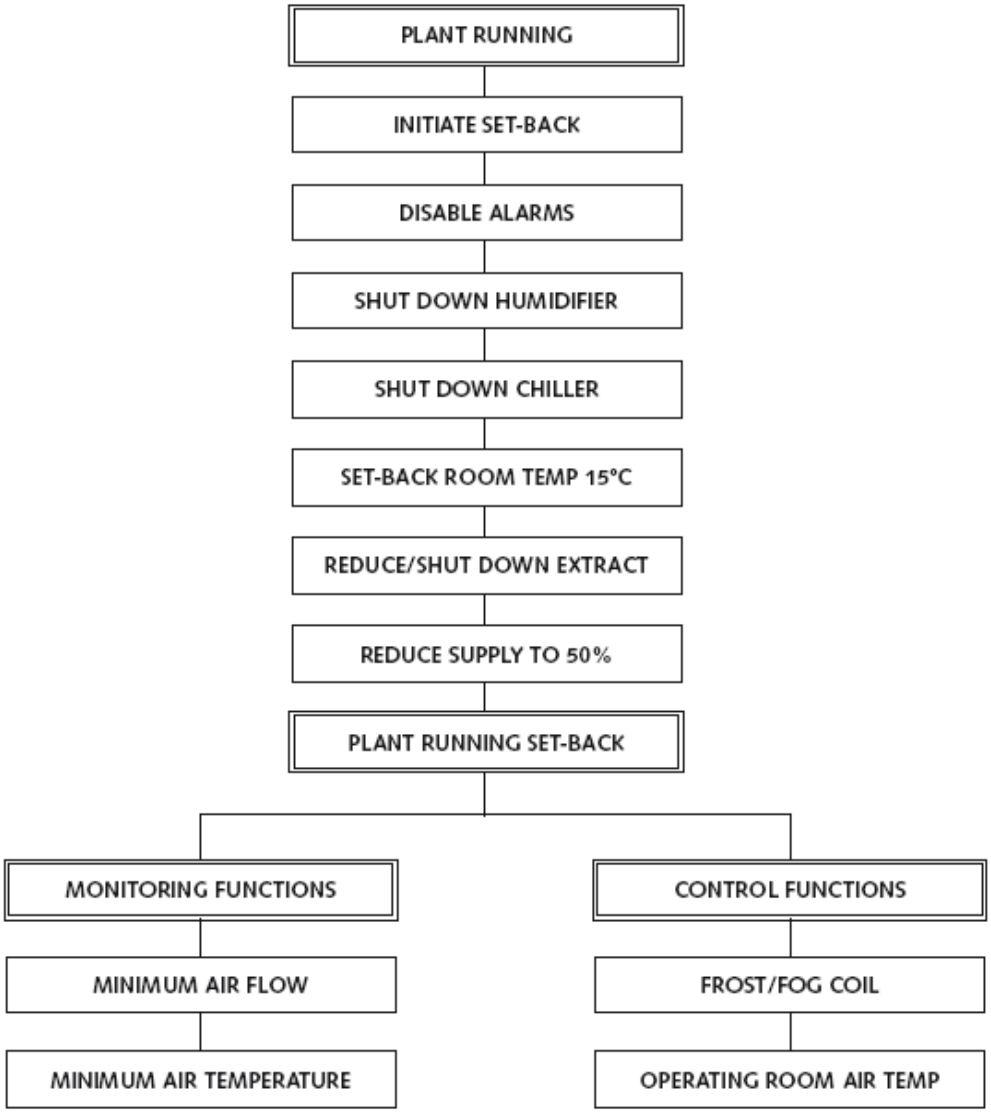


Figure 4: Plant control algorithm – set back sequence

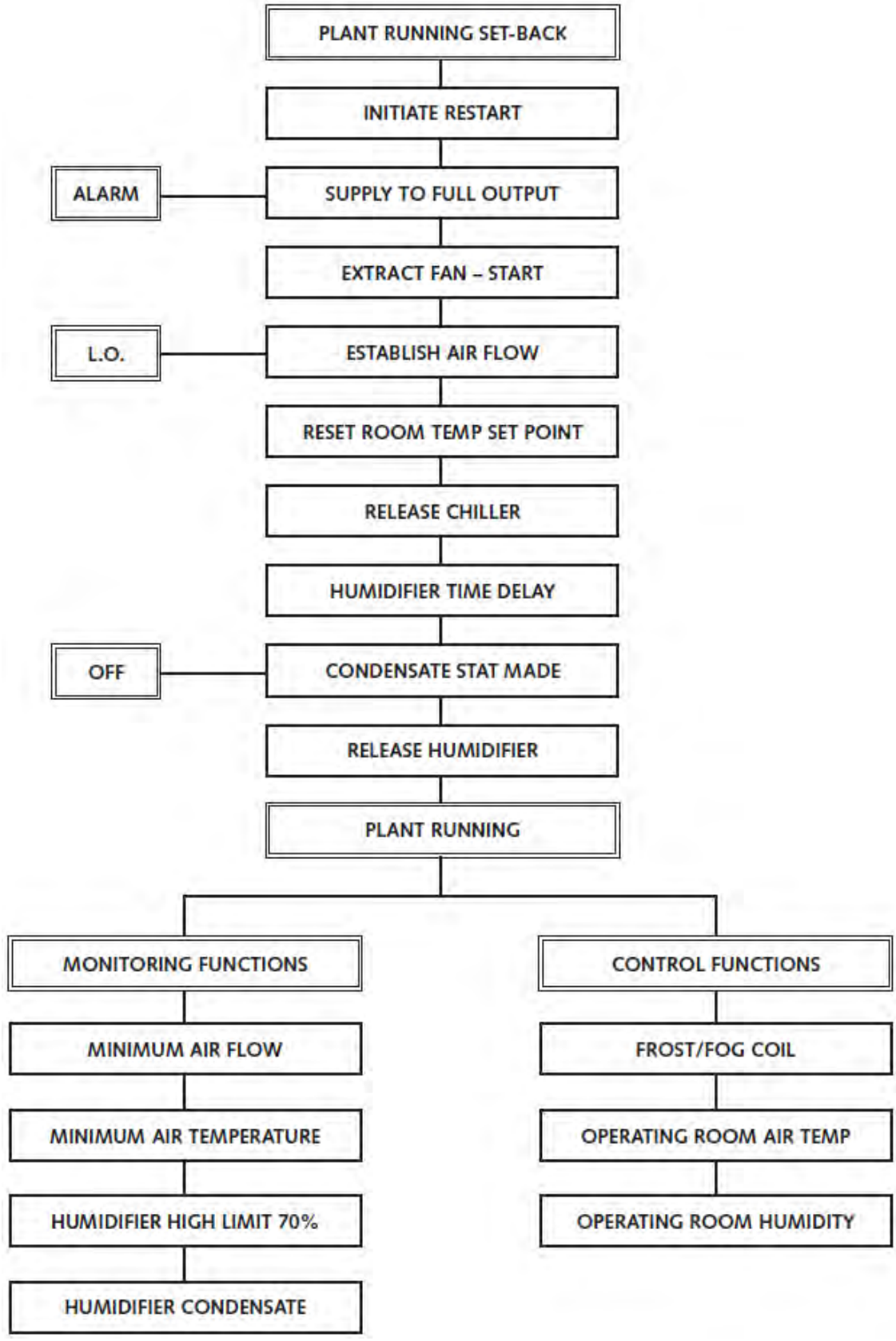


Figure 5: Plant control algorithm – restart from set-back

Set-back control

6.23 Where variable speed controls are installed, the setback facility for each plant should depress the control temperature to around 15°C; exclude any humidification and cooling from the system; and reduce the supply and extract air volumes to around 50%. The extract fan can also be turned off as long as the desired direction of air movement from clean to less clean will be maintained (See also Figures 2 - 5).

Use control

6.24 The installation of movement detectors allows for “use control” of ventilation systems. A simple control logic that reduces the system to a “set-back” condition if there has been no movement detected in the space for, say, 30 minutes and that switches the system “off” if no movement is detected for one hour is recommended for many applications, including operating suites.

6.25 A variation on this can be provided by linking ventilation controls to lighting. For example, in an operating theatre, the system may be off outside of working hours, could run at set-back when the general lighting was switched on and increase to full speed when the operating lamp is switched on. As with movement detection, a 30-minute run-on should be provided at each stage when the lights are turned off.

6.26 Either of the above control strategies may be refined by linking to the BEMS to provide a control logic related to normal working hours and associated ‘real-time’ movement within the zone being controlled. This should result in significant energy savings.

Environmental control

Temperature control methods and application

General

6.27 All control valves must fail safe, that is, close in the event of power or air-flow failure, with the exception of the fog/frost battery control valve, which should open upon power or airflow failure.

6.28 Control valves should be located in an accessible position. Isolation valves should be provided to enable the control valve to be removed for service without the need to drain-down the system.

6.29 Care should be taken to ensure that the installation of control valves and their associated pipework do not obstruct access to the AHU inspection doors and hatches.

Room temperature control

6.30 The limits for room temperature set point are generally between 16°C and 25°C depending on the particular application, and in some specialised instances (for

example, operating departments) are adjustable within a predetermined range by the user.

6.31 The selection of temperature set point for each room or zone may be by a control facility in the room / zone, or remotely at the control panel or BEMS. Where the control device is mounted within the room / zone and adjustable by the user, it should be marked either 'raise' and 'lower' or '+' and '-'. It should control within a specified temperature range to suit the user requirement with a control tolerance of ±1K. All other control set-points should be selectable either on the control panel or at the BEMS interface.

6.32 Where local control is provided, an indication of temperature will be required locally, or at a staff base (if appropriate), using an analogue or digital indicator. The indicator should be large enough to be read from the normal working position (for example, at the operating table in a theatre). This may be mounted in a supervisory or, 'surgeon's' control panel, with the signal repeated on the main system control panel or BEMS. It is important that this indicator displays the actual measured temperature and not the selected temperature.

6.33 Where the supply and extraction systems are designed for ventilation only and there is a wet heating system to provide background heating, care must be taken to avoid one system trying to heat the space while the other system is trying to cool the area.

Frost battery control

6.34 Steam-supplied frost batteries must be operated as on/off devices with their sensor mounted upstream of the battery. This will give 'open loop' control. A set point of +1°C is recommended.

6.35 Low pressure hot water (LPHW)-supplied frost batteries should be controlled using the proportional mode. Their sensor should be located downstream of the battery to give 'closed loop' control. A set point of between 2°C and 5°C is recommended.

6.36 If the temperature downstream of the frost battery, as sensed by a serpentine thermostat, falls below the required set point over any part of the coil, the plant must automatically shut down in order to prevent damage to the other batteries. The serpentine thermostat must not be in direct contact with the coil.

Off-plant control

6.37 The control logic must prevent the chiller and pre-heater being on at the same time.

Humidity control methods and application

6.38 In order to prevent excessive condensation when starting up from a total plant shut-down, a time delay should be incorporated into the control system such that the humidifier does not start until 30 minutes after the ventilation plant starts up.

6.39 Irrespective of the method of control, a high-limit humidistat should be installed to ensure that when the humidifier operates, the condition of the air in the duct does not exceed 70% saturated, particularly during plant start-up.

6.40 With certain types of steam humidifiers, it may be necessary to install a thermostat in the condensate line from the humidifier's steam supply, to ensure that the steam at the control valve is as dry as possible before it is injected into the air supply.

6.41 The humidifier and cooling-coil control must be interlocked so that they cannot be on at the same time.

6.42 The humidifier control system should ensure that it is switched off with the fan. It is preferable to design the control system so that the humidifier is isolated for an adequate time before the fan is turned off so as to purge humid air from the system.

6.43 All control valves must fail safe (that is, close in the event of power failure) and the humidifier must be interlocked with the low airflow switch.

Multi-zone control methods and application.

6.44 Close control of all air-conditioning parameters may be difficult to achieve with multi-zone systems, since each zone will in theory require a re-heater and humidifier to give total control of humidity if that is what is required. In reality such close control is rarely required in practice. It is therefore usual with multi-zone systems to provide control of zonal temperature only, with humidity control where fitted being based on average conditions within all zones, or minimum conditions within one zone.

6.45 Where there is a requirement for close control of air-conditioning parameters in a number of zones (e.g. an operating department) separate plants should be provided for each zone in order to avoid the need for expensive over-cooling and reheating of individual zones.

6.46 Most multi-zone systems within healthcare premises are controlled based on off-coil control within the central plant, with trimmer heater batteries on individual zones.

Alarms and indication

6.47 Supply and extract systems should include indicator lamps on the control panels to confirm the operational status of each system. Where the usage is on a regular daily pattern, time control with a user-operated timed manual over-ride should be provided.

6.48 Where a system is provided for a particular space, the indicator should be in, or immediately adjacent to, that space and local controls should be provided with labels clearly defining their function (eg. isolation suites.)

6.49 The 'plant failure' and 'low air-flow' alarms should be initiated by a paddle switch or other device located in the main air supply duct. This should operate when

the air quantity fails to reach or falls to around 80% of the design value and will give indication of fan failure, damper closed, access door left open, or any other eventuality that could cause a reduction of air quantity. Monitoring the current drawn by the fan motor is not a substitute for a sensing device that is directly affected by the air-flow.

6.50 The 'filter fault alarm' should be initiated by a predetermined increase of pressure differential across the filters, thereby indicating a dirty filter.

6.51 Direct-reading gauges or manometers should be installed across filters to give maintenance staff an indication of their condition.

6.52 Visual indication should be provided at a manned staff location (for example, the reception or staff base) and on the main control panel and BEMS to show 'plant failure' and 'low air flow'.

BEMS

6.53 Control of most systems will be via a Building Energy Management System (BEMS). This will enable the operating conditions and control tolerances to be set and monitored. The BEMS may also be set to log the actual energy consumed by the system and recovered by the energy recovery system. This will provide a useful check on the overall operating efficiency and provide evidence that energy targets are being achieved.

7. Specialised ventilation systems

7.1 This section contains design information for a range of healthcare ventilation applications.

7.2 The following departments will require a degree of specialised ventilation.

- the Operating department;
  - treatment rooms;
  - endoscopy, day case and minimum invasive suites;
  - cardiology and operative imaging suites;
  - conventional operating theatres;
  - Ultra-clean ventilation (UCV) operating theatres;
  - barn theatres;
  - recovery and ancillary areas.
- Obstetrics;
  - maternity theatres;
  - birthing rooms;
  - LDRP Rooms;
  - SCBU.
- critical areas and high-dependency units of any type;
- Isolation facilities;
  - infectious diseases units;
  - bone marrow and other transplant units;
  - chemotherapy and oncology units.
- Sterile Supply and Decontamination Units;
  - wash rooms;
  - inspection and packing rooms;
  - sterile pack stores.
- the Pharmacy departments;
  - aseptic suites;
  - extemporaneous preparation areas;
  - radio pharmacies.
- the Pathology department;
  - laboratories;
  - cat 3 and 4 rooms.

- the Mortuary and Post mortem suite;
  - mortuaries;
  - post-mortem rooms;
  - specimen stores.
- Hydrotherapy units;
- Burns units;
  - burns theatres;
  - treatment rooms;
  - isolation rooms;
  - tissue banks.
- Emerging specialties;
  - gene therapy units;
  - stem-cell laboratories.
- Infrastructure;
  - plant rooms housing combustion equipment;
  - welding facilities;
  - wood working workshops;
  - electric vehicle charging areas.

7.3 Design information for many of these applications is given in Appendix 1 Table A1, Appendix 2 and in the following Chapters within this section.

7.4 It is not possible within this existing document to give definitive guidance for every healthcare specific ventilation application. Additional detailed guidance may be issued in due course in the form of supplements.

General information

7.5 The section on operating theatres is the most extensive and contains much information that is common to other applications. Each theatre suite should have its own dedicated air-handling unit and extract fan. Where no specific guidance is given the principles set out below should be followed:

- the foregoing sections of the document contain general information on healthcare-specific aspects of ventilation system design and specification;
- a set of standard solutions for the design of general operating theatre suites to conform to past and new standards is given in new standard layouts Nos 1, 3, 5 and 7 and those for UCV theatres in new standard layouts Nos 2, 4, 6 and 8 within Appendix 3;
- the CIBSE Guides A & B contain basic information on ventilation design that can be applied to most applications;

- where a British or European standard exists that is specific to the application (for example, a clean room) it should be used as the basis of the design requirement;
- air should always move from clean to less-clean areas. A hierarchy of room cleanliness is given in Table A2;
- differential pressure will prevent contamination between areas when doors are closed. Information on air leakage through closed doors and hatches for a range of differential pressures is given in Table A3;
- the flow of air will prevent contamination between areas when doors are open. Information on air leakage through open doors and hatches for a range of differential pressures is given in Table A4;
- if anaesthetic gases are used, 15 air changes per hour will be required;
- a methodology for calculating a design solution for a non-standard suite of operating rooms is given in Appendix 4. This may be adapted as necessary to suit other less complex applications where air is required to cascade from clean to less clean areas.

7.6 The supply of air to a room has four main functions:

- to dilute airborne contamination;
- to control air movement within such that the transfer of airborne contaminants from less clean to cleaner areas is minimized;
- to control the temperature and if necessary the humidity of the space;
- to assist the removal of and dilute waste gases where used.

7.7 Because of the complexities of controlling air-movement patterns, much design effort will be required for this aspect. It is important that the design makes the best possible use of the air available, as excessive supply airflows for the control of air movement should not be used. The amount of air supplied will be determined by the number of doors and desired air-change rate.

7.8 There are four routes whereby airborne contaminants may appear in a room:-

- through the supply air;
- shed directly by the room occupants;
- arising as a result of the work activities;
- transferred from adjacent spaces.

7.9 Particles entering with the supply air can be controlled by the selection of suitable filter grades.

7.10 Particles shed directly by the room occupants can be controlled by:

- restricting access to essential persons only;
- the choice of the occupants' clothing;

- the room's air-change rate.

7.11 Particles arising as a result of the work activity can be controlled by:

- enclosing, semi-enclosing or otherwise controlling the work-based source;
- the room air-change rate.

7.12 The transfer of particles from adjacent spaces can be controlled by:

- differential pressure;
- air-flow paths.

7.13 Air change rates are given in Table A1. These figures have been found to give sufficient dilution of airborne contaminants, provided the mixing of room air is reasonably uniform.

7.14 A downward-displacement turbulent air distribution is generally preferred. The supply and extract diffusers should be positioned to ensure that all parts of the room are actively ventilated and that where necessary the staff will be in a clean air-flow path. (See Section 5 for additional guidance on supply terminals).

7.15 Horizontal-flow room-air distribution with or without a Coanda effect can be a source of draughts and difficult to set up correctly. Its use should be confined to non-critical areas.

Air movement control

7.16 The design of the system should seek to minimise the movement of contaminated air from less clean to cleaner areas. Transfer grilles enable air to pass in either direction between rooms of equal class and pressure. Pressure stabilisers operate in one direction only; they allow excess air to be directed to the area desired and assist in maintaining room pressure differentials. When closed they prevent significant reverse air-flow.

7.17 The relative locations of supply and extract terminals and their design air-volume rates will determine the basic airflow between adjacent spaces. Transfer grilles and pressure stabilisers will permit and control the flow of air between spaces ensuring a flow from the clean to less clean areas. Failure to provide such devices will lead to uncontrolled air flows when personnel move between rooms. They may also result in doors being held partially open by air pressure

Temperature and humidity control

7.18 To achieve the required room conditions, supply flow rates are calculated conventionally, taking account of all heat and moisture gains and losses, and of maximum permissible temperature differences between the room and supply air. In most applications the base heating load will be provided by a heating system. In critical systems the room or suite being considered will be within the heated building envelope so the ventilation will be sized to suit the casual gains or losses.

7.19 Temperature differences of up to 10K for winter heating and 7K for summer cooling must not be exceeded.

7.20 It is acceptable for the humidity to swing uncontrolled between 35% and 70% saturation.

Removal and dilution of waste anaesthetic gases

7.21 Anaesthetic gases are subject to occupational exposure limits. Waste anaesthetic gas must be contained and removed by a suitable gas-scavenging system. Some leakage from the anaesthetic equipment and the patient's breathing circuit will occur with all systems, particularly during connection and disconnection; and from the interface with the patient. The air movement scheme should ensure that this leakage is diluted and removed from the room. Anaesthetic agents are heavier than air so placing the supply terminal at high level with an extract at low level, adjacent to the anaesthetic gas terminal units will ensure that staff are in a clean air-flow path.

7.22 In LDRP and delivery rooms the use of anaesthetic gas is controlled on demand by the patient. This may result in significant leakage which, in order to reduce staff exposure, will need to be controlled by establishing a clean airflow path. A supply at high level at the foot-end of the bed with extract at low level at the head-end will provide such a path.

Fire aspects

7.23 When considering the overall airflow movement, careful thought needs to be given to the operation of the ventilation system, to limit smoke spread in the event of a fire.

Door protection

7.24 Air should flow from the cleaner to the less clean areas as shown in Table A2. There are several factors that affect the likelihood of a reverse air- flow through doorways:

- when a person passes through a doorway, both the passage of the person and the movement of the door flap cause a transfer of air between the areas separated by the door;
- when a door is left open there is a transfer of air between the two areas separated by the doorway. This is caused by air turbulence, but is greatly increased by any temperature differential between the areas (a 1.4m wide doorway may allow the transfer of 0.19 m^3/s of air in each direction when there is no temperature difference, but when the temperature differential increases to say 2K, the volume transferred may increase to 0.24 m^3/s).

7.25 Two methods of door protection are used in order to reduce the likelihood of contamination of clean area by a reverse air-flow from a less clean area:

- closed door protection – a pressure differential is created across a closed door so that any air leakage is from the clean to the less clean area.

Table A3 gives details of closed door leakage rates for a range of differential pressures;

- open door protection – the pressure differential drops (See Table A5) and is effectively replaced by a flow of air through the doorway from the clean to the less clean area. The flow of air needs to be sufficiently large to ensure that significant reverse airflow cannot occur and will be related to the relative cleanliness of the areas being considered. Table A4 gives air-flow rates for open door protection related to door / opening size and classification of the adjoining areas.

7.26 Pressure stabilisers enable the room differential pressure to be set when the doors are shut, thus providing closed-door protection. When a door is opened the stabilisers will close, forcing air to be directed through the doorway thus providing open-door protection.

7.27 The recommended air-flow rates to achieve this are given in Table A3. Provided that the dilution criteria in Table A1 are met, the occasional small back-flows created (when two doors are opened simultaneously; or when there is a high temperature difference across an open door) will have little effect on the overall air cleanliness of the affected room.

7.28 In applications where it is critical to maintain a specific airflow and /or pressure regime (for example isolation rooms) all windows in the zone should be locked shut or sealed. Trickle vents, if fitted, will also need to be sealed.

Systems design

7.29 The design of the ventilation system for an area depends on the overall configuration of the department. Where the department is served by more than one AHU, the control of the units may need to be interlocked so that reverse air-flow patterns do not occur.

7.30 Dual-duct high velocity systems have advantages, but are noisy, costly and may give rise to unacceptable values of humidity. Single-duct, low velocity/pressure systems are preferred.

7.31 Extract grilles should be sited and balanced to promote air movement in the desired direction.

7.0 (a) Operating department ventilation systems

7.32 The information given in this section relates to general operating suites. It will be applicable to other types of theatre suite such as maternity, burns, cardiac, etc. The standard values given may need to be adjusted to reflect non-standard room sizes, pressure regimes and air change rates.

7.33 A method of obtaining a design solution for non-standard theatres is given in Appendix 4.

7.34 Additional information for Ultra-clean ventilation (UCV) theatres is given in Section 7.0 (b).

General

7.35 The supply of air to an operating room has four main functions:

- to dilute airborne contamination;
- to control air movement within the suite such that the transfer of airborne contaminants from less clean to cleaner areas is minimized;
- to control the temperature and if necessary the humidity of the space;
- to assist the removal of, and dilute, waste anaesthetic gases.

7.36 Because of the complexities of controlling air-movement patterns, much design effort will be required for this aspect. It is important that the design makes the best possible use of the air available, as excessive supply airflows for the control of air movement should not be used. The amount of air supplied to the operating room will be determined by the number of doors and desired air-change rate.

7.37 The detailed considerations upon which the supply air-flow rate is based are as follows.

Dilution of airborne bacterial contaminants

7.38 There are four routes that airborne contaminants may appear in an operating room:

- through the supply air;
- shed by operating staff;
- produced by the surgical activities;
- transferred from adjacent spaces.

7.39 Supply flow rates for the main rooms of the operating suite are given in Appendix 3. For the other areas where room sizes and activities vary from site to site, air-change rates are given in Table A1. These figures have been found to give sufficient dilution of airborne bacterial contaminants, provided the mixing of room air is reasonably uniform.

7.40 A downward-displacement air distribution is preferred; it may be either turbulent or laminar flow. For turbulent flow the supply-air diffusers should be positioned either in the centre of each quadrant of the ceiling or along a line between the centres of each quadrant. This should ensure that all parts of the room are actively ventilated and that there will be adequate air movement at the operating table. Laminar flow would be provided by a perforated plenum terminal centred above the operating table. (See Section 5 for additional guidance on supply terminals).

7.41 Suspended articulated equipment is usually fitted in theatres. These require significant structural steelwork in the ceiling void to cater for the loads imposed by the resulting bending moments. It is important to ensure that the void is

deep enough to accommodate both the steelwork and the ventilation ducts. The location of the steelwork must not prevent a suitable layout of the ventilation ductwork and correct positioning of the supply air terminals. It needs to be recognised that the correct ventilation of an operating theatre plays a significant part in controlling healthcare acquired infections and is not subordinate to the desire to make equipment easy to move.

7.42 Horizontal flow distribution with or without a Coanda effect can be difficult to set up correctly and are unlikely to be as effective in Theatre applications. It should not be used in new installations. However space constraints may force its retention or replacement when refurbishing existing installations. Where fitted, the supply grilles will require a means of directional adjustment.

7.43 For general operating theatres, the air supply would be filtered in the AHU. Terminal HEPA filters are not generally required.

Control of air movement within the suite

7.44 The design of the system should seek to minimise the movement of contaminated air from less clean to cleaner areas. Transfer grilles enable air to pass in either direction between rooms of equal class and pressure. In older designs suitably dimensioned door undercuts were often used in lieu of transfer grilles. Pressure stabilisers operate in one direction only; they allow excess air to be directed to the area desired and assist in maintaining room-pressure differentials.

7.45 The relative locations of supply and extract terminals and their design air-volume rates will determine the basic air-flow between adjacent spaces. Transfer grilles and pressure stabilisers will permit and control the flow of air between spaces ensuring a flow from the clean to less-clean areas of the suite. Failure to provide such devices will lead to uncontrolled airflows when personnel move between rooms and doors being held partially open by air pressure.

Temperature and humidity control

7.46 Supply flow rates to achieve the required room conditions, are calculated conventionally, taking account of all heat and moisture gains and losses, and of maximum permissible temperature differences between the room and supply air. In most applications the room being considered will be within the heated building envelope.

7.47 Temperature differences of up to 10K for winter heating and 7K for summer cooling must not be exceeded.

7.48 It is acceptable for the humidity to swing uncontrolled between 35% and 60% saturation.

Removal and dilution of waste anaesthetic gases

7.49 Anaesthetic gases are subject to occupational exposure limits. The air-movement scheme should ensure that staff are in a clean air-flow path. (See Paragraph 7.21).

7.50 Air extracted from operating suites should not be re-circulated, as it may contain malodorous contaminants. However an energy recovery system should be fitted in the extract in order to reduce the plant energy consumption. (See Paragraphs 4.142 - 4.147).

Fire aspects

7.51 When considering the overall air-flow movement, careful thought needs to be given to the operation of the ventilation system, to limit smoke spread in the event of a fire. However, this is a highly staffed department with a low fire risk/load status and these factors need to be recognised when developing the fire strategy. It is considered satisfactory to treat the complete operating department as a single fire compartment providing there are at least two exits from it. Over-compartmentalisation can lead to difficulties in establishing clean air-flow paths and room-air dilution rates. This will lead to an increased risk of healthcare-associated infections. Staff areas within the department should be treated as a sub-compartment. (See Paragraph 6.18).

Door protection

7.52 Air should flow from the cleaner to the less clean areas as shown in Table A2. The factors that affect the likelihood of a reverse airflow through doorways are discussed in Paragraphs 7.24 - 7.26.

7.53 It is not possible to design an air-movement scheme, within the restraints of the amount of air available that will protect the operating room when two doors are simultaneously opened. The design process that has been used considers that each door is opened in turn and ensures that the direction and rate of air-flow through any open doorway is sufficient to prevent any serious back-flow of air to a cleaner area.

7.54 Provided that the air-change rates in Table A1 are met, dilution will be sufficient to ensure that the occasional small back-flows created (when two doors are opened simultaneously; or when there is a high temperature difference across an open door) will have little effect on the overall air cleanliness of the affected room.

7.55 The following general points should be taken into consideration during the design of operating suites:

- Number of exits – the fewer the number of rooms (and therefore doorways) leading from the operating room the better, as traffic is reduced and less complicated air-movement control schemes are required.
- Scrub and hand-wash facilities – these may be a part of the operating room, often in a bay. The bay would count as part of the operating room volume

and should have a low-level active or passive extract to remove the moisture-laden air. Should a separate room be required for the scrub area, a door between the scrub-up room and the operating room is an inconvenience to scrubbed staff, and could be replaced by an opening. This opening should be larger than a normal single doorway, but the scrub would not, in these circumstances, be considered part of the operating room volume.

- If an alcohol scrub regime is employed, individual theatre scrubs may not be required and would be replaced by a common departmental pre-/post-operation scrub position in the corridor. This would require local extract to prevent a build-up of moisture.
- Preparation 'Sterile Pack Store' (SPS) – if it is intended to 'lay-up' instruments in the operating room, the preparation room is then used simply as a sterile pack store. The nominal room pressure can therefore be the same as that of the operating room and the airflow between the two rooms in either direction. Air supplied to the preparation room may be directed into the operating room either through a door mounted transfer grille or if no door is fitted, through the opening. Alternatively, stock ready-use sterile items can be located in a bay within the theatre. In this case, a portion of the total theatre supply air should be provided in the bay to ensure it is actively ventilated.
- Preparation room 'lay-up' – when the preparation room is used as an instrument 'lay-up' room, it should be regarded as being of greater cleanliness than the operating room, and the design should minimise the transfer of air from the operating room to the preparation room. Air supplied to the room may be directed to the operating room through a pressure stabiliser taking care not to compromise the airflow pattern in the operating room. The air may also be directed into a corridor;
- Service corridor – if materials to be disposed of are placed in impervious material for transportation, it is not necessary to have a separate corridor for this purpose. However, a service corridor has many operational advantages it terms of the flow of materials through the theatre suite. It also permits routine service and maintenance access without compromising the use of adjacent theatre suites.

Standard air-movement control schemes

7.56 In the previous versions of this guidance standard air movement control schemes were given that provided a range of design solutions to typical operating suite layouts. These were satisfactory design solutions for 'standard' sized rooms within the suite but were never intended to be universal for any sized room or suite. Guidance on operating suites contained in HBN 26 (2004) has increased the recommended size of operating room from approximately 35m^2 to 55m^2. Associated room sizes and air change rates have also increased. This means that the original standard solutions are no longer appropriate for new-build installations.

7.57 Because of the resulting increase in the volume of air supplied to the theatre, provision needs to be made either to actively remove it or allow it to escape

passively through pressure stabilisers. The increase in room size has also made the number and position of air-supply terminals critical to the effective ventilation of the room.

7.58 Four new standard solutions have been developed to reflect the current guidance on theatre suite layout and room sizes given in HBN 26 (2004) as well as the general increase in air-change rates.

7.59 The most commonly used original standard solutions have been revised and updated. They have been retained in this guidance, as they will remain applicable to older theatre suites that are being refurbished to their original performance standards. They will also be applicable in existing departments where space constrains do not permit the upgrading of suites to the latest standard of performance or where a pre-built "shell" is being fitted out.

7.60 It is important to recognise that in any situation where a "non-standard" room size or theatre suite layout is being considered, the designer must return to first principles when developing a solution. Examples of non-standard configurations would be:

- cardiac theatres that typically have an operating room half as big again as normal, a perfusion laboratory and no anaesthetic room;
- operating departments served by a central instrument lay-up preparation area rather than individual prep rooms;
- balanced-flow theatres for infectious cases.

Appendix 4 contains a methodology for assisting the designer to arrive at a suitable solution.

7.61 The new and revised standard design solutions are as follows:

No 1 – Typical Conventional theatre – room sizes as HBN 26;

No 2 – Typical UCV theatre – room sizes as HBN 26;

No 3 – HBN 26 illustrated Conventional theatre;

No 4 – HBN 26 illustrated theatre with UCV terminal fitted;

No 5 – Pre-2006 Conventional theatre, single corridor (former SHTM 2025; 1b);

No 6 – Pre-2006 UCV theatre, single corridor (former SHTM 2025; 1a);

No 7 – Pre-2006 Conventional theatre, two corridor (former SHTM 2025; 5b);

No 8 – Pre-2006 UCV theatre, two corridor (former SHTM 2025; 5a).

7.62 Details of these standard solutions are given in Appendix 3. They contain diagrams that show the relationship of rooms and the various doors and transfer devices between them, **but should not be regarded as architectural layouts.**

The schemes have been developed using the calculation procedure described in Appendix 4. Important features of the solutions are:

- Zone trimmer heaters – a trimmer heater battery is advocated when calculations indicate that the temperature differential between rooms may be greater than 2K. Generally this will only be the case in the preparation room when designated as a lay-up.
- The preparation room (sterile pack store)/operating room interface – these rooms are deemed to be of equal cleanliness, and thus a transfer grille is required between these rooms or the door can be replaced with an opening wider than a standard door.
- Preparation (lay-up)/disposal room interface – pressure relief dampers are recommended here to provide an air path when doors are closed, while preventing back-flow when a door is opened elsewhere.
- Operating room/anaesthetic room interface – pressure stabilisers, or in some cases, carefully sized transfer grilles are recommended here, and between the anaesthetic room and corridor, and between the operating room and corridor.
- Operating room/scrub room interface – an opening is provided between these rooms. The flow of air through the opening provides protection, and gives bacterial dilution within the scrub room; the air is then exhausted to the corridor via a pressure stabiliser.

7.63 No mechanical supply or extract ventilation is provided in the scrub room, and thus when a door is opened elsewhere in the suite, the stabiliser will close, allowing the air to be re-directed to help protect the doorway. If the scrub is a bay within the theatre then a suitably positioned pressure stabiliser and / or active extract should be provided to ensure air movement and prevent a local build-up of moisture.

7.64 Any other scheme may be used and the standard solutions applied, if the following conditions are met:

- room relationships in air network terms are as shown in the plans;
- door-gap measurements approximate to those given in Scottish Health Technical Memorandum 58: ‘Internal doorsets’, (but see also Table A3 and Note 3);
- casual heat gains are accounted for;
- a trimmer battery is installed in the air supply system to the preparation room;
- leakage through the structure is kept to a minimum.

Note 3: It should be noted that many doors are now fitted with cold smoke seals as standard. These will significantly reduce the door leakage rate when new and undamaged. It is therefore recommended that provision for the design door leakage is factored into the sizing of the appropriate transfer grille or pressure stabiliser. Failure to do this will result in air gap whistles and doors being held partially open by air pressure.

7.65 It is recommended that every effort should be made to adopt one of the schemes described above.

Air terminals and air distribution within rooms

7.66 The selection and sighting of air diffusers will be critical in establishing an efficient pattern of mixing. To this end the diffusers selected must be fit for purpose. Ceiling mounted circular 'air master' style, square 'four-way blow' or similar diffuser designs that provide a downward displacement, turbulent airflow are the preferred option. (See Paragraph 5.68).

7.67 Plenum-type 'laminar'-flow-style diffusers with a footprint that encompasses the operating site are acceptable but may be prone to buoyancy effects as a result of temperature difference. Manufacturers' type-test data should be consulted to ensure that the terminal will achieve the required performance envelope. Note that these are not true laminar-flow systems in the strict sense of the word but produce a downward-displacement parallel-flow style of air distribution.

7.68 The diffuser equipment chosen should not cause 'dumping' and it should provide a velocity 1 metre above floor level at the operating position of between 0.2 m/s and 0.3 m/s.

7.69 In the operating room, the supply air terminals must be at high level, and should all be adjustable for rate of flow as well as being easily cleaned and silent in operation.

7.70 In order to ensure that all parts of the operating room are actively ventilated, there should be an air-out path on each face or in each corner of the theatre. This may be provided by a pressure stabiliser, transfer grille, active or passive extract terminal. A minimum of three, but preferably four, air-out paths - approximately equally spaced - should be provided.

Automatic control

7.71 The automatic control of ventilation in operating suites needs to be simple and robust. Over-reliance on complex room pressure and flow relationships linked to automatic fan speed control is unnecessary and in the long term have been shown to be unreliable. Complex software algorithms that can only be accessed and interpreted by off-site specialists should not be used. Whichever control strategy is chosen it is important that on-site staff have the facility to override the control system and keep the ventilation operating at least until the surgical procedure is complete. (See also Paragraph 6.11)

7.72 Theatre air-conditioning control sensors should be actively ventilated. They would typically be located in a sampling extract duct mounted in the surgeon's

panel, positioned at normal working height (1.8m above finished floor level) and be accessible for cleaning and the removal of fluff and lint.

7.73 Wall-mounted passive-temperature and humidity sensors are not recommended.

7.74 Controls should be provided to enable operating department ventilation plants to be closed down when the operating suites are unoccupied. (See also Paragraphs 6.24 - 6.26)

7.75 When in the 'off' mode, the control system should ensure that the ventilation plant is automatically reinstated if the space temperature falls below 15°C.

7.76 The theatre control panel should include plant status indication; clearly-readable temperature and humidity indicating gauges; and means of adjusting the set point for temperature. Theatre ventilation plant status indication should be located at the staff control base.

7.77 Where it is considered necessary to fit a humidifier, it should be selected to humidify to 40% saturation at 20°C during the design winter outside conditions. The cooling coil should be able to remove sufficient moisture so that 60% saturation at 20°C is not exceeded during the design summer outside conditions.

7.78 Each operating suite should be served by an independent supply and extract plant.

Ventilation of operating department ancillary areas

General

7.79 There are advantages in providing mechanical ventilation to all areas of the department. Maintaining operating suite airflow patterns is simpler and grilles and diffusers can be sited to eliminate condensation on windows. Where radiators or embedded wall or ceiling panels are installed they should be confined to the corridors and staff-only areas of the department.

Ventilation requirements

7.80 Table A2 gives guidance on the operating department areas in descending order of cleanliness, and this should be considered in the overall design of the department ventilation systems. The specified flow rates of air through doors given in Table A4 for the operating suite are not necessary for other areas of the department. However, the air-flow directions must be maintained from the clean to the less clean areas.

7.81 All windows in the department should be double-glazed and hermetically-sealed in order to ensure that the desired airflow pattern is maintained under all external environmental conditions and to avoid infestation. Trickle vents if fitted will need to be sealed.

Systems design

7.82 The design of the ventilation system for the ancillary rooms depends on the overall configuration of the department. The plant for the ancillary rooms may need to be interlocked to the theatre suite plants so that reverse air-flow patterns do not occur.

7.83 Extract grilles should be sited and balanced to promote air movement along the clean and access corridors towards the reception/transfer areas. This should not affect the air distribution in the operating suite(s).

Reception

7.84 The aim in these areas is to provide comfortable conditions having regard to the movement control requirements of the department as a whole. The number of air changes will depend on the particular design.

Sterile pack bulk store

7.85 The store needs to be maintained at a positive pressure in order to preserve the cleanliness of the outside of the packs; 6 air changes are recommended.

Recovery

7.86 The air-change rate in the recovery room will be rather higher than that needed merely to provide clean, comfortable conditions, as it is necessary to control the level of anaesthetic gas pollution; 15 air changes are recommended, with a balanced air flow.

7.87 The supply air terminals should be ceiling mounted above the foot-end of the recovery bed positions. Extract should be at low (bed height or below) level behind the bed head positions or in the corners. This will establish a clean airflow path so that staff do not inhale anaesthetic gases exhaled by recovering patients.

7.0 (b) Ultra-clean ventilation systems

General requirements

7.88 The design philosophy of a conventionally ventilated operating suite is based on the need to dilute contaminants and control both the condition and movement of air in an operating suite. Ultra-clean ventilation (UCV) is a means of significantly increasing the dilution effect by providing a large volume of clean filtered air to the zone in which an operation is performed and sterile items are exposed. Air is discharged above the operating zone and while not truly laminar, its downward displacement purges the clean zone of contaminants and particles generated by the activities within it. The airflow in and around the clean zone also serves to prevent particles originating outside the zone from entering it. The resulting reduction in contaminants has been shown to reduce significantly post-operative sepsis following certain orthopaedic procedures.

7.89 The number of bacteria that are present in the air at the wound site and exposed surgical items is dependent on the operating team, their procedural discipline, choice of clothing and the type of UCV system. Ultra-Clean air is defined as that containing not more than 10 CFU/m^3.

7.90 UCV systems are very successful in reducing contaminants at the wound site so it is often considered that there is no need for complex air movement control schemes in the rest of the suite. However, when designing the ventilation scheme, it should be noted that the users may switch the UCV terminal to "set-back" when non-orthopaedic surgery is taking place. This is because the high airflow rates can cause increased moisture evaporation of exposed tissue that may be detrimental to the surgical outcome. In recognition of this, the ventilation scheme should be capable of providing operating conditions to at least a "conventional" theatre standard throughout the suite with the UCV in set-back mode. It should also be remembered that suitable levels of ventilation will always be required in the peripheral rooms.

7.91 UCV systems can be designed and built from first principles or a range of bespoke modular units of varying shapes and sizes are available with each manufacturer having a slightly different approach to UCV design. Some systems are fitted with partial or full walls to delineate the clean zone and direct a laminar or exponential downflow of air within it. Other designs utilise slotted linear supply terminals to produce an air curtain around the clean zone together with laminar-flow diffusers to provide a downward-displacement supply within it. **Notwithstanding any variation in the design philosophy, all UCV systems will be required to achieve completely the performance standard set out in the "Validation" section of this document**. (Section 8)

7.92 As with conventional theatres, each UCV operating suite should have its own dedicated air handling unit (AHU) to the standard set out in Section 4 of this document. To ensure operational flexibility and permit routine maintenance, air handling units should not be shared between suites.

7.93 In retrofit installations, site conditions may preclude individual AHUs for each suite. In these circumstances an AHU may be shared between not more than two operating suites providing each suite has its own control of temperature. An accessible airflow measurement test point should be provided in the supply branch duct to each theatre so that the primary air volume to each UCV canopy can be determined. In addition the branch supply and extract should be capable of being physically isolated and the main air-flow rate reduced so that either suite can be taken out of use without detriment to operating conditions in the other.

7.94 An inherent feature of a UCV system is its large airflow so it is essential to re-circulate the air supplied to the operating theatre and/or to recover its energy in order to optimise operating costs.

7.95 The primary fresh-air volume supplied to a UCV suite will be the same as in a conventional suite and it should be dispersed to the rooms in the suite in the same manner. This is an important aspect of the design and requests by UCV suppliers for increased primary air-supply volumes should be resisted.

7.96 Laying-up in the clean zone is preferable for infection control reasons. Where a Sterile Pack Store (SPS) Preparation room is provided a transfer grille will be required in the preparation room / theatre door.

7.97 If the Preparation room is intended to be used for laying-up instruments, a pressure stabiliser will be required between the prep room and theatre. It should be fitted with a stand-off baffle to prevent air transfer interfering with the ultra-clean airflow distribution.

7.98 Separate scrub-up or disposal facilities are not necessary for air cleanliness although operational policy may prefer such a provision. A separate anaesthetic room should, however, be provided.

7.99 There is no aerobiological reason why two or more UCV systems should not be installed in a common area as long as adequate spacing is provided. These are known as “barn theatres” and require special design considerations and operational discipline. The relative positions of the UCV units, temperature control range and location of doors and openings to other areas will all significantly affect the airflow at the operating positions.

Types of UCV system

Remote plant systems

7.100 In a remote plant system, all the air-conditioning equipment is located outside of the operating room, except for the unidirectional air-flow terminal, terminal filter, air diffuser and the return-air grilles (see Figure 6).

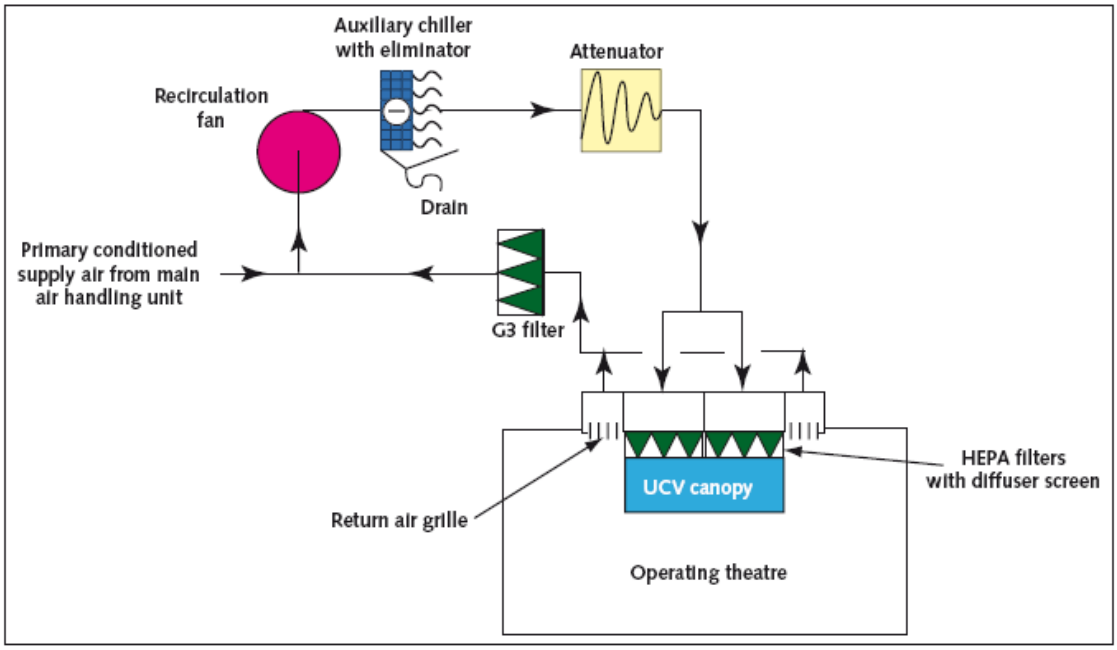


Figure 6: UCV theatre with remote air recirculation

7.101 This arrangement is the preferred option for new installations as it has the following advantages:

- the recirculation fans are out of the theatre thus reducing noise. Multiple recirculation fans can be replaced by a single fan unit with its drive out of the air stream;
- casual heat gains from recirculation fan(s), canopy lights, equipment and people within the theatre can be removed by a chiller battery in the return air stream. This will prevent heat build-up in the theatre;
- the return-air filters can be changed without needing access to the theatre making routine maintenance more feasible;
- the opportunity exists to locate the HEPA filter in the primary supply duct rather than the theatre terminal. This will reduce the number of filters required and allow them to be changed without entering the theatre.

Modular systems

7.102 Modular systems are frequently used in retrofit applications. Vertical or horizontal units are available.

7.103 Vertical-flow modular units comprise a ceiling-mounted air-terminal module containing return-air filters, return-air fans, final filter and air diffuser. Primary air is supplied by a remote air-conditioning unit at the volume and to the standard required for a conventional operating suite. (see Figure 7)

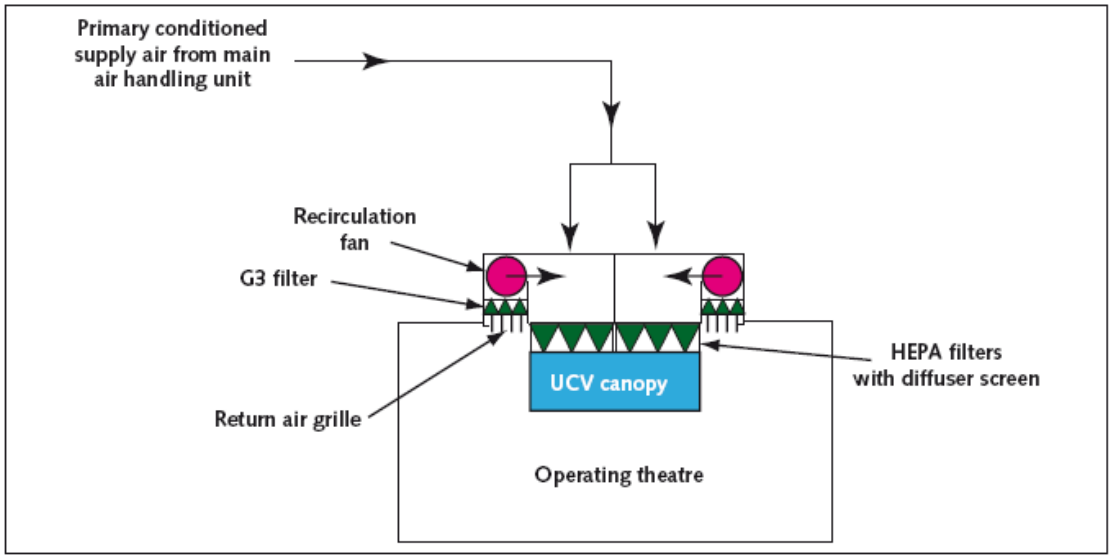


Figure 7: UCV theatre with modular system

7.104 Horizontal or cross-flow modular units comprise a wall-mounted air-terminal module standing vertically to produce a horizontal flow of air and containing final filter/diffuser, return-air filters and fans. The module may incorporate a cooling unit or be supplied with 'fresh air' from a separate primary cooling system.

Vertical flow UCV systems

7.105 Vertical-flow systems have a superior performance and are more effective at reducing infection risks. Air-curtain or partial-wall systems are acceptable, but are known to be more susceptible to problems arising from performance

deterioration, poor operating-team discipline and high occupancy rates than is the case with full-wall systems. A full-wall is considered to be any wall terminating not more than one metre above the finished floor level.

7.106 Because of the large volume of air being moved in a relatively small space, the siting of the return-air grilles can cause short-circuiting of the air discharged through the UCV terminal. If the return-air grilles are positioned at high level, partial walls should be provided to control short-circuiting. The partial-walls shall be not less than 1m from the operating room walls and terminate at least 2m above floor level. The clearance should be increased proportionally for larger terminals (that is, 1.15m for 3.2m x 3.2m units and 1.25m for 3.5m x 3.5m units). In all cases, the sidewalls should terminate at 2m above floor level.

7.107 Siting the return-air grilles around the periphery of the theatre at low level will eliminate short-circuiting, remove the need for partial walls and give an improved airflow path. In any event there should be an air-out path on each face or in each corner of the theatre. These may be provided by combination of pressure stabilisers and passive or active low level extract grilles. Failure to provide air-out paths on all faces of the theatre may result in the surplus air causing entrainment into the clean zone.

7.108 Vertical systems should have a clean zone large enough to encompass the operating site and all of the instrument trays likely to be needed for the surgical procedures to be undertaken. Ophthalmic and minor hand surgery would typically require a 1·4m circular or rectangular terminal. For major orthopaedic procedures a minimum size of 2·8m x 2·8m will be required. This is the area projected on the floor under the supply air terminal within the partial walls, full walls or air curtain. Any air outside this zone cannot be guaranteed to be ultra-clean although given the dilution factor the level of microbiological contamination will be much lower than the general level in a conventional operating room. The use of lines or a coloured area on the floor delineating the extent of the clean zone will assist staff and is therefore essential.

7.109 When upgrading an existing conventional theatre to an ultra-clean standard the only solution may be the installation of a modular system. In these units, the heat gains from the return-air fans and terminal lights may warrant the inclusion of supplementary cooling within the module although modern luminaries contribute substantially less unwanted heat. However issues of cooling coil drainage, condensate removal and maintenance access within the space constraints of the module may make this option impracticable. The additional cooling load should then be catered for by conditioning the primary air to compensate.

7.110 If an existing AHU is to be retained, it may require modification to ensure that it achieves the minimum standards set out in Section 4 of this document. The fan may need re-rating to accommodate the change in system resistance. The cooling coil may also need to be upgraded to cater for the increased load resulting from the return air fans and terminal lights. Failure to make adequate provision for this may make the theatre unusable during prolonged warm spells.

7.111 A factor affecting the air-flow pattern is the supply or room air temperature difference. When the supply-air temperature is significantly above room temperature, buoyancy effects will reduce the volume of air reaching the operating zone. If it is anticipated at design stage that this will be a regular occurrence, then a system incorporating full-walls should be used. Demountable extensions that convert a partial-wall to a full-wall unit are available.

7.112 Convection up-currents from the surgical team and operating lamp tend to counter the movement of clean air towards the operating site, hence the air velocity reaching the operating level is critical. The minimum velocity given below has been selected to take account of these factors and is greater than the theoretical minimum value.

7.113 For all vertical UCV systems the design discharge velocities will be as follows:

Air velocity 2 metres above floor level:

- partial-wall system = 0.38 m/s average;
- full-wall system = 0.30 m/s average.

Air velocity 1 metre above floor level:

- all systems = 0·2 m/s minimum within the operating zone.

The validation Paragraphs 8.75 – 8.86, gives details of the method of measurement.

7.114 Variable-speed recirculation fans with differential pressure control may be the most suitable solution for maintaining consistent performance and energy saving.

Horizontal UCV systems

7.115 Horizontal UCV air-flow systems have been shown to be less effective than vertical systems and are not the preferred solution. There may be occasions, however, where architectural, engineering, economic or workload considerations prevent the installation of a vertical-flow system and only a horizontal-flow system can be installed.

7.116 Horizontal- or cross-flow modular units comprise a wall-mounted air terminal standing vertically to produce a horizontal flow of air across the operating field. The terminal module contains the final filters, air diffuser, return-air grilles, filters and fans. The module may incorporate a full air-conditioning unit or be supplied with 'fresh-air' from a separate primary air-conditioning system. In the latter case the return-air fan power may warrant the inclusion of a supplementary cooling coil within the module.

7.117 The system should have sidewall panels at least 2·4m apart. The panels may fold to facilitate cleaning of the theatre. The minimum height of the terminal should be 2·1m and a deflector at the top of the filter/diffuser will be acceptable

as an alternative to a full roof. These dimensions reflect currently available equipment and may impose operational constraints in addition to a lower level of performance common to these systems.

7.118 In the horizontal flow systems, personnel working between the filter and surgical wound will disperse bacteria that are more likely to contaminate exposed surgical instruments and enter the wound. This may be minimised by the use of improved clothing and operating procedure to reduce dispersion of bacteria. The use of lines on the floor delineating the extent of the clean zone and hatching or colour coding the 'no-entry' zone between the air diffuser and patient will serve to prompt staff and are therefore essential.

7.119 The air discharge velocity as measured 1m from the diffuser face should have a mean value of 0·4 m/s. The validation Section 8 gives details of the method of measurement.

Filters

7.120 The main plant primary and secondary filters should be to the standards and in the location set out in Section 4.

7.121 Terminal filters should be provided within the airflow terminal or in the air supply to it. High efficiency particulate air (HEPA) filters grade H10 as specified in BS EN 1822 will be required as a minimum. There is no aerobiological benefit in fitting filters of a higher grade than this, although for practical reasons most UCV manufacturer recommend the fitting of H12-grade filters.

7.122 In some modular UCV units, the terminal filter is used as a pressure equaliser to balance airflow and filters of a higher grade with a greater pressure drop may be recommended by their manufacturer. The increased resistance may affect the velocity of air reaching the operating level and there will be penalties in terms of installed fan power and higher noise levels.

7.123 The final filters should be installed in a leak-proof housing in a manner that allows the terminal unit, filters and their seals to be validated. A challenge test will be carried out during commissioning to prove the effectiveness of the complete installation.

7.124 Where UCV units are constructed in sections, a means of measuring the pressure drop across the terminal filters in each section should be provided. The pressure test-points should be located outside of the partial wall, capped to prevent air leakage and accessible within the theatre without the need to open the unit inspection panels. Alternatively direct-reading pressure gauges should be fitted.

7.125 The UCV system will require a return-air filter to capture the relatively coarse particles that would otherwise significantly reduce the life of the final filter. This should be at least a G3 grade to BS EN 779. In remote recirculation systems there may be advantages in fitting a higher grade return air filter, as it will reduce the load on the terminal HEPA filters and extend their life.

Noise level

7.126 If sound-attenuating material is used to line any portion of the inside of the UCV unit it should be non-particle-shedding and fire-resistant. (Further guidance can be found in SHTM Firecode suite of documents).

7.127 The maximum noise level in an operating room fitted with a UCV terminal of any type shall not exceed 50 NR. The validation section gives details of the method of measurement.

Lighting and operating lights

7.128 CIBSE lighting guide LG2 and BS EN 12464-1 give detailed information of lighting requirements. Operating luminaires should comply with the photometric requirements detailed in relevant sections of BS EN 60601.

7.129 The position of the UCV light fittings and style of partial walls, where fitted, should neither adversely disturb the airflow nor result in significant spatial variations in illuminance levels.

7.130 In vertical units, specialised task lighting should be provided by toroidal, cruciform or small multiple dome-shaped luminaires as they have good aerodynamic properties. The ideal luminaire will have a minimal effect on the airflow regardless of where it is positioned. Large-diameter saucer-shaped luminaires should not be used in vertical-flow systems as they will occlude the airflow in the critical central zone. It is important to consider the suitability of existing luminaires when retrofitting UCV systems.

7.131 In vertical UCV installations a minimum of 2·75m from floor to underside of the diffuser is required to allow for supporting mechanisms and lamp articulation. When upgrading existing systems this dimension may not be achievable. However, when parked, the lowest point of the central light stem, luminaire and articulation arms should never be less than 2m above floor level.

7.132 The traditional means of light support is a central column that passes through the UCV terminal and is rigidly fixed to the building structure. The position of the support therefore prevents air being supplied at the centre of the terminal. Separate supports displaced from the centre of the clean zone would lead to improved airflow. This approach was advocated in the 1994 version of HTM 2025 but at the time of writing no UK manufacturer has chosen to adopt this solution.

7.133 In horizontal units the size or shape of the specialised task luminaire has little effect on the air-flow pattern.

Controls and instrumentation

7.134 The functions of the supply AHU and extract ventilation should be continuously monitored by a BEMS control unit. The controls and instrumentation for the main plant are set out in Section 6.

7.135 UCV systems will additionally require:

- a set-back facility that can reduce the air supplied through the UCV terminal to a volume that equates to not less than 25 air changes per hour of the operating room gross volume whilst still leaving the supply AHU operating at full speed;
- a facility to turn the entire system, supply AHU and UCV terminal, off. (an emergency stop is not required);
- a read-out sufficiently large to be clearly visible from the operating table that shows the temperature of the air being supplied by the UCV terminal;
- a read-out sufficiently large to be clearly visible from the operating table that shows the relative humidity of the air being supplied by the UCV terminal;
- a red indicator light that will illuminate when either the supply AHU or the UCV terminal fails, either or both are switched off or are at set-back;
- an amber indicator light that will illuminate when the UCV terminal is at set-back and the supply AHU is running;
- a green indicator light that will illuminate when both the supply AHU and UCV terminal are operating at full speed;
- a blue indicator light that will illuminate when the UCV terminal air flow, as detected by a differential pressure sensor, falls below 80% of the design flow rate.

AHU	UVC terminal	Indicator light	Comment
Off or Fault	Off or Fault	Red	Ventilation not operating at a suitable level to commence surgical procedures
Off or Fault	On (set-back)		
Off or Fault	On (full speed)		
On (set-back)	Off or Fault		
On (full speed)	Off or Fault		
On (set-back)	On (set-back)		
On (full speed)	On (set-back)	Amber	Ventilation provided to at least conventional theatre standard
On (full speed)	On (full speed)	Green	Full UCV standard conditions
-	-	Blue	HEPA-filter resistance causing low air flow

Table 7: Indicator light logic table

7.136 The switching devices and indicators should be incorporated in the surgeon's panel and their functions clearly labelled. In retrofit installations an auxiliary panel for the UCV may be the most practical option. If fitted it should be mounted adjacent to the surgeon's panel and their control functions interlocked as necessary.

7.137 When a system is designed to have partial walls with full-wall extensions, a volume control facility may be incorporated to allow the system to be run with reduced velocity when the demountable full-walls are in place. It would be the responsibility of the user to ensure correct operation of the system. To assist the user an explanatory notice should be included on the theatre control panel.

7.138 A direct-reading gauge should be fitted in the theatre to show a representative pressure drop across the final filters. If the UCV control box is located out of the theatre and has a means of manually adjusting the return air-fan speed then it should also be fitted with a direct-reading differential pressure gauge. The means of adjusting the return-air fan speed should be lockable to prevent casual adjustment. The direct-reading gauges should be fitted with a means of indicating the correct operating pressure range.

7.139 The UCV-unit manufacturer's control box should be located in an accessible position preferably in the operating department adjacent to the operating theatre that it serves. A service corridor, if provided, is an ideal location. The control box should be clearly labelled with the identity of the operating theatre that it serves.

7.0 (c) Extract systems

7.140 Extracts may be provided for a variety of reasons including:

- simple odour control (for example in a WC or mortuary);
- to receive and remove moisture-laden air (for example, in a kitchen);
- as part of a combined supply/extract balanced system (for example, in an operating suite);
- to capture a hazardous substance at source (for example a safety cabinet).

7.141 Devices that use an inflow of air to control exposure of staff to hazardous substances are classified as Local Exhaust Ventilation (LEV) systems under the COSHH Regulations.

7.142 An LEV system may comprise a self-contained unit incorporating its own carbon filter such as a simple bench-top fume cupboard. Alternatively it may be a complete "ventilation system" comprising a make-up air supply, multiple-exhaust-protected work stations, branch and central extract ductwork, duplex extract fans and a high-level discharge terminal. It may also incorporate a special filtration system appropriate to the hazardous substance being controlled. Such systems could be required for workshops containing woodworking machinery or large centralised pathology laboratories housing multiple safety cabinets, dissection benches, fume cupboards and specimen stores.

7.143 It is important to recognise at the design stage whether an extract is being provided for comfort or as an LEV system. Typical systems in healthcare include:

- microbiological safety cabinets and Category 3 containment rooms;
- fume cupboards;
- welding-fume extracts;
- woodworking machinery duct collectors;
- battery-charging bay extracts;

- powered plaster and bone saws;
- pharmaceutical preparation cabinets and tablet machines;
- dissection benches, cut-up tables and some specimen stores;
- medium- and high-risk infectious disease isolation facilities;
- decontamination facilities;
- dental furnaces, grinders and polishers.

7.144 General design information and guidance for LEV systems is produced by the Health and Safety Executive (HSE) as HS(G)37. Information on the design and installation of microbiological safety cabinets is given in BS5726 and that for fume cupboards is given in BS EN 14175. Their recommendations should be closely followed.

7.145 LEV systems are statutory items that will be subject to an independent inspection every 14 months.

Hood extract systems

Special requirements

7.146 Extract canopies will be required over steam-and-heat-emitting appliances, for example sterilisers, catering and washing equipment; and for the extraction of toxic fumes over benches used for mixing, sifting and blending procedures.

7.147 Perimeter-drain gulleys and corrosion-proof grease eliminators should be provided on kitchen hoods.

Typical arrangements

7.148 The air-flow rate must be sufficient to ensure an adequate capture velocity in the vicinity of the process; typical values are as follows:

- evaporation of steam and like vapours 0.25 m/s to 0.5 m/s;
- chemical and solvent releases 1.0 m/s;
- vapour of gases 5 m/s to 6 m/s;
- light dusts 7 m/s to 10.0 m/s.

Excessive velocities will be wasteful of power and generate noise.

7.149 The lowest edge of the canopy should be 2m above finished floor level, with a minimum of 300mm overhang beyond the edge of the equipment on all sides.

7.150 A compact arrangement of equipment (but with access for maintenance) will minimise the canopy area, and hence reduce the air volume necessary to achieve the optimum capture velocity.

7.151 Hoods required for the control of heat gain and vapours may be connected to the general extract system when it is convenient to do so, but where non-corrosive ductwork materials are necessary, a separate discharge is preferred.

7.152 Lighting and internal divider plates are often required to be built into the perimeter of large canopies. However, built-in shelving systems are not recommended, as they interfere with the air-flow, and constitute a maintenance problem.

Control of hood extracts

7.153 Provided that it does not interfere with the operation of the department when not in use, the ventilation system for the hood extract and any associated supply can be shut down. To this end, local control should be provided.

Bench extract systems

Special requirements

7.154 Bench extract ventilation is required in departments such as pathology and mortuary, where activities involve the release of malodorous or toxic fumes that should not be inhaled. Where hazardous substances are being controlled, the system should be designated an LEV.

Typical arrangements

7.155 Each ventilated position will usually be accommodated in a continuous run of benching, which should not be more than 650mm from front to rear and which should be provided with a continuous upstand at the rear. Each position should have a 1200mm x 150mm linear extract grille mounted on a purpose-designed plenum box (incorporating guide vanes as necessary), with its face flush with the upstand. The bottom of the grille should be as close as practicable to the level of the working surface (usually 75mm above, to allow for cleaning). The minimum velocity across any part of the grille should be 1 m/s. The grille should be readily demountable to allow for cleaning.

Control of bench extract systems

7.156 Provided that it does not interfere with the operation of the department when not in use, the ventilation system for the bench extract and any associated make-up supply can be shut down. However, a run-on timer with a minimum setting of 30 minutes must be provided. To this end, local or automatic-use control should be provided.

7.157 Processes that produce hazardous vapours, fumes, dusts or noxious vapours should be enclosed or semi-enclosed in a suitable cabinet or exhaust protected workstation.

Safety cabinet and fume-cupboard extract systems

7.158 Safety cabinets and fume cupboards are devices that use an inflow of air to control exposure of staff to hazardous substances. The units, their exhaust

systems, filters, fans and discharge terminals are all classified as Local Exhaust Ventilation (LEV) systems under the COSHH Regulations. The make-up air system to a room that contains an LEV system should also be considered as an essential part of the system and be included in the LEV classification. Information on the design and installation of microbiological safety cabinets is given in BS5726 and that for fume cupboards is given in BS EN 14175. Their recommendations should be closely followed.

7.159 The Advisory Committee on Dangerous Pathogens (ACDP) publishes 'The Management, Design and Operation of Microbiological Containment Laboratories' covering the general environment in which they are used and operational considerations.

Special requirements

7.160 The supply-air system should not distort the unidirectional and stable air pattern required for fume cupboards and microbiological safety cabinets. In general, supply-air ceiling diffusers should not discharge directly towards fume cupboards or safety cabinets, unless the terminal velocity is such that the air-flow pattern of the cabinet is unaffected. The design should ensure that high air-change rates, and/or the opening and closing of doors do not have any adverse effect on the performance of safety cabinets or fume cupboards. A damped door-closure mechanism may help.

7.161 In order to safeguard the user, all safety cabinets and fume cupboards must be fitted with a clear indication that they are operating correctly. Direct-reading gauges or falling-ball indicators are preferred (in addition to electronic pressure indicators). The system should be set to alarm audibly if the face velocity falls below the minimum safe operating level.

Arrangements for safety cabinet installations

7.162 The manufacture and installation of microbiological safety cabinets must be in accordance with the relevant national standards and guidance issued by the Advisory Committee on Dangerous Pathogens (ACDP).

7.163 A Class 1 microbiological safety cabinet must be specified for routine work involving Group 3 pathogens. It should be housed in a Category 3 containment room. Specific design information on containment rooms is issued by ACDP in conjunction with the Health and Safety Commission.

7.164 Siting and installation of microbiological safety cabinets are of particular importance because:

- the protection afforded to the operator by the cabinet depends on a specific and stable unidirectional air flow through the open front;
- the protection to the environment by the cabinet depends on the high efficiency particulate air (HEPA) filters. The exhaust air should never be considered as totally free from microbiological hazard.

7.165 Microbiological safety cabinet is HEPA filtered prior to being discharged to outside. The extract ductwork should as far as practicable be kept under negative pressure while inside the building.

7.166 Current standards permit the installation of microbiological safety cabinets with integral fans, provided that the extract ductwork can be kept short (that is, less than 2m); such an installation however, is likely to be noisy and is not recommended for use in new buildings.

7.167 The discharge from the cabinet should be fitted with a back-draft damper. In multiple installations where several cabinets discharge into a common extract and discharge duct, it must be possible to isolate each cabinet from the system when not in use.

7.168 Roof-level discharge, wherever practicable, is preferred since it removes much of the uncertainty over air re-entering the building through ventilation inlets and/or windows. In such an installation, the extract fan should be situated separately from the cabinet and close to the discharge outlet, to maintain the duct within the building under negative pressure. The discharge point on a flat roof should be through a 3m high terminal. This is required to safeguard staff who may need to access the roof periodically for maintenance. This requirement will also be applicable to fume-cupboard discharges.

7.169 Where this is impracticable, discharge into the room via a double HEPA filter has been accepted. The preferred method, however, is to discharge 3m above the roofline in line with the similar standard for fume cupboard designs.

Arrangements for fume cupboard installations

7.170 The manufacture and installation of fume cupboards must be in accordance with the relevant national standards and associated guidance.

7.171 The primary factors that contribute to the effective performance of fume cupboards include:

- an adequate volume of supply air;
- an effective exhaust system to promote the safe dispersal of waste products to atmosphere.

7.172 The air velocities through sash openings must be sufficient to prevent hazardous materials from entering the laboratory while avoiding excess flow rates that interfere with the investigation process. Average face velocities should be between 0.5 and 1.0 m/s, with a minimum at any point within 20% of the average, the upper end of the range being applicable to the containment of materials of high toxicity. The design velocity must be maintained irrespective of whether the sash opening is varied, or whether doors or windows are open or closed. Variable Air Volume (VAV) cupboards are available which offer a reduction in energy use.

7.173 The possibility of a fire or explosion that may not be contained by a fume cupboard must always be considered. A fume cupboard should not, therefore,

be sited in a position where exit to an escape route will necessitate passing directly in front of it.

7.174 Fume-cupboard fans should be installed as near as possible to the termination of the duct, thus maintaining the maximum amount of ductwork at negative pressure.

7.175 Where there are adjacent buildings with opening windows, or where downdraughts occur, it may be necessary to increase the height of discharge ducts in order to achieve adequate dispersal. In complex locations, airflow modelling or wind tunnel tests may be required to determine the optimum height of the stack (see also Paragraph 7.167).

7.176 Fume-cupboards for certain processes must have separate extract systems. However, where appropriate, individual fume-cupboard exhaust systems may discharge via non-returning dampers into a single collection duct rather than having a large number of separate stacks. The collection duct should have a large cross-sectional area to minimise its effect on the individual exhaust systems; be open to atmosphere upstream of the first connection; and be designed to discharge a total air volume at least equal to the combined individual extract systems.

7.177 Individual fume-cupboard extract systems, discharging either directly to atmosphere or into a collection duct, do not require duplex fans. However, a collection duct designed to provide dispersal of effluent from a number of individual extracts, should have duplex fans with automatic changeover.

7.178 Some fumes are particularly corrosive, so the choice of material for the ductwork, and type of extract fan fitted should reflect the nature of the fume being conveyed.

Control of extract systems

7.179 It is desirable to provide local control of safety cabinets in order to maximise the life of the HEPA filter, and to permit the sealing of the cabinet and room for fumigation if spillage occurs.

7.180 To cope with the risk of an accident or spillage outside safety cabinets, a ‘panic button’ should be provided to switch off the supply to that area; and discharge all extracted air to atmosphere.

7.181 In pathology departments, it will be necessary to have one or more microbiological safety cabinets and one or more fume cupboards available for use at all times, including weekends, therefore, local overriding controls for all these items and any associated ventilation plant will be necessary.

7.0(d) Plantroom ventilation

General requirements

7.182 Plant rooms are required to be ventilated in order to maintain acceptable temperatures for satisfactory operation of the plant and controls, and for

maintenance activities. In the case of plant rooms housing combustion equipment, a secondary function of the ventilation is to provide make-up air for the combustion process.

7.183 The air required for these purposes should be introduced into the space through inlets positioned to minimise the discomfort to occupants; they should be unlikely to be blocked, closed deliberately (except in the case of fire shutters if required), or rendered inoperative by prevailing winds.

7.184 Plantroom ventilation air should not be used for any other purposes, such as make-up air for extract; and where the plantroom contains combustion equipment, the appliance pressure must not fall below the outside air pressure.

7.185 Specialised healthcare air handling equipment must not be located in a fire compartment that houses combustion equipment.

7.186 Statutory regulations for plantroom ventilation are contained in the Scottish Building Regulations, and further guidance is given in CIBSE Guides A & B.

Assessment of ventilation levels

7.187 Ventilation requirements must take into account all heat sources within a plantroom, and where there are large glazing areas, solar gains. The ventilation rate should limit the maximum temperature within the plantroom to 32°C.

7.188 As the level of equipment operating during mid-season and summer is often lower than the winter condition, and the cooling effect of the outside air is reduced, it is necessary to calculate the minimum volume for each season of operation, and the inlet and outlet grilles or fan sizes should be chosen to cater for the largest seasonal air volume.

7.189 Replacement air should not be drawn through pipe trenches or fuel service ducts. Where metal ducts penetrate walls and floors, effective sealing should be provided to confine the ventilation to the boiler room and to meet fire protection requirements. Penetration of fire barrier walls by ventilation ducts should be avoided if possible.

7.190 Fire dampers in plant room ventilation ducts should be electrically interlocked with the boiler plant.

7.191 Care must be taken to prevent any noise generated in the boiler room emerging from natural or mechanical ventilation openings to the detriment of the surrounding environment. Particular care is necessary with mechanical flue draughts and fan-diluted flue systems.

7.192 Information on required air volumes in contained in the CIBSE Guide A & B.

7.193 Where combustion plant is installed, the high-level (outlet) openings should be sized to cater for the total ventilating air quantity; and the low-level (supply) openings sized to cater for the total combined ventilating and combustion air quantity.

Choice of ventilation system

7.194 Ventilation air may be introduced and exhausted by either natural or mechanical means or a combination of both. However, natural systems are preferred where possible.

7.195 Generally, small installations at or above ground level should have their combustion and ventilation air provided by natural means, employing both high- and low-level openings.

7.196 Basement, internal and large installations at or above ground level will usually require a combination of natural and mechanical ventilation. If the airflow rate is difficult, both supply and extract may require mechanical means.

7.197 Whether natural or mechanical, the system should be designed to avoid both horizontal and vertical temperature gradients. Both inlet and outlet openings should be placed on opposite or adjacent sites of the building to reduce the effect of wind forces.

7.198 Where mechanical air supply is employed, electrical interlocks with the boiler plant should be provided to prevent damage in the event of failure of the supply fan(s) once the air volume is established.

7.199 The necessary free opening areas for a naturally ventilated plantroom may be calculated using either the method in A4 of the CIBSE Guide A or the table in section B13 of CIBSE Guide B.

7.200 A combined natural and mechanical ventilation system should allow for natural extract at high level, to take advantage of convective forces in the room, with mechanical supply at low level. The high level natural ventilators should be sized to cope with the total quantity of ventilation air, as above.

7.201 To prevent leakage of flue gases and to ensure that the flue draught is not impeded at any time, the air pressure in the boiler room must not exceed the prevailing outside pressure. Therefore, the fan duty should exceed the calculated total combined combustion and ventilation air quantity by at least 25%. Fan-powered inlets should be arranged to flow outside air into the space at a point where cross-ventilation will ensure pick-up of heat without causing discomfort to occupiers.

7.202 Where it is impractical to provide sufficient natural ventilation to remove the heat emitted by the plant, both mechanical supply and extract will be required.

7.203 The high-level extract should be sized to cater for the total ventilating air quantity and the low-level supply should exceed the total combined combustion and ventilating air quantity by at least 25%, as above.

7.0(e) Ventilation of hydrotherapy suites

General requirements

7.204 In a hydrotherapy suite heat recovery should be via heat pump.

7.205 The quantity of supply air should be calculated as 25 litres/sec/m^2 wetted surface, with the wetted surface taken as 110% of the pool water surface area.

7.206 A re-circulation plant is recommended, with a minimum of 20% fresh air.

7.207 As far as practicable, re-circulated pool air should be provided to the ancillary changing and recover accommodation, with the only extract from the toilets, laundry/utility room and pool hall.

7.208 Supply air to the pool hall should be introduced at high level and directed towards the perimeter to mitigate condensation, with extract air taken from directly over the pool. Dampers should not be located over the pool water.

Control of hydrotherapy pool installations

7.209 The supply and extract fans should be interlocked so that the supply fan does not operate until flow is established within the extract system.

7.210 Time-clock control should be provided, with a local override switch to extend the normal operating period as required.

7.211 Night setback temperature (in the range of 21°C -25°C) and high humidity control (in the range of 60-75% sat) should be provided to override the time clock in order to prevent condensation. The exact set points should be ascertained post-installation.

7.212 A remote indication panel should be provided in the pool hall, giving a visual display of the pool water and pool air temperature.

8. Validation of specialised ventilation systems

Definitions

Commissioning - Commissioning is the process of advancing a system from physical completion to an operating condition. It will normally be carried out by specialist commissioning contractors working in conjunction with equipment suppliers. Commissioning will normally be the responsibility of the main or mechanical services contractor.

Validation - A process of proving that the system is fit for purpose and achieves the operating performance originally specified. It will normally be a condition of contract that "*The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life.*"

Note: Commissioning is often sub divided into sections e.g. air handling unit, automatic controls, airside balance, building fabric and fittings. Each section may be commissioned by its specialist installer and they are often accepted in isolation. Validation differs from commissioning in that its purpose is to look at the complete installation from air intake to extract discharge and assess its fitness for purpose as a whole. This involves examining the fabric of the building being served by the system and inspecting the ventilation equipment fitted as well as measuring the actual ventilation performance.

It is unlikely that 'in house' staff will possess the knowledge or equipment necessary to validate critical ventilation systems such as those serving operating suites, pharmacy clean rooms and local exhaust ventilation systems. Validation of these systems should therefore be carried out by a suitably qualified independent Authorised Person appointed by the NHS Board.

It is anticipated that training in the validation of specialised healthcare ventilation systems for independent Authorised Persons will become available during the life of this SHTM.

Commissioning general

8.1 Commissioning is an essential process for ventilation systems. It is therefore important that adequate provision for the process be made at the design stage of the project. Procedures for commissioning air-handling systems are given in CIBSE Commissioning Codes and BSRIA Application Guide Set COMPAK 1.

8.2 The duct-sizing procedure should take into account the requirements of system balancing, and the position and number of regulating dampers included in the design should be sufficient for this purpose.

Location of dampers and test holes

8.3 Balancing/commissioning dampers will be required in each branch of the distribution ductwork.

8.4 Test holes for the measurement of air-flow will be required at carefully selected points in main and all branch ducts. The number and spacing of holes are given in the BSRIA Application Guide Set COMPAK 1. Their positions must be identified at the design stage.

8.5 The test positions need to be accessible for commissioning to take place. They may also be required for subsequent annual verification of the system performance, so they should not be covered by permanent lagging.

8.6 The measurement point should be in a straight length of duct as far away as possible from any upstream bends, dampers or other elements that could cause disturbance to the airflow. The actual location should be:

- at least 1.5 duct diameters upstream of sources of turbulence such as dampers and bends;
- if this is not possible, 10 diameters downstream of dampers, bends or tees, and 5 diameters downstream of eccentric reducers;
- where there is enough space round the duct to insert the pitot tube and take readings;
- where the duct has a constant cross-sectional area.

8.7 Test holes for measuring total airflow from a fan should be located either 4 diameters upstream or 10 diameters downstream of the fan. Provision should also be made for measuring the speed of rotation.

Information to be provided

8.8 It is essential that the designer should pass on his intentions fully to the commissioning engineer by indicating which parts of the system are high, medium and low pressure, and by providing:

- relevant parts of the specification;
- schematic drawings indicating performance data as indicated in Table 8;
- equipment schedules;
- controller and regulator schedule;
- fan performance curves;
- wiring diagrams for electrical equipment, including interlock details.

Items in system	Information to be provided
Fans	Fan total pressure Volume flow rate at high and low speed Maximum motor current
Plant items	Type and identification numbers from equipment schedules Fluid and air volume flow rates Fluid and air side pressure losses Dry bulb temperatures Wet bulb temperatures Humidity
Dampers, including motorised and fire dampers	Identification numbers from equipment schedules Location Identification number Volume flow rate
Main and branch ducts	Dimensions Volume flow rates and velocities Identification numbers from equipment schedules
Terminal	Location Identification number Grille or diffuser factor Volume flow rate and neck velocity Operating static pressure
Test holes and access panels	Location Identification number
Controllers	Set points

Table 8: Information to be provided on schematic drawings

Notes: For Table 8

1. Fan total pressure is the difference between the total pressure (static pressure + velocity pressure) at the fan outlet and the total pressure at the fan inlet.

2. Where volume flow rates are variable, maximum and minimum values should be provided.

Commissioning personnel

8.9 As one individual is unlikely to possess all of the required commissioning skills, a commissioning team is therefore usually needed. The objective of commissioning is to ensure that the necessary performance and safety requirements are met.

8.10 During the commissioning process a great deal of information will be generated which will form an invaluable future source of reference about the plant. It is essential to ensure that it is collected together in the form of a commissioning manual and handed over to the client on completion of the contract together with the 'as fitted' drawings. This information should be both in hard copy and electronic format.

8.11 In order to be successful the commissioning process must start before achieving practical completion as many parts of the system will become progressively less accessible. The correct installation of those parts will need to be witnessed and leak-rate tests carried out as construction proceeds. Failure to establish responsibility for commissioning early enough will delay the completion of the project or lead to unsatisfactory plant performance.

Commissioning brief

8.12 The commissioning team will require a detailed brief from the system designer. This should include:

- a 'user' brief comprising a description of the installation and its intended mode of operation;
- the precise design requirements with regard to the scheme of air movement, room static pressures, supply and extract air-flow rates and acceptable tolerances;
- full details of the design conditions both inside and out, for winter and summer together with the control strategy;
- equipment manufacturer's type test data, commissioning, operation and maintenance recommendations;
- drawings showing the layout of the system, positions of air-flow measurement test points, dampers, regulating devices and filters within the duct runs, together with sizes of ducts and terminal fittings. It will save time if these drawings are annotated with the design volumes and static pressures required at each branch and outlet point;
- wiring diagrams for all electrical equipment associated with the air handling systems including motor control circuit details and any interlocking and safety devices such as emergency-stop buttons adjacent to the item of plant.

8.13 The CIBSE Commissioning Code, Series 'A' – "Air Distribution", provides full guidance on the information that will be required by the commissioning team.

8.14 The designer should include in the contract document instructions on verifying the accuracy of test instruments that should be supported by reference to relevant calibration certificates.

8.15 The system, on completion, should be operated by the contractor as a whole and subject to performance tests in accordance with the contract requirements. For critical systems, these may include independent validation of the system performance on behalf of the client.

8.16 Prior to dynamic commissioning, it is essential that builders' work in the area served by the system is complete, all rubbish and dust is removed, concealed plumbing (IPS-type) panels are in position and ceiling tiles are in place and clipped. Floors should be mopped and visible dust removed from all other surfaces.

8.17 Once the system is shown to meet the design intent the handover documentation should be completed. In the event of performance not being acceptable, the matter should be dealt with in accordance with the contract arrangements.

Pre-commissioning checks

8.18 The pre-commissioning checks consist of visual inspection, manual operation of equipment, static measurements and functional tests of individual components. They should be carried out prior to setting the system to work and undertaking the dynamic commissioning process set out in Paragraph 8.29 onwards of this guidance.

Standard of installation

8.19 During the installation of the system the following must be witnessed:

- that the plant and installations have been provided and installed in accordance with the design specification and drawings;
- that only approved sealants have been used in the installation;
- that all components function correctly;
- that the satisfactory sealing of access doors and viewing ports have been carried out;
- that air pressure tests and air-leakage tests on ventilation ducting have been carried out in accordance with the methods set out in the HVCA's DW/143: Ductwork Leakage Testing. It is usual to carry out these tests, a section at a time, as the ductwork is installed and before its insulation is applied. The results must be recorded in the commissioning manual;
- that gaps around doors and hatches are as specified in the design;
- that the correct operation of pressure stabilisers, control dampers, isolating and non-return dampers have been checked and installed in the correct orientation for air-flow;
- that test holes have been provided in their specified locations and are sealed with suitable grommets;
- that control dampers are secured and their quadrants fitted correctly;
- that any interlocks are operative and in accordance with specification;
- that the electric circuits are completed, tested and energised;
- that electric motors have been checked for correct direction of rotation both at full speed and set-back;
- that cooling and heating media are available at correct temperatures and pressures and in specified quantities;
- that the air-conditioning plant components and controls function correctly;
- that the air-conditioning plant interlocks and safety controls function correctly;

- that the plant is physically complete, insulation is applied and all ducts and pipework are identified as specified;
- that the building housing the ventilation plant is generally in a fit condition for commissioning and performance tests to commence, that is, windows, doors, partitions etc are completed, surfaces sealed and their final finish applied;
- that the areas containing the ventilation plant and those being served by it are clean;
- that access to all parts of the system is safe and satisfactory.

Cleanliness of installation

8.20 During installation it must be established that ductwork is being installed to the 'advanced level' as defined in the HVCA (2005) 'TR/19 – Guide to good practice: internal cleanliness of ventilation systems'. This specifically includes ensuring that ductwork sections arrive on site and are stored with their open ends sealed and that open ends remain sealed during installation to prevent the ingress of builders' dust.

8.21 Should any doubt exist whether the guidance has been observed, the ducts must be cleaned internally to restore them to this standard before being taken into use.

8.22 "Builders work" ducts of brick or concrete must be surface sealed to prevent the release of dust before being taken into use.

8.23 The area around the supply air intake must be free of vegetation, waste, rubbish, builders' debris or any other possible source of contamination.

Certification of equipment

8.24 The following test certificates should be assembled by the commissioning team and be available for inspection at any time during the contract period. They will form part of the handover information and should be placed in the commissioning manual:

- type-test performance certificates for fans;
- pressure-test certificates for:
  - heater-batteries;
  - cooling coils;
  - humidifiers (if appropriate);
- type-test certificates for attenuators;
- type-test certificates for primary and secondary filters;
- individual test certificates for high efficiency particulate air (HEPA) filters.

Equipment tests

8.25 Prior to setting the system to work, the checks in Paragraphs 8.26 - 8.28 should be witnessed, and proving tests should be carried out as detailed.

Filters

8.26 The quality of filter housing and in particular, the seals is a critical factor in maintaining the efficacy of the filtration system by ensuring that air does not bypass the filter panels. Therefore, the following checks should be made:

- filter seals should be fitted and in good condition;
- filters should be installed correctly with respect to air flow;
- bag filters should be installed so that the bags are vertical and their pockets free;
- HEPA filters should be installed in a sealed housing and their seals tested to DIN 1946 if specified;
- all filters should be checked to ensure they are free of visible damage;
- the differential pressure indicators should be checked for accuracy and that they are marked with the initial and final filter resistance.

Drainage arrangements

8.27 The drain should conform in all respects to the “Design considerations” of this SHTM. In addition the following must be proved:

- that the drain tray is easily removable;
- that a clear trap is fitted and is easily removable;
- that the drain has a clear air gap of at least 15mm;
- that the pipework is supported so that the air break cannot be reduced;
- that the drain system from each drain tray is independent up to the air break;
- that the operation of the drainage system is proved by introducing water into the duct at the drain tray and observing that it completely drains out. This check is to be repeated both at normal speed and set back once the fans have been commissioned. At this time the clear trap can be marked to indicate the normal water level with the fan running.

Fire dampers

8.28 The following must be witnessed and proving tests should be carried out as detailed:

- the operation of all fire dampers;
- the access provided to enable the dampers’ to be visually inspected and / or re-set should be sufficient for the purpose;

- indication should be provided of the dampers' position (open/tripped);
- indication of the fire dampers' location should be provided both on the ductwork and at a visible point on the building fabric if the ductwork is concealed.

Dynamic commissioning

Air-handling and distribution system

8.29 The fan drive, direction of rotation, speed and current drawn should be set in accordance with their manufacturer's instructions.

8.30 After the installation has been checked to ensure that it is in a satisfactory and safe condition for start-up, it should be set to work and regulated to enable the plant to meet its design specification. The proportional balancing method described in the CIBSE Commissioning Code "A" must be followed. The air-flow rates must be set within the tolerances laid down in the design brief. This will normally be the design airflow rate +10% -0%.

8.31 When combined supply and extract systems are to be balanced and the area that they serve is to be at or above atmospheric pressure then the supply should be balanced first with the extract fan switched off, and then the extract balanced with the supply fan(s) on.

8.32 For combined systems where the area that they serve is to be below atmospheric pressure then the extract should be balanced first with the supply fan switched off and then the supply balanced with the extract fan on.

8.33 On completion of the balance all volume air-flows in supply and extract ducts and from grilles and diffusers must be measured and recorded. The true air change rate can them be calculated from the data obtained.

8.34 The main supply and extract duct volume control dampers must be locked and their position marked.

8.35 All grille and diffuser volume control registers must be locked to prevent alteration and their final position marked.

Room air distribution

8.36 The pressure-relief dampers and pressure stabilisers must be set to achieve the specified room static pressures and locked. The grille direction control vanes and diffuser cones must be set to give the specified air-movement pattern. Visualisation techniques may need to be employed in order to prove that the required air-flow pattern is being achieved. This may be a potential requirement when commissioning LEV systems or rooms that contain them.

Air-conditioning plant

8.37 The specified flow rate and/or pressure drops must be set for all heater batteries, cooling coils and humidifiers. The methods described in the CIBSE

Commissioning Codes “W” and “R” should be followed. On completion their regulating devices must be locked to prevent alteration.

Control system

8.38 The control system should not be commissioned until both the air distribution system and air-conditioning equipment have been commissioned.

8.39 Because of the specialised nature of control systems and the fact that each manufacturer’s system will contain its own specialist components and settings, the commissioning should be completed by the supplier and witnessed by a representative of the user.

8.40 The location of all control and monitoring sensors should be checked and their accuracy proved.

8.41 The control system’s ability to carry out its specified functions must be proved.

8.42 If the plant is provided with a “user’s” control panel in addition to the one located in the plantroom then the operation of both must be proved. This will typically apply to operating departments and laboratory systems.

Specific performance standards

Air movement

8.43 The performance of the system should be measured and compared with information provided by the designer.

Plant capacity and control

8.44 When setting to work and proving the design, both the manufacturer of the air-handling plant and the control specialist should attend site together and jointly commission the system.

8.45 If any doubt exists as to the capacity of the installed system, then its ability to achieve the specified inside design conditions with the plant operating at winter and summer outside design conditions must be proved. Artificial loads will be required in order to simulate the internal gains/losses and the outside design conditions.

8.46 On completion of the plant performance test, recording thermo-hygrographs should be placed in each room/area served by the plant and also the supply air duct upstream of the frost battery. The plant should be run for 24 hours with all doors closed. During this period the inside conditions must stay within the tolerances specified. The BEMS should be used to obtain the information required wherever possible. Periodic tests will be required during the defects liability period.

Noise levels - general

8.47 The commissioning noise level is the level measured with a sound-level meter in the unoccupied room and taking account of the external noise together with the noise generated by the ventilation system. When occupied and in use this commissioning level will constitute a continuous background noise that will allow the overall noise level to be achieved. The ventilation plant design noise level is that generated by the plant alone with no other noise source being considered. The levels suggested make recognised allowance for the ingress of environmental noise.

8.48 The noise levels apply at the maximum velocity for which the system is designed to operate. Acoustic commissioning tests should be carried out with all plant and machinery running normally and achieving the design conditions of airflow, temperature and humidity.

8.49 An industrial-grade sound-level meter to BS3489 or IEC 651 Type 2 will normally be sufficient to check the noise level.

8.50 The noise level readings are to be taken at typical normal listening position 1.5m above floor level and at least 1m from any surface and not on any line of symmetry. In critical rooms the noise should be measured at the centre of the room and at the centre of each quarter. The mean of the 5 readings should then be calculated.

8.51 In the event of a contractual deficiency, a Type 1 precision-grade sound-level meter should be used and the noise level determined by the procedure given in Scottish Health Technical Memorandum 08-01 (2011).

Filter challenge

General ventilation filters

8.52 In-situ performance tests will not normally be required for primary and secondary filters and their housings. However the filters should be visually inspected for grade, tears, orientation and fit within their housing. Filters should be clean and a replacement set available. Bag filters should be installed so that their bags are vertical and spaced so that air can move through them freely. Any filter found to be wet should be replaced and the cause investigated.

HEPA filters (for exhaust protective enclosures and laboratories)

8.53 Pathogenic material may be discharged through damaged or badly installed HEPA terminal filters. The complete installation must be tested using the method set out in BS EN: 14644 ‘Method of Testing for the Determination of Filter Installation Leaks’.

8.54 The challenge tests may be carried out using either of the following techniques:

- use Dispersed Oil Generator (DOP) to provide the challenge and a photometer to detect leaks;

- use a Discrete Particle Counter (DPC) to detect leaks. (In order to obtain a sufficient challenge it may be necessary to remove temporarily the supply AHU secondary filters).

8.55 In both cases the upstream challenge should be measured. A measurement of particle penetration through a representative section of the HEPA filter media is then taken and used as the reference background level. These two readings enable the range of the detecting instrument to be set.

8.56 A challenge aerosol of inert particles of the type produced by a DOP generator should be introduced into the air, upstream of the HEPA filter. The downstream face of the filter, its mounting seal and housing would then be scanned for leakage using a photometer. A leak should be deemed to have occurred if a steady and repeatable reading on the photometer at any point exceeds 0.01% of the upstream reading.

8.57 Alternatively a Discrete Particle Counter (DPC) may be used. For the Discrete Particle Counter method the filter face is sampled at several points to establish the smallest non-penetrating particle size. If particles at or above this size are detected when subsequent scans of the filter face, its seal and housing are made, then there is deemed to be a significant leak at, or near, the test position.

8.58 Should the HEPA filter fail this test it must be replaced. Should the filter mounting seal or housing fail this test it may be repaired and the test repeated.

Bacteriological sampling

General ventilation systems

8.59 Bacteriological sampling will not normally be required for either general or local exhaust ventilation (LEV) systems unless otherwise specified.

Conventional operating rooms

8.60 The level of airborne bacteria introduced by the supply air can be checked by closing all doors and leaving the operating room empty with the ventilation system running for 15 minutes. An active air sampler set to 1 cubic metre and mounted on the operating table should then be activated remotely. Aerobic cultures on non-selective media should not exceed 10 bacterial and/or fungal colony forming units per cubic metre (CFU/m^3).

8.61 The results should be examined to establish the broad category of organisms present. A high preponderance of fungal organisms may be an indication of inadequate filtration for the particular installation. Precise guidance is inappropriate and will depend on local circumstances.

8.62 It may be appropriate to carry out a check of airborne bacteria during a surgical operation. If required this should be carried out as soon as possible after handover. Unless there are unusually high numbers of personnel or extensive activity in the room, the number of airborne bacterial and/or fungal CFU

averaged over any five-minute period, would be unlikely to exceed 180 per cubic metre.

8.63 Information on the additional validation testing of UCV Operating suites is given in Section 8.0(a).

Ventilation system commissioning/validation report

8.64 Following commissioning and/or validation a full report detailing the findings should be produced. The system will only be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life.

8.65 The report shall conclude with a clear statement as to whether the ventilation system achieved or did not achieve the required standard. A copy of the report should be lodged with the following groups:

- the user department;
- infection control (where required);
- estates and facilities.

8.0(a) Validation of UCV operating suites

General

8.66 Commissioning of a UCV terminal will normally be carried out by its supplier. Commissioning of the air-handling unit, fire dampers, distribution ductwork and control systems may be undertaken by different teams. It is therefore important to recognise that the UCV terminal is only one element of the specialised ventilation system serving the operating suite and it cannot be accepted in isolation.

8.67 In order to ensure that the complete system operates correctly it will be necessary to validate the system as a whole from the air intake through to the extract discharge. It is unlikely that “in house” staff will possess the knowledge or equipment necessary to undertake this process. Validation of Ultra-Clean operating theatre ventilation systems should therefore be carried out by a suitably qualified independent Authorised Person appointed by the client.

8.68 It is anticipated that training in the validation of specialised healthcare ventilation systems for independent Authorised Persons will become available during the life of this SHTM.

8.69 The following regime of inspection and testing should be applied to the validation of new installations designed to provide Ultra-Clean conditions in an Operating suite. The test regime has been devised to ensure that the system as installed fully achieves the design requirement for these systems as set out in Section 7.0(b) of this document.

Basic requirement

8.70 The operating suite to be validated should be physically complete with final finishes applied. All ventilation systems serving it should be operating correctly and delivering the design air-flow rates.

8.71 In order to avoid pre-loading the UCV terminal's recirculation ducts and HEPA filters, the Operating suite should be free of any obvious dust and at least "builders clean" before the recirculation fans are set to work.

8.72 The validation procedure for a conventional theatre suite should have been satisfactorily completed to the standard set out in Section 8 prior to attempting to validate the UCV unit. In particular:

- the supply AHU will have achieved the minimum standard;
- the operation of all fire dampers will have been proved;
- the supply and extract air-flow rates as measured in ducts and at room terminals will achieve their design values +10%; -0%;
- room differential pressures will be correct.

Evidence of the satisfactory achievement of the foregoing standard should be available for inspection and independently measured as necessary *prior to validating the UCV unit.*

UCV unit validation procedure

8.73 Tests to validate the suitability and performance of an ultra-clean operating suite should be undertaken in the order that they appear below. Should an item fail to meet the required standard it should be rectified and successfully retested before passing on to the next test.

Summary of test regime

- Challenge tests to ensure that:
  - the UCV terminal unit is correctly assembled and sealed so that no air will bypass the filters;
  - the terminal filters are correctly sealed in their housings;
  - the terminal filters are of the same grade, of uniform quality and undamaged.
- Air velocity measurements to ensure that
  - a sufficient quantity of air is being delivered by the terminal;
  - the terminal quadrants are in balance;
  - the air flow has sufficient velocity to reach the working plane.
- An entrainment test to ensure that contaminants arising outside of the UCV terminal footprint are not drawn into it.

- Visualisation techniques to gain an understanding of the overall system performance.
- Noise measurement to ensure that working conditions are satisfactory.
- Control system checks to ensure that the system operates as specified.
- Biological monitoring to determine how effective the system is in use.

Test and measuring conditions

8.74 While validating the UCV terminal, the conditions in the Operating room shall be stable and within the given ranges.

temperature: – 19°C - 23°C dry bulb.

humidity: – 30 – 65% relative humidity.

Test and measuring equipment

8.75 Any test or measuring equipment used should have a certificate to prove that it has been validated within the previous 12 months at a calibration facility using traceable national standards.

8.76 In the case of a noise meter, its “matched sound source” should have a certificate to prove that it has been validated within the previous 12 months at a calibration facility using traceable national standards. The noise meter should be calibrated to the sound source on each occasion that it is used.

Test grid – vertical units

8.77 A test grid should be constructed on the floor within the ultra-clean terminal footprint as projected by the inside dimensions of the sidewalls or boundary air curtain. A suitably marked test sheet will provide a consistent standard of test grid.

8.78 The test grid should comprise test squares of 280mm each side.

8.79 The test grid should be aligned along the centre lines of the terminal footprint with its centre under the centre point of the terminal.

8.80 Any test square with 80% of its area within the UCV footprint should be used as a test position.

8.81 An inner zone should be designated that is not less than 36% of the total footprint. It should be made up of a number of test squares distributed symmetrically about the terminal footprint centre line. Regardless of the shape of the terminal footprint, the inner zone should comprise a minimum grid of 6 x 6 test squares.

8.82 Unless specified otherwise, a test position should be in the geometric centre of a test square.

8.83 Test position 1 should be the leftmost test square in the row nearest to the operating room wall that houses the surgeon's panel.

(For an example of a grid for a 2.8 x 2.8 metre terminal see Figure 8)

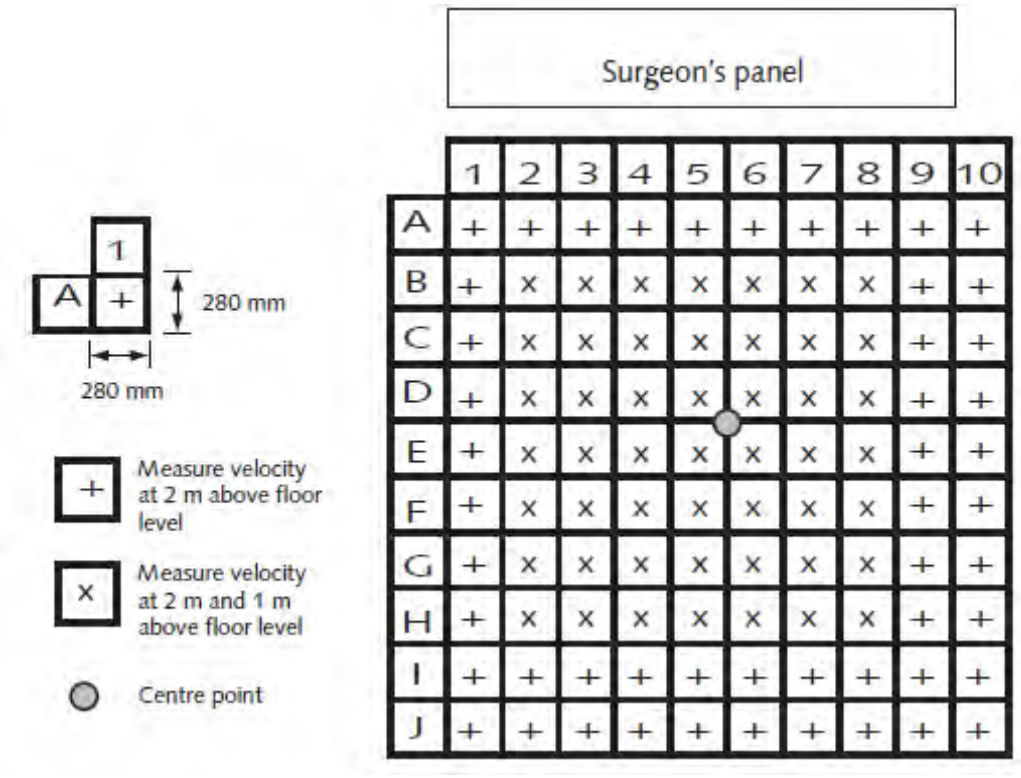


Figure 8: Example of a Test Grid for a 2.8m x 2.8m UCV Terminal

Test grid – horizontal units

8.84 A line of test positions should be marked on the floor 1m in front of the face of the UCV terminal.

8.85 A test position should be marked in the centre of the line. Additional test positions should be marked at 280mm spacing along the line either side of the centre position, up to the full-face width of the unit.

UCV terminal challenge tests (Vertical and horizontal systems)

8.86 The diffuser screen fitted below the face of the terminal HEPA filters should be lowered or removed while the challenge tests are being carried out.

8.87 The installed HEPA filters should be checked to ensure that their grade accords with the design specification and that their performance has been certified by the manufacturer.

8.88 The challenge tests may be carried out using either of the following techniques:

- use DOP to provide the challenge and a photometer to detect leaks;
- use a DPC to detect leaks. In order to obtain a sufficient challenge it may be necessary to remove temporarily the supply AHU secondary filters.

8.89 In both cases the upstream challenge should be measured. A measurement of particle penetration through a representative section of the HEPA filter media is then taken and used as the reference background level. These two readings enable the range of the detecting instrument to be set.

8.90 For the DOP test this should be set as the reference level and a leak will be declared significant if penetration greater than 0.01% of the range is detected. (See Paragraph 8.56 for details).

8.91 For the DPC method the filter face is scanned to establish the smallest non-penetrating particle size. If significant particles at or above this size are detected when subsequent scans are made then there is deemed to be a significant leak at, or near, the test position. (See Paragraph 8.57 for details)

UCV terminal unit clean zone leak test

8.92 This test will confirm that there is no unfiltered air bypassing the HEPA filter.

8.93 The joints and service penetration points under the UCV terminal within its side walls or boundary air curtain should be scanned to prove that there are no leaks.

8.94 A leak is defined as a significant rise above the background level.

Terminal HEPA filter seal leak test

8.95 The test will confirm that there is no unfiltered air bypassing the HEPA filter's seal.

8.96 Each HEPA filter's seal should be scanned to prove that there are no leaks.

8.97 A leak is defined as a significant rise above the background level.

Terminal HEPA filter media leak test

8.98 The test will confirm that the HEPA filters have not sustained damage while being installed.

8.99 The face of each HEPA filter should be scanned to prove that there are no leaks.

8.100 A leak is defined as a significant rise above the background level.

Vertical UCV terminal air velocity tests

Test set up

8.101 The terminal face diffuser screen should be in place for these tests.

8.102 Take spot readings to establish that the room is within the specified temperature and humidity test conditions.

8.103 Set out the test grid as described previously.

8.104 Swing the operating lamp arms and any other stem arms so that they align to present the least resistance to air flow, are perpendicular to the front edge of the test sheet and face the back edge. Any lamp and equipment heads should as far as practicable be outside of the UCV terminal footprint.

Test instrument

8.105 The measuring instrument should be a hot-wire anemometer with a digital read-out. The instrument resolution should be at least 0·01m/s, have a tolerance of ±0·015 m/s or 3% of that reading and be calibrated down to 0·15 m/s or lower. An alternative instrument may be used providing it is of no lesser specification.

Test method

8.106 The instrument should be mounted on a test stand and set to take a mean reading over a ten-second sample interval.

8.107 It is recommended that a printer be linked to the test instrument so that readings are recorded automatically. Alternatively they could be downloaded to a computer or data logger at the end of the test.

8.108 The test stand to be positioned on each test point in turn and the reading taken when the instrument has stabilised.

8.109 When taking a reading the test person should not stand within the same quadrant as the test instrument.

8.110 Readings are to be taken at the test positions with the instrument probe facing the wall housing the surgeon's panel, commencing at the first test position. Readings are taken working along the row from left to right and back, or for all text positions in one quadrant at a time.

8.111 When all test positions under one half of the terminal have been covered, readings of temperature and humidity are then taken at the specified height in the centre of the terminal. The read-outs on the surgeon's panel should be recorded at the same time.

8.112 Having completed one half of the test grid, the operating lamp arms and any other stem arms should be swung round through 180º and the test stand reversed so that the wall housing the surgeon's panel is behind the test person. Readings are recommenced starting at the right of the test row and working from right to left a quadrant at a time, as above.

UCV high-level discharge velocity test

8.113 Measurements of air velocity are to be taken at every test position 2m above floor level and the results averaged.

8.114 The average of the total readings taken is to be not less than:

0.38 m/s for a partial-wall system;

0.30 m/s for a full-wall system.

The average air velocity for each quadrant should not exceed ±6% of the measured average velocity for the terminal

UCV low-level air velocity test

8.115 Measurements of air velocity are to be taken at each of the inner zone test position 1m above floor level.

8.116 The measured velocity at every test position in the inner (operating) zone shall be not less than 0·2 m/s.

Horizontal UCV terminal air velocity test

Test set up

8.117 Set out the line of test positions as described previously.

8.118 Swing the operating lamp arms and any other stem arms so that they align to present the least resistance to air flow and are perpendicular to the line of test positions.

Test instrument

8.119 See that specified for vertical systems (Paragraph 8.105 refers).

Test method

8.120 The instrument should be mounted on a test stand and set to take a mean reading over a ten-second sample interval.

8.121 It is recommended that a printer be linked to the test instrument so that readings are recorded automatically. Alternatively, they could be downloaded to a computer or data-logger at the end of the test.

8.122 The test stand should be positioned on each test point in turn and the reading taken when the instrument has stabilised.

8.123 When taking readings the test person should stand well downstream of the instrument.

8.124 Readings are to be taken at the test positions with the instrument probe facing the UCV terminal, commencing at the first test position on the left and working along the row from left to right at the specified height.

8.125 The instrument should be reset to the next specified height and the test repeated and so on.

8.126 Readings of temperature and humidity should be taken at the specified height in the centre of the terminal. The read-outs on the surgeon's panel should be recorded at the same time.

UCV discharge velocity test

8.127 Measurements of air velocity are to be taken at all test positions at 1m, 1·5m and 2m above floor level.

8.128 The average of the total readings taken should be no less than 0·4 m/s.

UCV entrainment test (Vertical systems only)

Rationale for the entrainment test

8.129 The performance of UCV systems may be compromised by room air being drawn into the ultra-clean airflow, a phenomenon known as “entrainment.” Significant levels of entrainment could lead to microbial contamination of items left exposed on instrument trolleys laid out beneath the canopy.

8.130 UCV systems having permanently fitted full sidewalls do not need to be tested, as the sidewalls physically prevent entrainment.

Principle of the test

8.131 A source of particles is produced outside of the UCV terminal and is used to challenge the system. A detector is placed within the ultra-clean airflow and used to determine the percentage penetration of the test particles at predefined locations under the UCV terminal footprint. The source and detector are moved in tandem around the UCV canopy and pairs of readings taken, from which the percentage penetration at specified locations is calculated. The degree of penetration should be below specified maximum limits if entrainment is to be declared not significant.

8.132 The entrainment test may be carried out using either of the following techniques:

- use DOPs to provide the challenge source at the specified release position and a photometer to measure the entrainment; or
- duct non-HEPA-filtered air to the specified release position and use a DPC to measure the entrainment.

Test set-up

8.133 The terminal face diffuser screen should be in place for these tests.

8.134 The test should be performed without any equipment in place beneath or closely adjacent to the UCV terminal.

8.135 The theatre lights should be moved to a central position beneath the terminal and raised to 2m above floor level, so as not to interfere with the peripheral airflows.

8.136 Take spot readings at the centre of the canopy, one metre from floor level, to establish that the room is within the specified temperature and humidity test conditions.

8.137 Set out the test grid as described previously.

8.138 For either of the following entrainment tests, a measurement of particle penetration through a representative section of the HEPA filter media is to be taken and used as the reference background level.

Test equipment, challenge source, measuring instrument and detector head

8.139 The challenge and detector equipment should be chosen so that:

- the tracer particles are mainly within the size range 0.3 to 5 microns and thus capable of remaining airborne for a substantial time;
- the particles used should not be able to penetrate the terminal filters in sufficient numbers to cause a background count that is more than 0.1% of the challenge count;
- the choice of particle and detector will enable a minimum of a three-logarithm (1,000-fold) range of counts to be recorded between the highest (that is, source) and lowest (that is, background) readings expected. (A concentration of approximately 10^5 particles per cubic metre of source air has been shown to be adequate.)

Source – Dispersed Oil Particles (D.O.P.)

8.140 The DOP generator should be able to produce a cloud of test particles in the form of a visible smoke. The test smoke should be delivered via an aperture so that it flows vertically downward from the lowermost edge of the partial wall, on the outside of the UCV canopy.

8.141 The test smoke is to be delivered via an aperture.

Note 4: To prevent undue contamination of the theatre and filters with deposits of oil, DOP should only be released for the minimum amount of time necessary to complete the test.

Challenge source – natural particles

8.142 The source unit should be a fan/blower or other method that takes non-HEPA-filtered air and expels it via a delivery head at the specified release position to provide the particle challenge. The challenge air should be delivered vertically downwards from the lowermost edge of the partial wall, on the outside of the UCV canopy, parallel to the airflow coming from the diffusers. The challenge air velocity should be the same as the measured average velocity at 2m from the terminal under test.

Note 5: The use of DOP for testing is gradually being phased out and replaced by a natural challenge measured with a DPC. At the time of writing research is under way to define more precisely a challenge source unit for natural particles. It is anticipated that such a unit, together with a matching test methodology, will become available during the life of this Scottish Health Technical Memorandum.

The detector (defined in terms of range and resolution)

8.143 This may be a photometer or a DPC. It is recommended that a printer be linked to the test instrument so that readings are recorded automatically. The instrument should be capable of sampling a minimum a 28.3 litres of air per minute and in the case of the DPC, provide readings for particle size ranges from 0.3 microns to 5.0 microns and greater. The instrument should be compliant with the requirements of BS EN ISO 14644-1. An alternative instrument may be used providing it is of no lesser specification.

Test positions and orientation of source and detector

8.144 The test positions should be at the centre of each test square, as defined for the velocity test.

8.145 For rectangular UCV terminals, measurements of penetration are to be taken at the four corner test squares of the test grid and at intermediate positions along the line of test squares between the corners. The number of intermediate test positions will be as equally spaced as possible around the periphery with no fewer than 3 and no more than 5 complete test squares between test positions.

8.146 A further series of measurements are to be obtained around the periphery of the inner zone. Measurements of penetration are to be taken at the four corner test squares of the inner zone of the test grid and if necessary at intermediate positions along the line of test squares between the corners as equally spaced as possible, with no fewer than 3 and no more than 5 complete test squares between test positions.

8.147 A single measurement should be taken at the geometrical centre of the UCV terminal footprint. The centre measurement will be taken with the detector head mounted vertically upwards 1 metre above floor level.

8.148 The centre of the challenge particle source should be aligned with the centre of the designated test square, with its longer edge against the outer edge of the partial wall and delivering the challenge from the lower edge of the partial wall. The air containing challenge particles is directed vertically downwards from the lower edge of the partial wall, in a plane parallel to the adjacent partial wall. Where there is physical interference due to obstructions such as gas pendants, the source will be moved to the next available non-obstructed test-square location nearest to the stipulated sampling position. The detector should then also be moved to remain opposite the source.

8.149 In the case of non-rectangular terminals, an interpretation of the above strategy should be adopted that will yield a no less searching examination of the unit's ability to control entrainment.

Test method

8.150 The sampling head of the detector instrument is mounted on a test stand with its sampling orifice facing outwards horizontally from the centre of the UCV canopy, 1m above floor level. The sampling head should be orientated at right angles to the partial wall when sampling along the sides of the test grid but will be set to bisect the angle when measuring at the corner test positions (Figure 88 illustrates the challenge and detector orientations when evaluating a 2.8m x 2.8m UCV terminal).

8.151 The test will commence at the first test position, this being designated the leftmost corner of the test grid when facing the wall housing the surgeon's panel. The penetration will also be measured at the corresponding test point on the inner zone commencing at the corner nearest to the first test position. When these tests have been completed, the source and detector equipment should be moved to the next test positions, working around the test grid in a clockwise direction.

8.152 The test stand should be positioned on each test point in turn and a pair of readings (challenge, then penetration) taken when the instrument has stabilised. The detector should be set to take a reading over a 15 second sample interval.

8.153 When taking a reading the test person should stand within the UCV terminal footprint but not in the same quadrant as the detector head.

Analysis and interpretation

8.154 The following standard is to be achieved:

- penetration to be not greater than 10% of the challenge at each test position in the outer zone;
- penetration to be no greater than 1% of the challenge at each test position in the inner zone;
- penetration to be no greater than 0·1% of the challenge at the centre of the test grid.

If a result is close to, or above the given limits, then a further reading must be obtained using a longer time base (1 minute) and the penetration must not exceed the given limit.

Basis of the test

8.155 Whyte W, Shaw BH, Freeman MAR. An evaluation of a partial-walled laminar-flow operating room. *J Hyg Camb* 1974; 73: 61 – 75.

Whyte W, Lidwell OM, Lowbury EJL, Blowers R. Suggested bacteriological standards for air in ultraclean operating rooms. *J Hosp Infect* 1983; 4: 133 – 139.

UCV visualisation

8.156 The use of smoke to gain an understanding of the overall performance of the system may prove useful at this stage in the validation process but cannot be relied on to produce a contractually definitive measure of performance.

UCV noise level

8.157 An industrial-grade sound-level meter to BS EN 61672 Type 2 fitted with a muff should be used to check the noise level. The instrument should be calibrated using a matched sound source prior to each set of readings.

Vertical systems

8.158 The noise level readings should be taken at typical normal listening positions 1·5m above floor level and at least 1m from any surface and not on any line of symmetry. Measurements should be taken under the centre of each quadrant of the UCV terminal and the four readings averaged.

Horizontal systems

8.159 The noise level readings are to be taken at typical normal listening positions 1·5m above floor level on the test line. The width of the unit should be divided in two and a measurement taken in the centre of each half but avoiding any line of symmetry. The two readings should be averaged.

8.160 Measurements should also be taken in each room of the suite.

8.161 In the event of a contractual deficiency a Type 1 precision-grade sound-level meter complying with BS EN 61672 should be used. Readings should be taken at the positions specified above and in each case the logarithmic mean of the results should be calculated in order to determine the noise level. Further information can be found in SHTM 08-01 (2011).

8.162 For vertical or horizontal systems, the noise level shall not exceed:

- 50NR [55dB(A)] – for UCV operating rooms and spaces without doors that open directly on to it (for example the scrub);
- 40NR [45dB(A)] – for all other peripheral rooms of the suite.

UCV control system checks

Temperature

8.163 The readings of temperature taken under or in front of the UCV unit should be within ±1 K of each other and the read-out on the surgeon's panel.

Humidity

8.164 The readings of humidity taken under or in front of the UCV unit should be within ±5% of each other and the read-out on the surgeon's panel.

Direct-reading differential pressure gauges

8.165 The differential pressure across the terminal filter(s) should be measured to confirm the accuracy of the indicated reading of any gauge.

Control functions

8.166 The operation of all control functions provided on the surgeon's panel should be proved for conformity with the design specification.

8.167 If an auxiliary panel has been fitted then its interlocking with the main surgeon's panel control functions must be proved to conform to the design specification.

Panel indicator lights

8.168 The panel indicator lights should illuminate as appropriate when the control functions are selected or warning levels are reached

BEMS interface

8.169 The operation, monitoring and alarm functions must be proved to conform to those set out in the design specification.

UCV theatre microbiological tests

8.170 There is little value in performing microbiological sampling in a new theatre supplied with ultra-clean ventilation. The foregoing filter challenge tests, air velocity measurements and entrainment test should have proved that the system operates satisfactorily and achieves the contracted level of performance. The HEPA filters will remove bacteria-sized particles from the air supplied through the UCV terminal. Therefore there will be an insignificant number of bacterial and/or fungal CFUs present until the Theatre is actually used.

8.171 Once the theatre has been taken into use, microbial sampling during a surgical procedure should help to confirm the satisfactory performance of the system and discipline of the users. Before commencing bacteriological testing, the room and its ventilation system should have achieved a steady state condition: (see also Paragraph 8.74)

8.172 The installation should be tested during surgical procedure at intervals between the time of the first incision and final closure of the wound. On average, the air sampled within 300mm of the wound should not contain more than 10 CFU/m^3.

UCV validation report

8.173 Following validation a full report detailing the findings should be produced. The report shall conclude with a clear statement as to whether the UCV theatre suite achieved or did not achieve the standard set out above.

8.174 A copy of the report should be lodged with the following groups:

- operating department;
- infection control;
- estates and facilities.

Appendix 1: Recommended air-change rates

Application	Ventilation	ac/Hour	Pressure (Pascals)	Supply Filter	Noise (NR)	Temp (°C)	Comments For further information see Section 6
General ward	S / N	6	-	G4	30	18-28	
Communal ward toilet	E	10	-ve	-	40	-	
Single room	S / E / N	6	0 or –ve	G4	30	18-28	
Single room WC	E	3	-ve	-	40	-	
Clean utility	S	6	+ve	G4	40	18-28	
Dirty utility	E	6	-ve	-	40	-	
Ward Isolation room	-	-	-	-	-	-	See SHPN 4; Supplement 1
Infectious disease Iso room	E	10	-5	G4	30	18-28	Extract filtration may be required
Neutropenic patient ward	S	10	+10	H12	30	18-28	
Critical Care Areas	S	10	+10	F7	30	*18-25*	Isolation room may be –ve press
Birthing Room	S & E	15	-ve	G4	40	*18-25*	Provide clean air-flow path
SCBU	S	6	+ve	F7	30	*18-25*	Isolation room may be –ve press
Preparation room (Lay-up)	S	>25	35	F7*	40	*18-25*	*H12 if a lay-up for a UCV Theatre
Preparation room / bay sterile pack store	S	10	25	F7	40	*18-25*	*50NR if a bay in a UCV Theatre
Operating theatre	S	25	25	F7	40	*18-25*	
UCV Operating theatre	S	25*	25	H12	40	*18-25*	Fresh air rate; excludes re-circulation
Anaesthetic room	S & E	15	>10	F7	40	*18-25*	Provide clean air-flow path
Theatre Sluice/dirty utility	E	>20	-5	-	40	-	
Recovery room	S & E	15	0	F7	35	*18-25*	Provide clean air-flow path

Table A1

Application	Ventilation	ac/Hour	Pressure (Pascals)	Supply Filter	Noise (NR)	Temp (°C)	Comments For further information see Section 6
Recovery room	S & E	15	0	F7	35	*18-25*	Provide clean air-flow path
Cardiac catheterisation lab	S	15	+ve	F7	40	*18-22*	
Endoscopy room	S	15	+ve	F7	40	*18-25*	
Endoscopy cleaning	E	>10	-ve	-	40	-	
Day case theatre	S	15	+ve	F7	40	*18-25*	
Treatment room	S	10	+ve	F7	35	*18-25*	
Pharmacy aseptic suite	S	20	#	H14	-	*18-22*	# See EGGMP (Orange guide) a
Cat 3 or 4 containment room	#	>20	#	H14*	-	*18-22*	# See ACDP guide; *Filter in extract
Post mortem room	S & E	S = 10 E = 12	-ve	G4	35	*18–22*	Provide clean air-flow path
Specimen store	E	-	-ve	-	-	-	Fan accessible from outside of store

Table A1 continued

Notes: 18°C-22°C indicates the range over which the temperature may float

18°C-22°C indicates the range over which the temperature should be capable of being controlled

S = supply N = natural ventilation

E = extract [a] – European guidelines on good manufacturing practice published by the Medicines and Healthcare products Regulatory Authority (MHRA)

Appendix 2: Hierarchy of cleanliness

			Air-flow rate for bacterial contaminant dilution	
Class	**Room**	**Nominal pressure (Pa) a**	**Flow in or supply m^3/s**	**Flow out or extract m^3/s**
Sterile	Preparation room (a) lay-up (b) sterile pack store Operating room Scrub bay b	 35 25 25 25	See standard schemes in Appendix 3 for recommended design values	
Clean	Sterile pack bulk store Anaesthetic room c Scrub room	 +ve 14 c 14	6 ac/h The greater of 15 ac/hr or 0.15 -	- The greater of 15 ac/hr or 0.15 0.10
Transitional	Recovery room Clean corridor General access corridor Changing rooms Plaster room	3 0 0 3 3	15 ac/hr d e e 7 ac/hr 7 ac/hr	15 ac/hr d 7 ac/hr 7 ac/hr 7 ac/hr 7 ac/hr
Dirty	Service corridor Disposal room	0 -5 or 0	- -	f 0.41 or 0.10

Table A2

Notes (applicable to Table A2):

a. Nominal room pressures are given to facilitate setting up of pressure relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not critical, provided the desired airflow rates and movement are achieved.

b. An open or semi-open bay is considered to be part of the operating room; provided air movement is satisfactory, no specific extract is required. However if the layout means that air movement is poor, a local extract may be required to control local condensation on the building surfaces, which can result in mould growth.

c. For design purposes, anaesthetic should be assumed to be at 14Pa. When commissioning 10Pa is considered suitable.

d. 15 ac/hr are considered necessary for the control of anaesthetic gas pollution.

e. Supply airflow rate necessary to make up 7 ac/hr after taking into account secondary air from cleaner areas.

f. No dilution requirement. Temperature control requirements only.

Type	Pressure difference - Pa						
	5	10	15	20	25	30	40
Single door (CDB Size 2.4.3.2.6.)	.03	.05	.06	.06	.07	.07	.08
Double door (CDB)	.04	.08	.10	.11	.12	.13	.14
High permanent length of 3mm gap	.004	.008	.010	.011	.012	.012	.013

Table A3: Leakage flows in m^3/s through closed door gaps

Note: CDB = Component Data Base

It should be noted that many doors are now fitted with cold smoke seals as standard. These will significantly reduce the door leakage rate when new and undamaged. It is therefore recommended that provision for the design leakage is factored into the sizing of the appropriate transfer grille or pressure stabiliser. Failure to do this will result in air gap whistles and doors being held partially open by air pressure.

Factory-assembled door-sets with a steel frame and pre-hung leaves have become common. There is effectively no leakage across these doors when closed. Therefore, when this type of door assembly is fitted, the door leakage can be ignored and the design airflow into the room reduced accordingly. The design airflow would then become that required either (i) for open door protection, or (ii) to achieve the specified air-change rate - whichever is the greater.

Room class		Dirty	Transitional	Clean	Sterile
Sterile	Hatch	0.3	0.24	0.18	
	Single door	0.47	0.39	0.28	0 or 0.28 a
	Double door	0.95	0.75	0.57	0 or 0.57 a
Clean	Single door	0.39	0.28	0 or 0.28 a	
	Double door	0.75	0.57	0 or 0.57 a	
Transitional	Single door	0.28	0 or 0.28 a		
	Double door	0.57	0 or 0.57 a		
Dirty	Single door	0	Open single door = 0.80m x 2.01m high		
	Double door	0	Open double door = 1.80m x 2.01m high		

Table A4: Recommended air flow rates in m^3/s through a doorway between rooms of different cleanliness to control cross-contamination

Designer's Notes:

a. The degree of protection required at an open doorway between rooms is dependent upon the degree of difference in cleanliness between them.

b. Flow rate required between rooms within the same class tends to zero as class reduces.

c. If two rooms are of equal cleanliness, no flow is required (in practice there will be an interchange in either direction) and the design of the air movement will assume zero air-flow. In certain cases, however, interchange is not permitted and protection airflow of 0.28 is assumed in the design, for example, in the case of a preparation room used as a "lay up".

		Effect on other rooms	
Door open between	Resultant pressure in these rooms (Pa)	Room	Pressure (Pa)
Operating room and corridor or Scrub bay and corridor	0	Anaesthetic Preparation – lay up Disposal Preparation – sterile pack store	0 12 -6 5
Operating room and anaesthetic room (or other series room with double doors)	17	Preparation – lay up Disposal Preparation – sterile pack store	26 -9 22
Operating room and disposal room or Operating room and preparation room	25	No change	
Anaesthetic room and corridor (or other series room with double doors)	0	Preparation – lay-up Disposal Operating room Preparation – sterile pack store	30 -6 20 25
Preparation room – corridor Disposal room & corridor	0	No change	
Disposal room & outer corridor	0	No change	

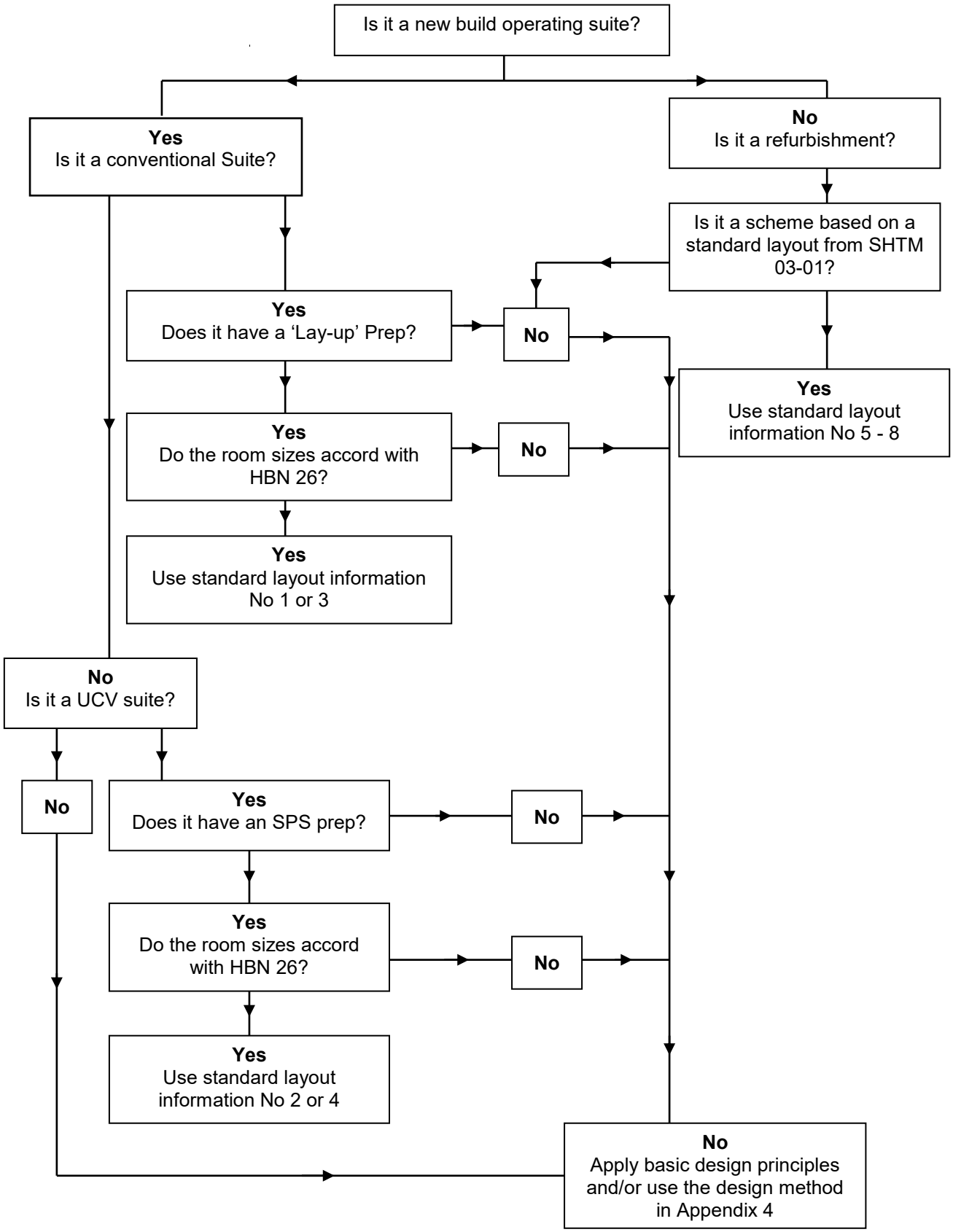
Table A5: Typical pressures in an operating suite when a given door is open

Notes: 1. The room differential pressure protects against reverse flows when the door is closed.

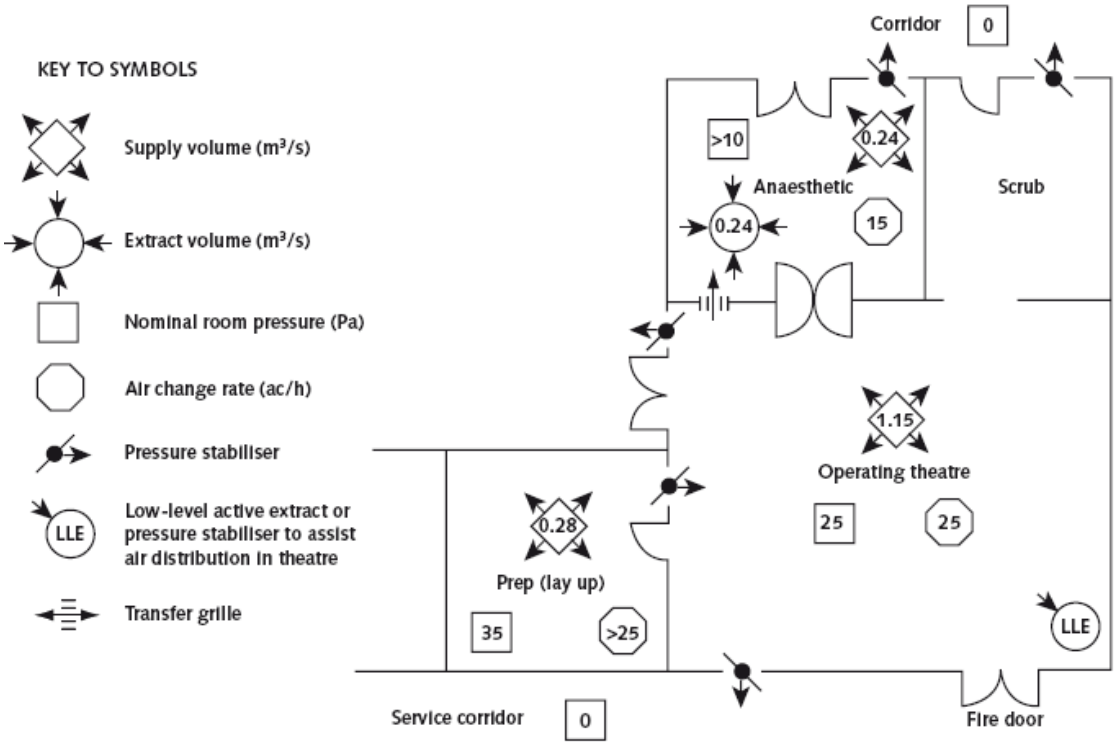
2. The flow of air through a doorway protects against reverse airflow when the door is open.

3. Pressure stabilisers control flow and ensure a known air-flow path between rooms when doors are closed and reduce back-flow between rooms when doors to other rooms are open.

Appendix 3: Operating suite design logic



New Standard Layout N° 1 - Suitable for a typical conventional theatre suite (Room sizes as specified in HBN 26)



Room	Size m³ Derived from HBN26	Air-Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	165	25	25	1.15
Anaesthetic	57	15	>10	0.24
Lay-Up-Prep	36	>25	35	0.28**
Scrub	*	-	25	-

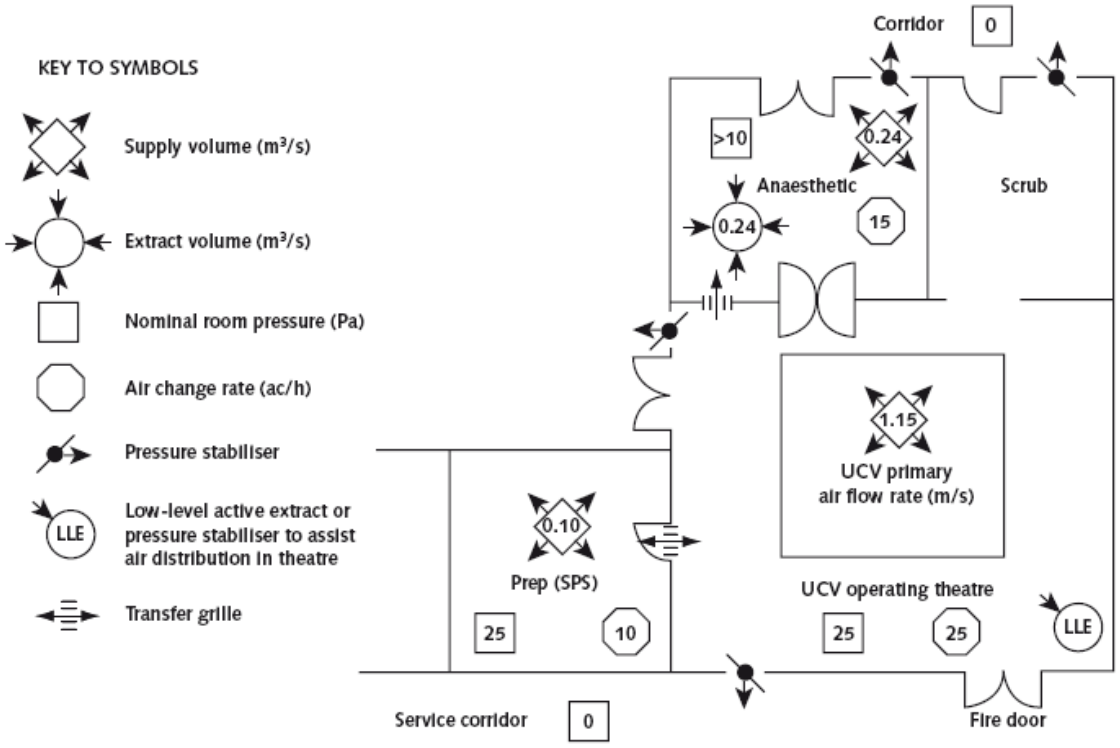
*This is a separate scrub and is not considered as being part of the theatre volume.

**Interchange is not permitted between the theatre and lay-up prep; therefore an airflow protection of 0.28 + 0.06 closed-door airflow is required as a minimum.

The volume of air to be extracted from the theatre should be determined by subtracting the airflow required for door protection at the exits from the total air entering the theatre space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre may be either passive and fitted with pressure stabilisers or active and connected to the extract system. They should be located at low level and positioned to promote the ventilation of all areas of the space.

New standard layout N° 2 - Suitable for a typical UCV theatre suite (Room sizes as specified in HBN 26)



Room	Size m³ Derived from HBN26	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	165	25	25	1.15**
Anaesthetic	57	15	>10	0.24
Sterile Prep	36	25	25	0.10
Scrub	*	-	25	-

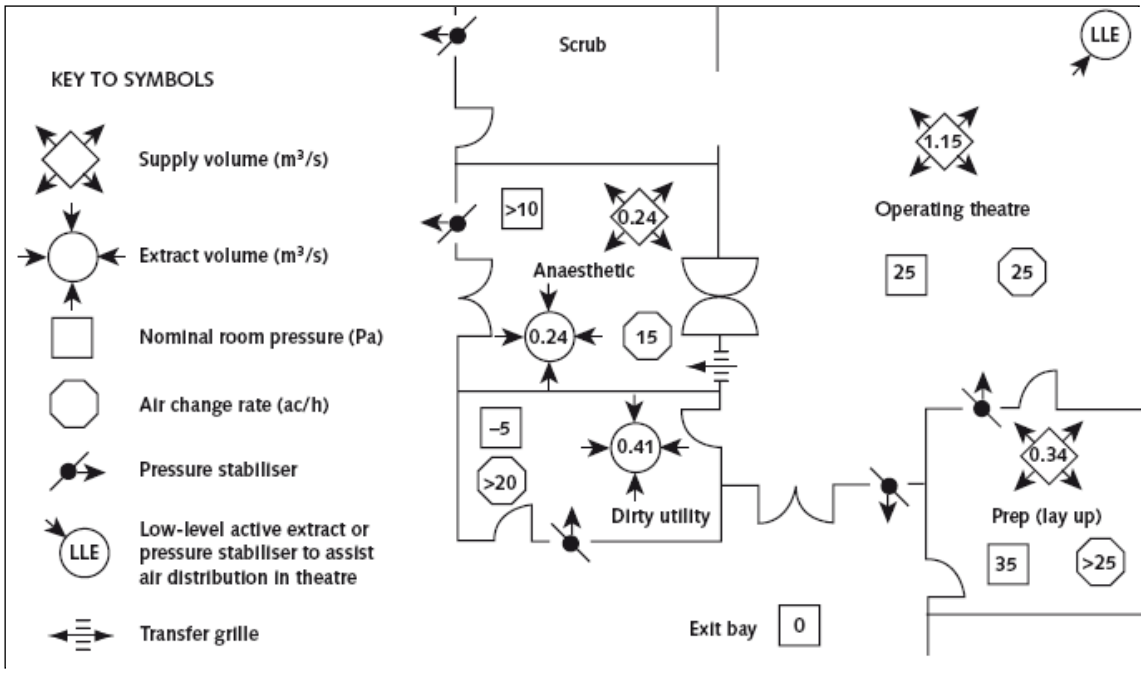
*Separate scrub and not considered as part of theatre volume

**Primary Fresh air Volume Only

The volume of air to be extracted from the theatre should be determined by subtracting the airflow required for door protection at the exits from the total air entering the theatre space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre may be either passive and fitted with pressure stabilizers or active and connected to the extract system. They should be located at low level and positioned to promote the ventilation of all areas of the space.

New standard layout N° 3 - Suitable for a typical Conventional theatre suite (Layout and room sizes are as illustrated in HBN 26)



Room	Size m³ Derived from HBN26	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	165	25	25	1.15
Anaesthetic	57	15	14	0.24
Lay-Up Prep	36	>25	35	0.34**
Scrub	*	-	25	-
Dirty Utility	36	-	-5	0.41

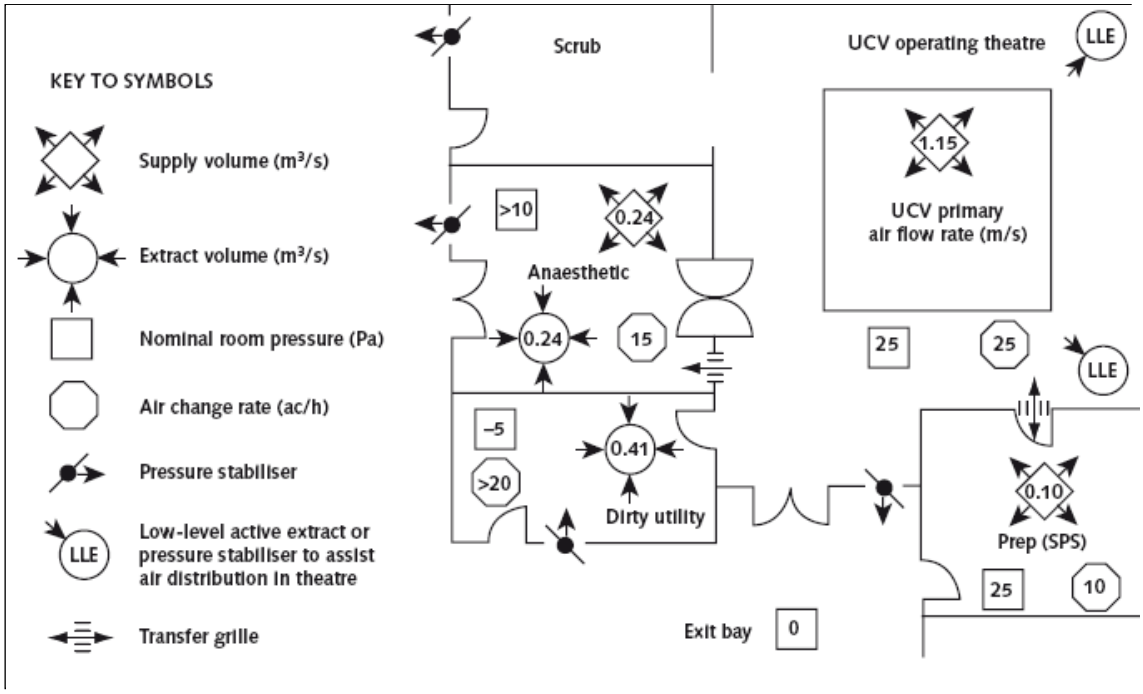
*Separate scrub not considered part of theatre volume.

**Interchange is not permitted between the theatre and lay up prep therefore as Table 4 an airflow protection of 0.28 + 0.06 closed door air flow is required as a minimum.

The volume of air to be extracted from the theatre should be determined by subtracting the airflow required for door protection at the exits from the total air entering the theatre space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre may be either passive and fitted with pressure stabilizers or active and connected to the extract system. They should be located at low level and positioned to promote the ventilation of all areas of the space.

New standard layout N° 4 - Suitable for a typical UCV theatre suite (Layout and room sizes are as illustrated in HBN 26)



Room	Size m³ Derived from HBN26	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	165	25	25	1.15**
Anaesthetic	57	15	>10	0.24
Sterile Pack Prep	36	10	25	0.10
Scrub	*	-	25	-
Dirty Utility	36	-	-5	0.41

* Separate scrub not considered part of theatre volume

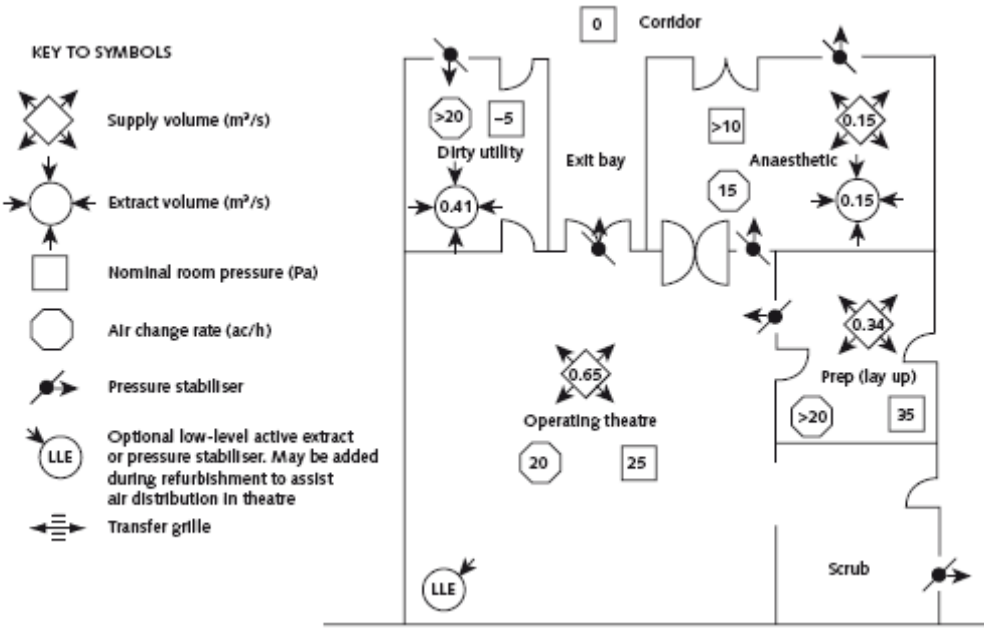
**Primary Fresh air Volume Only

The volume of air to be extracted from the theatre should be determined by subtracting the airflow required for door protection at the exits from the total air entering the theatre space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre may be either passive and fitted with pressure stabilizers or active and connected to the extract system. They should be located at low level and positioned to promote the ventilation of all areas of the space.

New standard layout N° 5 - SHTM 2025 Existing standard plan '1b' typical layout for a conventional theatre suite

This layout and data is for historical purposes only. The information is to be used for the evaluating of existing systems or rebalancing following ventilation system cleaning.

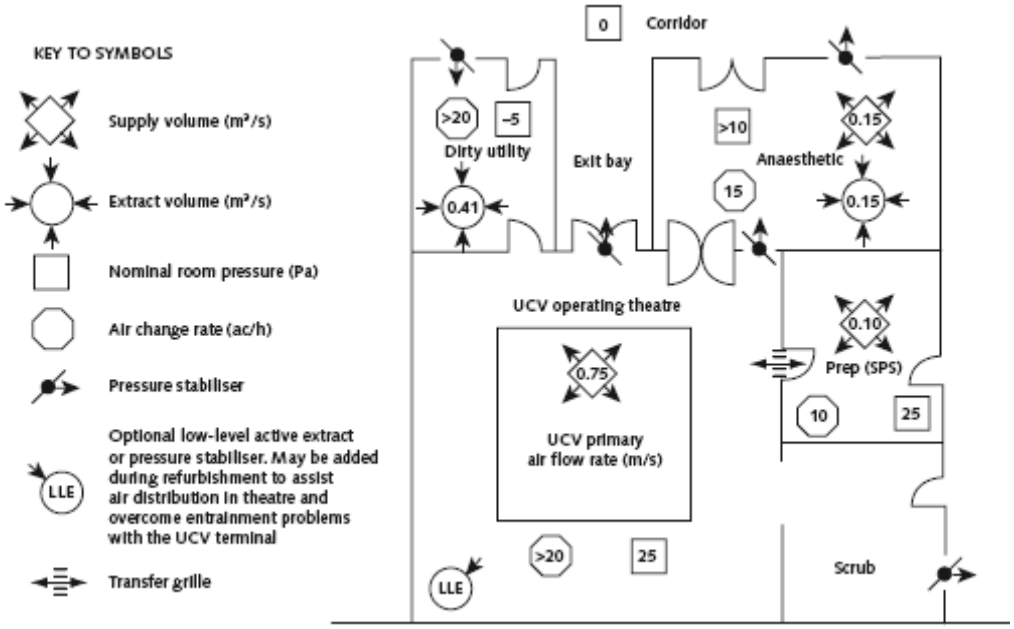


Room	Size m³	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	Existing Theatre Suite to Be measured on site	20	25	0.65
Anaesthetic		15	14	0.15
Lay-Up Prep		-	35	0.34
Scrub		-	25	Included within theatre
Disposal		-	-5	0.41

The disposal layout detailed will remain the same should a hatch be utilised instead of a door onto the outer corridor.

Standard layout No 6 - SHTM 2025 Existing standard Plan '1a' Typical layout for a UCV theatre suite

This layout and data is for historical purposes only. The information is to be used for the evaluating of existing systems or rebalancing following ventilation system cleaning.



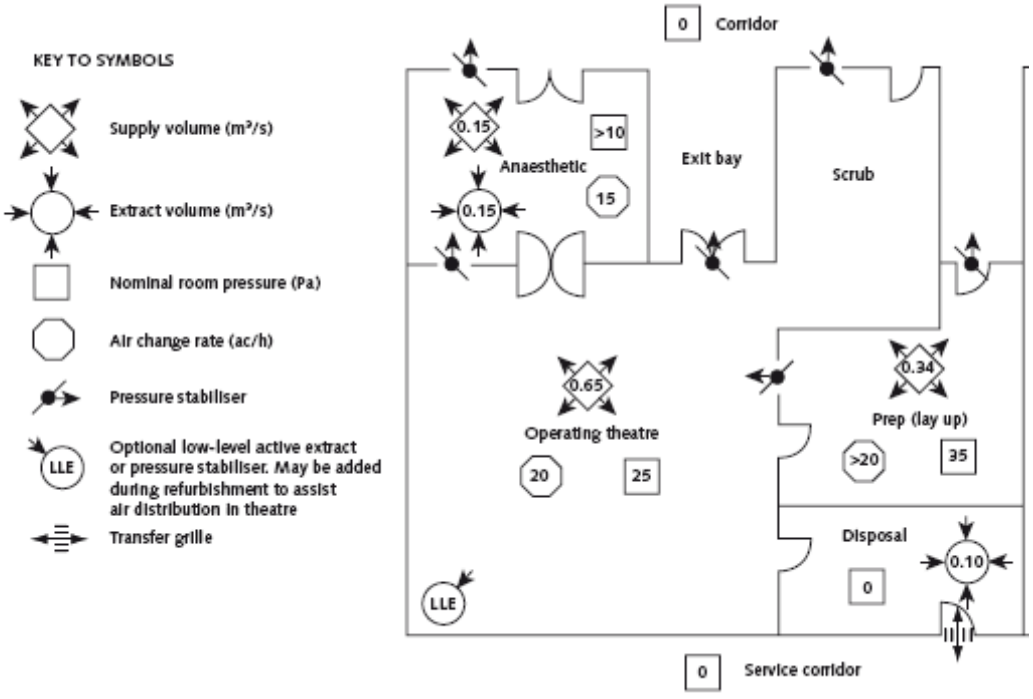
Room	Size m^3	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m^3/s
Theatre	Existing Theatre Suite to be measured on site	20	25	0.75*
Anaesthetic		15	>10	0.15
Sterile Pack Prep		10	25	0.1
Scrub		-	25	Included within theatre
Disposal		-	-5	0.41

*Primary fresh airflow volume

The disposal layout detailed will remain the same should a hatch be utilised instead of a door onto the outer corridor.

Standard layout N° 7 - SHTM 2025 Existing standard Plan '5b' Typical layout for a conventional theatre suite

This layout and data is for historical purposes only. The information is to be used for the evaluating of existing systems or rebalancing following ventilation system cleaning.

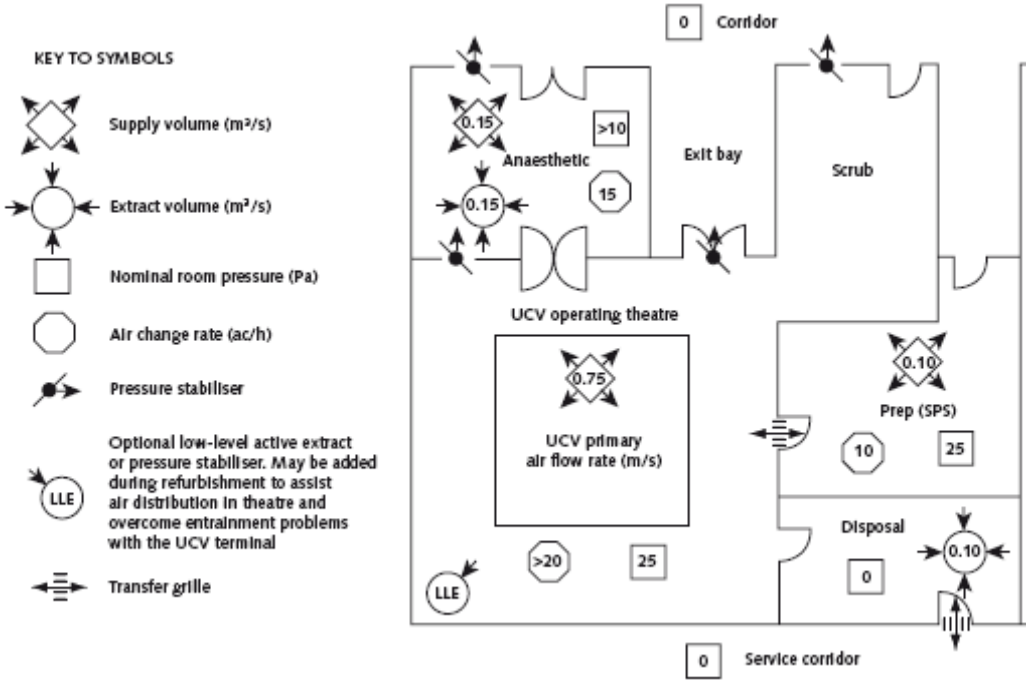


Room	Size m³	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	Existing Theatre Suite to be measured on site	20	25	0.65
Anaesthetic		15	>10	0.15
Lay-Up Prep		>20	35	0.34
Scrub		-	25	Included within theatre
Disposal		-	0	0.1

The disposal layout detailed will remain the same should a hatch be utilised instead of a door onto the outer corridor. Alternatively the disposal room could be omitted and replaced with a disposal hatch between the theatre and corridor.

Standard layout N° 8 - SHTM 2025 Existing standard Plan '5a' Typical layout for a UCV theatre suite

This layout and data is for historical purposes only. The information is to be used for the evaluating of existing systems or rebalancing following ventilation system cleaning.



Room	Size m³	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	Existing Theatre Suite to be measured on site	20	25	0.75*
Anaesthetic		15	>10	0.15
Sterile Prep		10	25	0.1
Scrub		-	25	Included within theatre
Disposal		-	0	0.1

*Primary fresh air-flow volume only

The disposal layout detailed will remain the same should a hatch be utilised instead of a door onto the outer corridor. Alternatively the disposal room could be omitted and replaced with a disposal hatch between the theatre and corridor.

Appendix 4: Design of air-movement control schemes for operating theatres.

General

A4.1 Standard operating suite design solutions are given in Appendix 3. If these standard solutions cannot be used, the following procedure should be adopted, which will result in an acceptable design. Note that the method employed can equally be used to provide a design solution to a ventilated suite of rooms for any application.

A4.2 The method is concerned with the calculation of airflow rates to ensure that correct air movement occurs between rooms when any one door is open. Under most circumstances, the air quantities required for air-movement control will approximate to those for either temperature control or bacterial contaminant dilution. This flow rate is sufficient to control the effects of any slight reverse flows occurring when a door is opened.

A4.3 The progression through the design procedure is shown in the airflow design procedure chart (Figure A4/3) and is supported by worksheets WS1 to WS7 described in Paragraph A4.4. It is recommended that a plan of the suite and an airflow network be made (Figure A4/2) to collate all information. Flow rates, air-transfer devices etc should be entered as required. The remainder of this Appendix may be treated as reference data to assist in the various steps. The following symbols are used:

S_S – supply airflow rate for summer temperature control;

S_W – supply airflow rate for winter temperature control;

S_D – supply airflow rate for dilution of bacterial contaminants;

S_L – supply airflow rate for heat loss;

S_G – supply airflow rate for heat gain;

E_D – extract airflow rate for dilution of bacterial contaminants;

S_F – final supply airflow rates;

E_F – final extract flow rates;

S_{AMC} – air-supply flow rate for air-movement control;

E_{AMC} – air-extract flow for air-movement control;

L_{OUT} – leakage airflow rate outward;

L_{IN} – leakage airflow rate inward;

$\sum_{OUT}$ – total airflow rate outward;

$\sum_{IN}$ – total airflow rate inward.

A4.4 To simplify the procedure, standard worksheets (WS1 to WS7) have been devised. For each operating suite, a set is required comprising one each of WS1, WS3, WS5, WS6a, WS6b and WS7, one WS4 for each corridor and one WS2 to cover each peripheral room. WS2 has five versions:

- WS2a single flow;
- WS2b parallel/series multi-flow;
- WS2c parallel multi-flow or series multi-flow (unbalanced);
- WS2d series multi-flow (balanced); and
- WS2e bay (semi-open).

Peripheral room type

A4.5 The rooms in the operating suite other than the operating room and corridor are referred to as peripheral rooms. Peripheral rooms have been classified according to the flows in and out. These room classifications are defined below in Paragraphs A4.6 – A4.11.

Single flow

A4.6 This is a room with only one door and a net surplus of supply or extract air.

Parallel multi-flow

A4.7 This is a room with two or more doors through each of which the air-flows either outwards (high-pressure) or inwards (low-pressure) (for example the Prep (lay-up) in standard layout 5).

Parallel/series multi-flow

A4.8 This is a room having a net surplus of supply or extract and with two or more doors. One or more doors will be to an area of equal cleanliness and need not be protected; hence, the flow may vary between inwards and outwards, the remaining door being to an area of greater or lesser cleanliness (for example the Prep (SPS) in standard layout 6).

Series multi-flow (unbalanced)

A4.9 This is a room having a net surplus of supply or extract and with two or more doors. Air flows inwards through one or more doors and outwards through one or more doors.

Series multi-flow (balanced)

A4.10 This is a room as in Paragraph A4.9 above, but having either no mechanical ventilation or no net surplus of supply or extract. (for example an anaesthetic room).

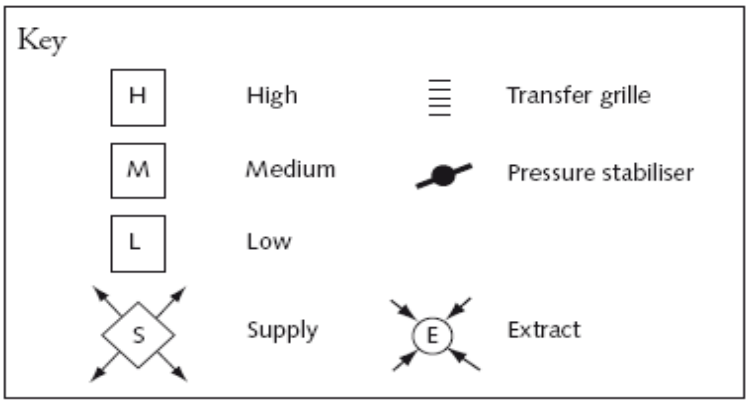
Bay

A4.11 A room that has a permanent opening to the operating room may be considered as a bay off the latter (for example a scrub). Two categories exist:

- open bay – the opening is larger than a normal single door opening. The bay may be considered as part of the main room;
- semi-open bay – the opening is no larger than a normal single door opening. In this case it is possible to protect the bay from the main room by provision of air supply or extract in the bay, or by passing air to or from another area.

Air-movement control in peripheral rooms

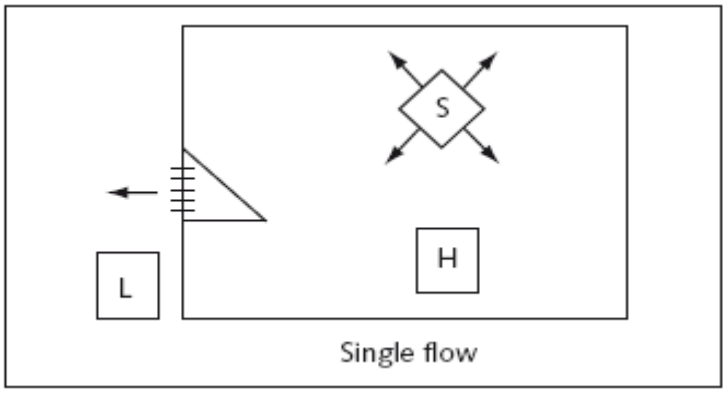
A4.12 For the design of air-movement control, two types of air-transfer device are considered. These are transfer grilles and pressure stabilisers. Each has a particular field of application within the design, as described in Paragraphs A4.34 – A4.43. Air movement is controlled in each of the different room types described in Paragraphs A4.13 – A4.31.



Note: This key applies to each diagram in A4.13 - A4.27.

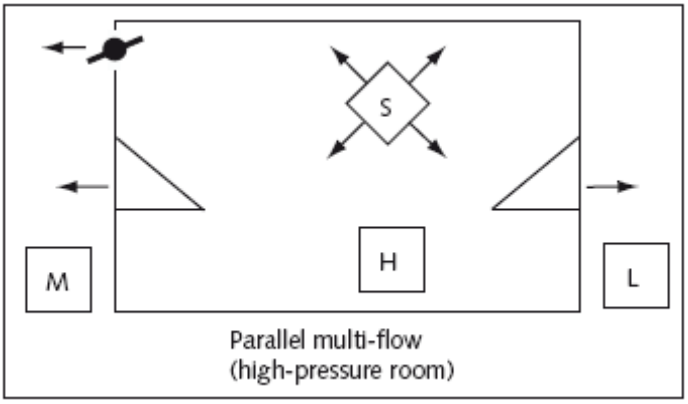
Single flow rooms

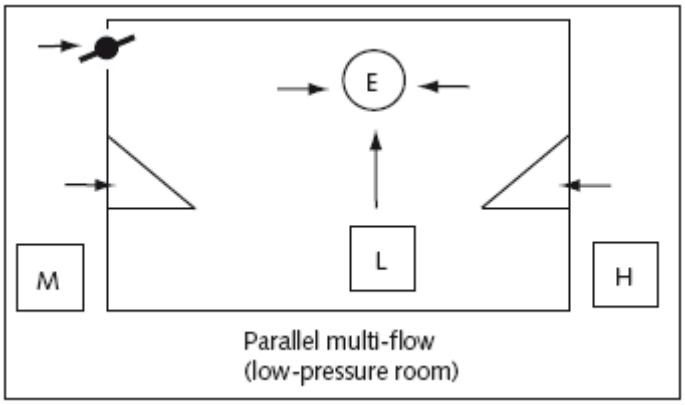
A4.13 An appropriately sized transfer grille should be located in or adjacent to the door of each single flow room to relieve the pressure differences across the door when closed.



Parallel multi-flow rooms

A4.14 The pressure difference across the closed doors must be relieved, but transfer grilles are not appropriate where two doors lead to areas of different pressures, because reverse flow could occur when the other door is open. For this reason, pressure stabilisers are used.



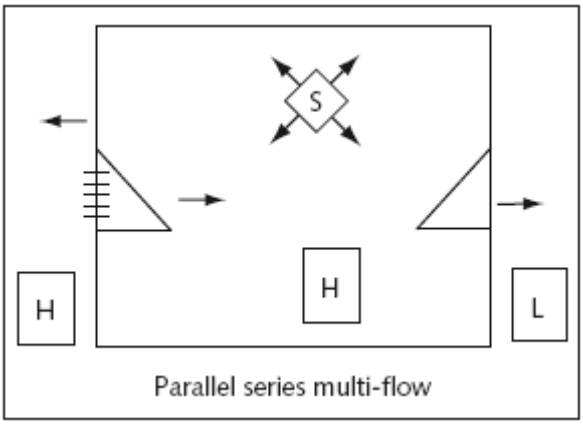


A4.15 These rooms will be either high-pressure or low-pressure with respect to the adjacent areas (see preparation lay-up room and disposal room, respectively, in standard layout 5). The pressure-relief damper is always situated between the room and area, which results in the smaller differential pressure to ensure best use of air.

A4.16 Just as reverse flow can occur if transfer grilles are used, it can similarly occur via door gaps when the other door is opened. It is not possible to avoid this, except by using air locks, but due to the low flow rates and short durations involved, this is not considered to be of importance.

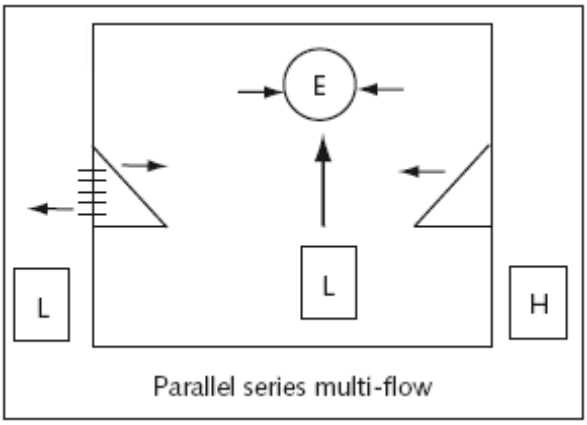
Parallel-series multi-flow rooms

A4.17 These rooms are similar to those in Paragraph A4.14 above, but because the room is of equal cleanliness to one of the adjacent rooms the nominal pressures will be equal and air may flow through the adjoining doorway in either direction. (for example the Prep (SPS) in standard layout 6).



Parallel series multi-flow

A4.18 Where the nominal room pressure equals that of the higher-pressure adjacent room, the best use of air is by supplying air required for bacterial dilution only and allowing this to exhaust via a transfer grille to the area of equal cleanliness. The doorway to the lower pressure area is protected by the combination of the supply air and the air that will flow inwards through the transfer grille from the area of equal cleanliness.

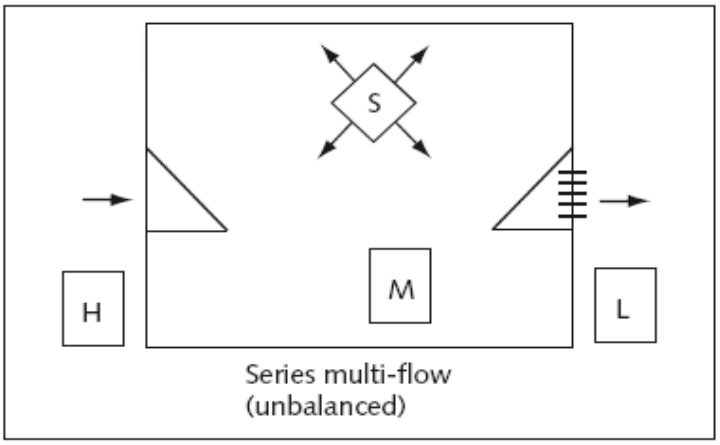


Parallel series multi-flow

A4.19 Conversely, where the nominal pressure equals that of the lower-pressure adjacent room, extract ventilation and a transfer grille to the lower pressure adjacent room should be provided. (for example, the disposal room in standard layout 8).

Series multi-flow (unbalanced)

A4.20 These rooms are somewhat similar to those in Paragraph A4.15 above, but because the pressure lies between that of the rooms on either side, the back-flow problem does not exist.



Series multi-flow (unbalanced)

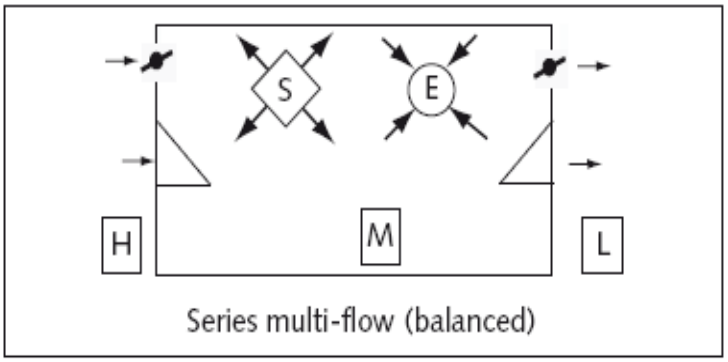
A4.21 Where the room has a net surplus of mechanical supply air, a transfer grille should be located in or adjacent to the door through which air flows outwards, and the mechanical supply flow rate to the room should be chosen to give protection when this door is open.

A4.22 Where the room has a net surplus of mechanical extract air, a transfer grille should be located adjacent to the door through which the air flows inwards, and the mechanical extract flow rate to the room should be chosen to give protection when this door is open.

A4.23 The grille must be sized for the protection requirement of the opposing door when open. When the room on the high-pressure side depressurises, there is a possibility of back-flow through gaps around the door, but this problem may be ignored.

Series multi-flow (balanced)

A4.24 In these rooms, a transfer device adjacent to each doorway is required in order to provide a flow path for the air required to protect the opposing door when opened.



Series multi-flow (balanced)

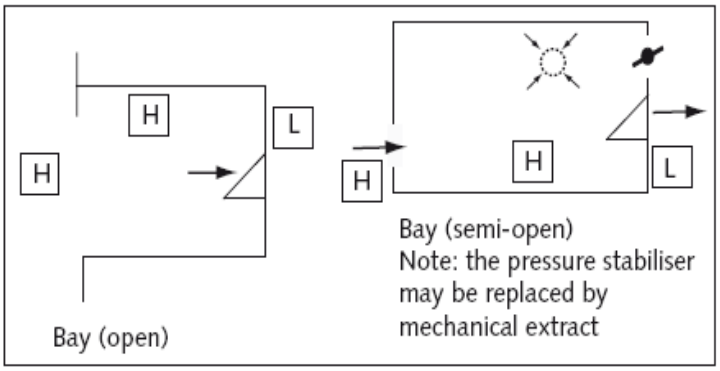
A4.25 These transfer devices will normally be pressure stabilisers, although transfer grilles may be used where a large amount of excess air is to be exhausted from the operating room when all doors are closed. (for example, anaesthetic rooms).

A4.26 The calculation procedure is to assume that pressure stabilisers are being used; then (if there is sufficient excess air) change to transfer grilles as described in Paragraph A4.50.

Bay

Open bay

A4.27 A bay of the open type (for example scrub-up) is considered to be part of the operating room. Provided air movement is satisfactory, no specific extract is required.



Semi-open bay

A4.28 In a bay of the semi-open type, protection of one area from the other is possible. (For example scrub-up).

A4.29 As stated previously, the need for protection between operating room and scrub-room is not very great. Better use of air can therefore be achieved in this case by installing a pressure stabiliser between the scrub-room and clean corridor. This will allow a flow of air through the scrub-room at all times, except when a door is opened elsewhere in the suite. The pressure stabiliser will then close and the air will be diverted to the other door. When it is considered necessary to protect the scrub-room at all times, either a transfer grille to the corridor or mechanical extract in the scrub-room should be provided.

Operating room

A4.30 Once the peripheral rooms have been considered, the operating room requirements may then be decided and the supply flow rate required for air-movement control calculated. This flow rate should be such that, with any one door open, the correct air movement directions are maintained. There will be one door in the suite that will require the largest supply flow rate to the operating room for protection when open. This is called the “key door” and is discussed separately in Paragraph A4.33. Use of this concept avoids repetitive

calculations for each door in turn. Having established the required supply flow rate, a relief route must be provided to the clean corridor for any excess air when the doors are closed. This would be via transfer grilles or pressure stabilisers through a series-flow room or via pressure stabilisers to the clean corridor directly.

Corridors

A4.31 All surplus air from the suite, except that lost through structure leakage and any passing to the outer corridor, will arrive in the patient/staff corridor. Should this air be insufficient to achieve the required air-change rate (see Appendices 1 and 2), some additional air supply should be provided. (The air balance should take account of structural leakage.)

Door opening

A4.32 Whereas the resulting pressures are dependent on ductwork layout, room relationships and characteristics of the fan, the generalisations shown in Appendix 2 can be used to estimate the change in room pressure when a door is opened.

A4.33 The “key door” will be the open double door which leaves the operating room at the highest pressure, and/or requires the largest air flow. This should be determined using the procedure in worksheet WS3.

Transfer grilles

A4.34 These may be used to limit the pressure differences across the closed door of a single-flow room or, in some instances, for protection of a series-flow or parallel-series-flow room. They allow airflow in both directions and may not be suitable for all applications.

A4.35 The free area of a grille is calculated from the following equation:

$$A = \frac{Q}{0.84\sqrt{\Delta P}}$$

where:

A is free area (m^2)

Q is flow rate (m^3/s)

P is pressure difference (Pa).

A4.36 The flow through a grille at a different pressure may be found from the following equation:

$$Q_2 = Q_1\sqrt{\frac{\Delta P_1}{\Delta P_2}}$$

where:

Q_1 and P_1 are original flow and differential pressure

Q_2 and P_2 are new flow and differential pressure.

A4.37 The transfer grille may be replaced by carefully proportioned door undercuts of the equivalent free area.

A4.38 The function of the transfer grille is to provide a means of airflow control by which the volume and pressure loss can be established. If a grille is used, it should have an easily removable core to facilitate cleaning.

Pressure-relief dampers

A4.39 The functions of a pressure-relief damper are now carried out by pressure stabilisers. Accordingly, all further mention of them has been removed from this document.

Pressure stabilisers

A4.40 Pressure stabilisers can be adjusted to hold the pressure constant over a wide range of flow rates. They are used where requirements exist for accurate room-pressure control or rapid shut-off on pressure fall.

A4.41 The installation of a grille or baffle in association with a stabiliser will alter the operating characteristics. It is recommended that a location be chosen to avoid the need for visual screening, for example, at high level. The location should be chosen to minimise the likelihood of damage.

A4.42 The stabilisers used should be virtually silent in operation, adjustable on site, maintenance-free and of a type that cannot be wrongly inserted. They should not be used in external walls or where the pressure difference is less than 5 Pa. The required size of a pressure stabiliser is dependent on the design pressure difference across it and flow rate through it. The manufacturer should provide data relating pressure difference to mean velocity (or flow rate per unit area). From this, the required area can be calculated and then rounded-up to the nearest size manufactured or nearest combination of smaller sizes.

A4.43 It is sometimes possible to arrange for a pressure stabiliser to perform two tasks. In an anaesthetic room, for example, the two pressure stabilisers may be made to pass the open door protection air, and also control the operating and anaesthetic room pressures with the door closed. To achieve this, the stabilisers are sized for the flow rate required with one of the doors open, but

the pressure setting is adjusted to be the value required with the doors closed. This is shown in Figure A4/1.

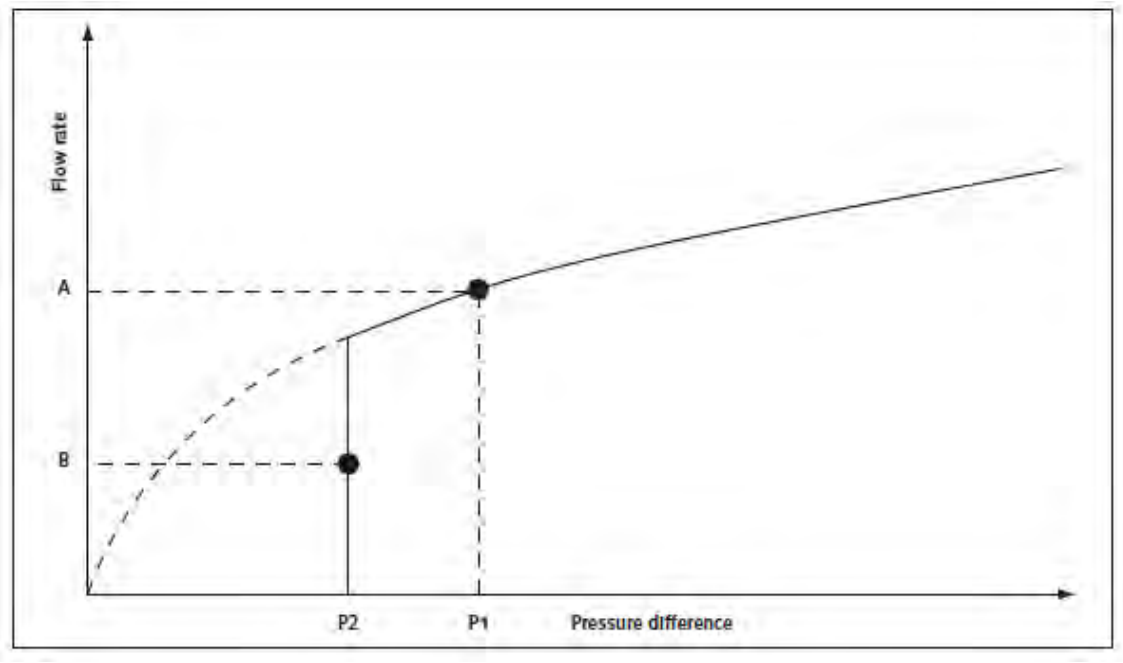


Figure A4/1

Door leakage flows

A4.44 For an air-movement control scheme to work satisfactorily, it is essential that the estimates of door-gap leakage made at the design stage are closely related to those which are achieved in practice. The calculation of gap-flows is complicated by the fact that such flows generally fall into the transition region between laminar and turbulent flow and hence do not follow the normal flow equations. The gaps assumed are 4mm along the bottom, 3mm at the top and sides, and 2mm between double leaves. Doors should not have wider gaps than these. Tighter gaps would result in lower flow-rate requirements and hence lower fan power, but care should be taken to ensure that all doors in the suite have similar gap dimensions. It may be possible to ignore the door leakage and so reduce the airflow requirement (see the notes in Appendix 3).

Room temperature estimation

A4.45 The air-flow rate required to prevent back-flow through an open door is dependent on the temperature difference across the door. The design figures shown in Appendix 3 are based on the temperature differences that will normally occur in practice, assuming heat gains and losses in accordance with Appendix 2.

A4.46 In accordance with the airflow design process, the temperature differences across the doors of all rooms classed as “sterile” is calculated. Worksheet WS6 is recommended for the calculations, using the following criteria:

- assume that the operating room is being controlled at 20°C and calculate the incoming air-supply temperature as shown on worksheet WS6;

- the calculation should be repeated for both summer and winter conditions, with an operation in progress;
- assume all doors are closed;
- use the room supply flow rates from WS1;
- use the inward air flows through air-transfer devices and closed door leakages from WS2a to WS2e;
- the formula used in worksheet WS6 is as follows:

$$T = \frac{(t_1Q_1 + t_2Q_2 + \cdots + t_nQ_n) + 0.828H}{(Q_1 + Q_2 + \cdots Q_n)}$$

where:

Q = flow rate from source (m^3/s)

t = the temperature of source (°C)

H = the room heat gain (kW).

A4.47 If the evaluated temperature differences between rooms do not exceed 2°C, the solution is satisfactory; otherwise proceed as follows:

- check the assumption on which the heat gains are based;
- take steps to reduce the heat gains;
- if the door is to a corridor, the flow through the open door will be larger than the value given in Appendix 2. Calculate on WS3, assuming it is the “key door” with door-flow unknown, and the supply as known;
- if the door leads to a room with mechanical supply, install a trimmer heater in the supply to the room controlled by either a differential thermostat or a thermostat slaved to the operating room thermostat to ensure that T is minimized.
- If the door leads to a room with no mechanical supply, increase the door protection flow as follows:

$$Q_{new} = Q_{old}\left[\frac{\Delta T + 1}{2}\right]$$

A4.48 These options should be considered in the above order, and the first three should be investigated thoroughly before proceeding to the latter two. The mechanical supply may need to be increased in order to achieve the desired air-change rates.

Relief of excess air from operating room when all doors are closed

A4.49 As the mechanical supply to the operating room is sized to provide an appropriate flow outward through any door that is opened, it follows that when all doors are closed, there will be more air supplied to the operating room than

can exit from it via leaks etc. This “excess” air can be relieved by either of the two methods described in Paragraphs A4.50 - 4.54.

By transfer devices via the anaesthetic room

A4.50 For door protection, the transfer devices in the anaesthetic room are typically designed to pass 0.47 m^3/s at a differential pressure of 14 Pa. When the doors are closed, the differential pressure will change to 11 Pa between theatre and anaesthetic room, and 14 Pa between anaesthetic room and corridor; the volume of air passed by the transfer devices will be modified as shown in the following formula:

$$Q = Q_1\left(\frac{\Delta P_1}{\Delta P_2}\right)^{1/2}$$

$$= 0.47\left(\frac{11}{14}\right)^{1/2}$$

$$= 0.42\ m^3/s$$

where:

Q = “excess” air to be vented with doors closed;

Q_1 = air-flow required for door protection through transfer device;

ΔP_1 = nominal differential pressure with door to operating room closed and door to corridor closed;

ΔP_2 = nominal differential pressure between either the anaesthetic room and corridor when the operating room door is open, or the anaesthetic room and operating room when the corridor is open. This differential pressure is used when selecting size of both devices.

A4.51 If the “excess” air is less than 0.42 m^3/s, a pressure stabiliser is required to ensure that the correct protection airflow is available to pass through the door.

A4.52 If the “excess” air is greater than 0.42 m^3/s, a transfer grille is acceptable because at all times the airflow will exceed the flow required for door protection.

By pressure stabilisers to the corridor

A4.53 If it is undesirable to pass operating room air through the anaesthetic room, it may be passed directly to a corridor via a separate pressure stabiliser.

A4.54 If there is sufficient “excess” air, the transfer grille solution at Paragraph A4.52 should be adopted, as it provides the simplest solution and, once set up, will require no further maintenance. With less excess air, it is recommended that the air be passed through the anaesthetic room via the pressure stabilisers as at Paragraph A4.51, thus keeping the number of pressure stabilisers to a minimum. Both these solutions increase the air-change rate in the anaesthetic

room, but care should be taken to avoid passing excessive amounts through that would cause discomfort to the occupants.

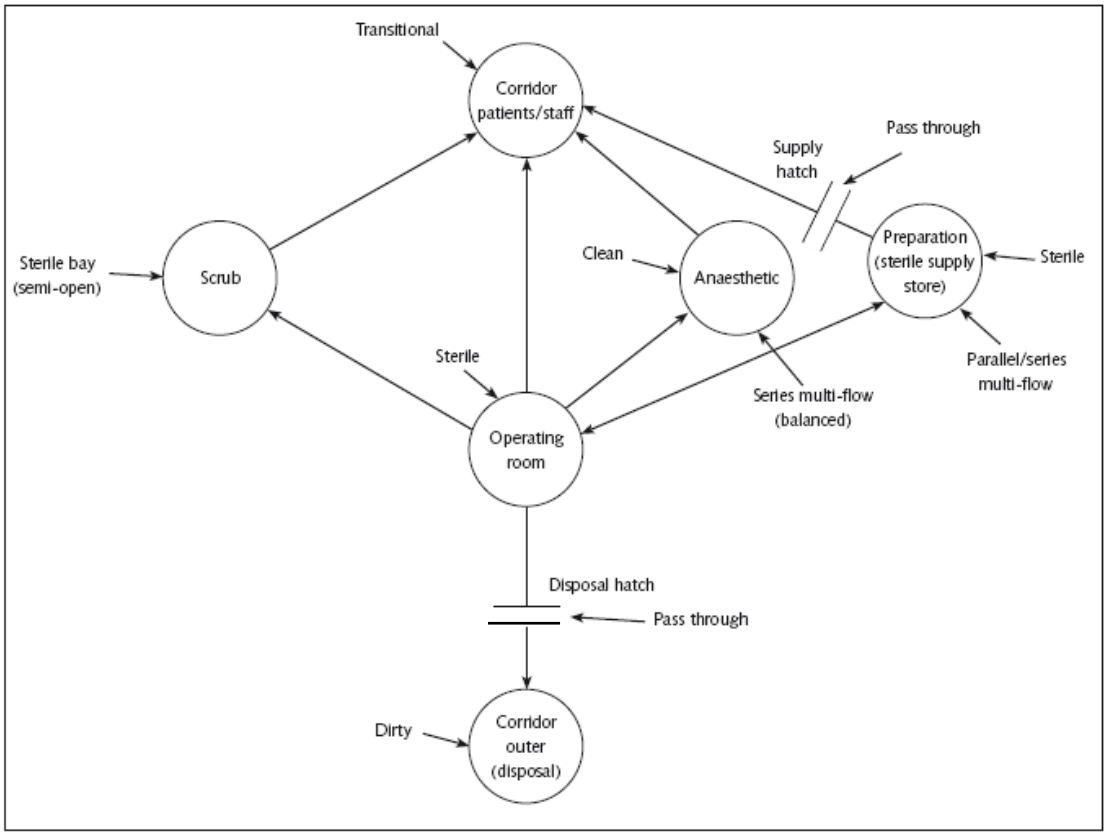
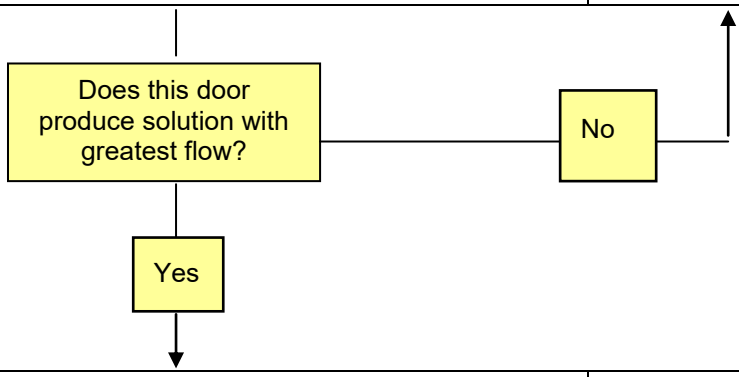
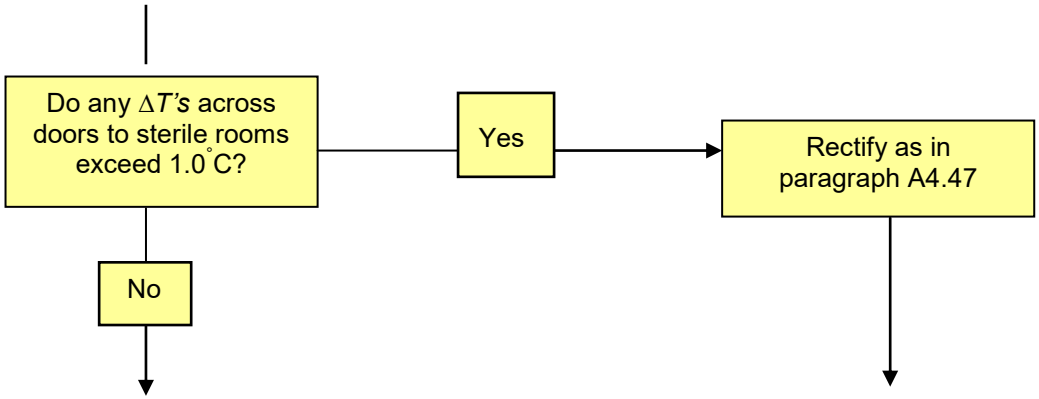


Figure A4/2: An example of an airflow network

Step	Description	Worksheet
1	Show nominal room pressures and air flow directions on the plan of the theatre suite and WS1	WS1
2	Enter heat/loss/gain data and calculate supply airflow rates for temperature control only. Categorise room types e.g. sterile, clean etc.	WS1
3	Enter airflows required for bacterial contamination control or air change rate whichever is the greater, add supply and extract volumes (S_D, E_D) on the plan.	WS1
4	Define peripheral room types, see paragraphs A4.5 - A4.11, and select appropriate worksheets.	Select from WS2a - WS2e
5	Locate air transfer devices, enter details on worksheets and locate on the plan and Figure A4/2	Selected worksheets from WS2a - WS2e
6	For each peripheral room, determine air flows through doors when open and calculate mechanical supply or extract and transfer device flows	As above
7	Select "Key Door" and calculate air supply for operating room	WS3



8	Transfer to WS1 and select final rate S_F and E_F	WS1. WS3
9	Make provision for relief of excess air with doors closed	Selected Worksheets and WS3
10	Calculate supply and extract flow rates for corridor(s)	WS4, WS5
11	Calculate room temperatures (all doors closed) and ΔT's	WS4, WS5



12	Make summary of flows	WS6a and WS6b
13	Size transfer devices, size ductwork, central plant etc	WS7
14	Design ductwork layout, control plant etc	

Figure A4/3: Airflow design procedures

Note: In the following worksheets WS1, WS2a-e, WS3, WS4, WS5, WS6a&b and WS7 it has been necessary to reduce the font size to 8pt instead of the usual 10pt in order to set out the complete tabular information for each within a single page for ease of use.

Calculation sheet for			**Worksheet WS1** **Reference:**			
Room Name:						
1. Summer Temperature Control Heat Gain	kW					
2. Acceptable Δt	°C					
3. Air flow rate (S_G) $= \frac{\text{Gain}}{\Delta t \times 1.2}$	m^3/s					
4. Winter Temperature Control Heat Loss	kW					
5. Acceptable Δt	°C					
6. Air flow rate (S_L) $= \frac{\text{Loss}}{\Delta t \times 1.2}$	m^3/s					
7. Dilution of bacterial contaminations Air flow rate	m^3/s					
S_D or E_D						
8. Desired air change rate	ac/hr					
$\frac{\text{AC/hr x room volume } (m^3)}{3600}$	m^3/s					
9. Maximum of S_G, S_L, S_D or E_D or air change rate from Step 8	m^3/s					
10. Air movement control	S m^3/s					
Air flow for air movement control S_{AMC} or E_{AMC} (from WS2, WS3, or WS4)	E m^3/s					
11. Final Supply Flow Rate (S_F)	m^3/s					
12. Final Extract	m^3/s					
13. Total Supply	m^3/s					
14. Total Extract	m^3/s					

Surveyor (AP(V)/CP(V))…… **Date**……

Air Movement Control **Peripheral Room** ..... **type, single flow**	**Worksheet WS2a** **Reference:** **Nominal Pressure:** ..... **Pa**

Consider door to..... open

Flow required through doorway to give protection	Pa	Δt	Air flow, m^3/s Out	In	Remarks
Total					

S_{AMC} $(\sum_{OUT} - \sum_{IN})$ ____ m^3/s

or

E_{AMC} $(\sum_{OUT} - \sum_{IN})$ ____ m^3/s

Transfer S_{AMC} or E_{AMC} to WS1

Consider door to.....closed

Closed door leakage	Pa	Δt	Out	In	Remarks
Total					

Return S_F and E_F to WS1 ____ ____

Flow through transfer grille outward ($S_F - E_F - L_{OUT}$ ____

or

Flow through transfer grille inward ($E_F - S_F - L_{IN}$) ____

Surveyor (AP(V)/CP(V))..... **Date**.....

Air movement control **Peripheral Room ..... type, parallel/series multi-flow**	**Worksheet WS2b** **References:** **Nominal Pressure: Pa**

Door from this room to ..... (room of equal cleanliness) is not to be protected.
A transfer grille is located in, or adjacent to, this door.

Consider door to..... open

Room pressure now becomes [ ] or [ ] or [ ] Pa (see Appendix 6)

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
At above pressures leaks through closed doors	Pa	ΔP			
Mechanical supply or extract (S_F/E_F)					
		Total			

X ($\sum$ OUT - $\sum$IN) [ ] Or Y ($\sum$ IN - $\sum$OUT) [ ]

Transfer grille required:

or from high-pressure zone Flow = *X* [ ] at [ ] ΔPa

to low-pressure zone Flow = *Y*

Size of transfer grille (free area) A1 [ ]

Consider doors and hatch closed – room pressure becomes [ ] Pa (nominal)

Closed door leakage from Appendix 4 (assuming no transfer grille)	Pa	ΔP	Out	In	Remarks
Mechanical supply or extract					
		Total			

Air flow required through transfer grille = IN – OUT = Z' [ ]

or OUT – IN = Z'' [ ]

Transfer grille required flow *Z' or Z''* [ ] @ [ ] ΔP

Size of transfer grille (free area) A2 = [ ]

Select larger of A1 or A2 [ ]

Surveyor (AP(V)/CP(V))..... Date.....

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Air movement control **Peripheral Room ..... type, parallel multi-flow high/low or series multi-flow (unbalanced)**	**Worksheet WS2c** **References:** **Nominal Pressure: Pa**

Consider door from this room to ..... open.

Room pressure now becomes [ ] or [ ] or [ ] Pa (see Appendix 6)

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
At above pressures leaks through closed doors	Pa	ΔP			
		Total			

S_1 ($\sum_{OUT} - \sum_{IN}$) [ ] Or E_1 ($\sum_{IN} - \sum_{OUT}$) [ ]

Consider door from this room to ..... open

Room pressure then becomes [ ] or [ ] or [ ] Pa

			Out	In	Remarks
Flow required through open doorway to give protection					
At above pressures leaks through closed doors are:	Pa	ΔP			
		Total			

S_2 ($\sum_{OUT} - \sum_{IN}$) [ ] Or E_2 ($\sum_{IN} - \sum_{OUT}$) [ ]

Consider doors closed. Closed doors leakage from Appendix 4

Door to:	Pa	ΔP	Out	In	Remarks
		Total			

Return S_F and E_F to WS1 [ ] [ ]

Flow through transfer grille outward ($S_F - L_{OUT}$) [ ] to .....

or

Flow through transfer grille inward ($E_F - L_{IN}$) [ ] from.....

Transfer grille [ ] Pressure relief damper [ ]

Surveyor (AP(V)/CP(V))..... Date.....

A46676816

Air movement control **Peripheral Room ..... type, parallel/series multi-flow**	**Worksheet WS2d** **References:** **Nominal Pressure:** **Pa**

Note: In this type of room the supply and extract air flow rates are equal and take no part in the air movement control (AMC)

First, open door to higher pressure area.

Room pressure then becomes [ ] or [ ] or [ ] Pa (see Appendix 2)

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
At above pressures leaks through closed doors	Pa	ΔP			
Total					

Q_1 ($\sum_{IN}$ - $\sum_{OUT}$) [ ] (+ve inwards)

Next, open door to lower pressure area.

Room pressure then becomes [ ] or [ ] or [ ] Pa

			Out	In	Remarks
Flow required through open doorway to give protection					
At above pressures leaks through closed doors are:	Pa	ΔP			
Total					

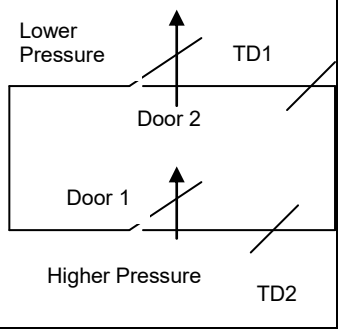
Q_1 ($\sum_{IN}$ - $\sum_{OUT}$) [ ] (+ve inwards)

Flow through transfer device (TD1) to protect Door 1 = Q1 at resultant [ ]

ΔP .....

Flow through transfer device (TD2) to protect Door 2 = Q2 at resultant [ ]

ΔP .....



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Air movement control **Peripheral Room ..... type bay (semi-open)**	**Worksheet WS2e** **References:** **Nominal Pressure:** **Pa**

Note: If the room is of the open bay type (i.e. opening is larger than normal single doorway), then room should be considered part of the main room. No air movement control considerations need then be made, and this sheet can be discarded. Supply and/or extract flow ill be based on air distribution considerations.

Consider permanent opening

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
At above pressures leaks through closed doors	Pa	ΔP			
		Total			

E_{AMC} [ ] or flow outward through transfer ($\sum_{IN} - \sum_{OUT}$) [ ]

Transfer S_{AMC} or E_{AMC} to WS1

Transfer device – transfer grille [ ]

– pressure stabiliser [ ]

Size select transfer device for flow rate [ ] @ ΔP [ ]

Note: A door from the bay is considered with the peripheral room to which it leads or, if it leads to the corridor, it is considered with the main room.

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Air movement control **Operating Room**	**Worksheet WS3** **References:** **Nominal Pressure:** **Pa**

Note: To avoid considering each door open in turn, the "key door" concept is introduced. This is the door which requires the greatest mechanical flow when open. See paragraph A4.33

Select "key door" (see above).

Consider this door open – room pressure now becomes _____ Pa (See Appendix 2)

See Appendix 3 for room pressures

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
Air flow "out" or "in" via doors, transfer devices etc.	Pa	ΔP			
Mechanical extract					
Total					

S_{AMC} $(\sum_{OUT} - \sum_{IN})$ _____ Transfer S_{AMC} to WS1

Consider all doors closed.

Return S_F and E_F to WS1 _____ Room pressure now _____ Pa (nominal)

Air flow "out" or "in" via door leakage, transfer devices etc	Pa	Δt	Out	In	Remarks
Mechanical extract					
Total					

Flow $(\sum_{IN} - \sum_{OUT})$ through transfer device _____ @ ΔP _____ to……

……

For final selection of transfer device see paragraphs A4.50 – A4.54

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Air movement control **Corridor**			**Worksheet WS4** **References:** **Nominal Pressure:** **Pa**		
Consider all doors closed					
			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
Leaks through closed doors, transfer devices, permanent openings etc.	Pa	ΔP			
Total flow inwards (S_1)					
Add mechanical input (S_2) if necessary to increase S_1 to give 7 AC/hr					
Total Flow Outwards and Inwards					
$S_{AMC} = (\sum_{OUT} - \sum_{IN} + S_2)$		Transfer to WS5			
or $E_{AMC} = (\sum_{IN} - \sum_{OUT} + S_2)$		Transfer to WS5			

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Air movement control **Corridor**	**Worksheet WS5** **References:**

Summary of Air Supply and extract for an Operating Suite

Consider all doors closed

Air Flow to Corridor	All Doors Closed	Anaesthetic (key door open)
	m^3/s	m^3/s
From Preparation		
From Operating Room		
From Scrub		
From Anaesthetic		
Total (a)		
Air Flow to Corridor from Disposal		
From other source		
Total (b)		
Other Room Supplies.....Total (c)		
Total Air Supply (a) + (b) + (c)		

Consider corridor ventilation (see Appendix 2) and calculate air volume required, based on 7 ac/hr (see Note 1)	
	m^3/s
Additional Air to Ventilate Corridor	
Additional Air to Ventilate Service Corridor (see Note 2)	
Air Extract The size of the extract plant should be of the order of 10% below the supply to assist in maintaining the department under positive pressure relative to the outside departments.	
	m^3/s
Extract Plant = Supply less Leakage	
Less 10% of Supply	
Total Extract (see Note 3)	

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Room Temperature - Summer | **Worksheet WS6a**

References:

Find summer supply temperature T_{SS} = 20 – 0.828 H/(O/R) ____ = T_{SS} ____ °C

Q(O/R) ____

Note: The temperature of a space may be calculated from

$$T = \frac{t_1 Q_1 + t_2 Q_2 + \ldots\ldots\ldots\ldots + t_n Q_n + (0.828H)}{Q_1 + Q_2 + \ldots Q_n}$$

Where t_1 is temperature of source (1°C)
Q_1 is flow from source 1 when all doors are closed (m^3/s)
H is heat gain in space (kW)

Summary of Air Supply and extract for an Operating Suite

Consider all doors closed

Room	Heat Gain kWh	Supply		Flows Inwards										Temperature °C T
		Q	T_{SS}	From		From		From		From		From		
				Q	t	Q	t	Q	t	Q	t	Q	t	

Check Doors to Sterile Areas

Door Between	Calculated Room ΔT (°C)	Maximum ΔT *Permitted*	Remarks

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Room Temperature - Winter | **Worksheet WS6b**

References:

Find winter supply temperature T_{SW} = 20 – 0.828 H/(O/R) _____ = T_{SW} _____ °C

Q(O/R) _____

Note: The temperature of a space may be calculated from

$$T = \frac{t_1 Q_1 + t_2 Q_2 + \ldots\ldots\ldots\ldots + t_n Q_n + (0.828H)}{Q_1 + Q_2 + \ldots Q_n}$$

Where t_1 is temperature of source (1°C)
Q_1 is flow from source 1 when all doors are closed (m^3/s)
H is heat gain in space (kW)

Summary of Air Supply and extract for an Operating Suite

Consider all doors closed

Room	Heat Gain kWh	Supply		Flows Inwards										Temperature °C T
		Q	T_{SW}	From		From		From		From		From		
				Q	t	Q	t	Q	t	Q	t	Q	t	

Check Doors to Sterile Areas

Door Between	Calculated Room ΔT (°C)	Maximum ΔT *Permitted*	Remarks

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Transfer Grilles, Pressure Relief Dampers and Pressure Stabilisers	**Worksheet WS7** **Reference:**

Transfer Grilles – see paragraphs A4.34 – A4.38

Check Doors to Sterile Areas

No	Location	Pressure Difference Pa	Flow Rate m^3/s	Free Area m^2	Model	Resultant Δp Pa	Remarks

Pressure Relief Dampers – see paragraph A4.39

No	Location	Pressure Difference Pa	Flow Rate m^3/s	Free Area m^2	Pressure Setting Pa	Remarks

Pressure Stabilisers –see paragraphs A4.40 – A4.43

Note: where a stabiliser is acting both as series room door protection and operating pressure control, "pressure difference" and "flow rate" are from WS2d; "pressure setting" is from WS3

No	Location	Pressure Difference Pa	Flow Rate m^3/s	Free Area m^2	Pressure Setting Pa	Remarks

Surveyor (AP(V)/CP(V))…… Date……

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Department of Health

Health Building Note 04-01
Supplement 1
Isolation facilities for infectious patients in acute settings

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Health Building Note 04-01 Supplement 1
Isolation facilities for infectious patients in acute settings

Preface

About Health Building Notes

Health Building Notes give "best practice" guidance on the design and planning of new healthcare buildings and on the adaptation/extension of existing facilities.

They provide information to support the briefing and design processes for individual projects in the NHS building programme.

The Health Building Note suite

Healthcare delivery is constantly changing, and so too are the boundaries between primary, secondary and tertiary care. The focus now is on delivering healthcare closer to people's homes.

The Health Building Note framework (shown below) is based on the patient's experience across the spectrum of care from home to healthcare setting and back, using the national service frameworks (NSFs) as a model.

Health Building Note structure

The Health Building Notes have been organised into a suite of 17 core subjects.

Care-group-based Health Building Notes provide information about a specific care group or pathway but cross-refer to Health Building Notes on **generic (clinical) activities** or **support systems** as appropriate.

Core subjects are subdivided into specific topics and classified by a two-digit suffix (-01, -02 etc), and may be further subdivided into Supplements A, B etc.

All Health Building Notes are supported by the overarching Health Building Note 00 in which the key areas of design and building are dealt with.

Example

The Health Building Note on accommodation for adult in-patients is represented as follows:

> "Health Building Note 04-01: Adult in-patient facilities"

The supplement to Health Building Note 04-01 on isolation facilities is represented as follows:

> "Health Building Note 04-01: Supplement 1 – Isolation facilities for infectious patients in acute settings"

Health Building Note number and series title	Type of Health Building Note
Health Building Note 00 – Core elements	Support-system-based
Health Building Note 01 – Cardiac care	Care-group-based
Health Building Note 02 – Cancer care	Care-group-based
Health Building Note 03 – Mental health	Care-group-based
Health Building Note 04 – In-patient care	Generic-activity-based
Health Building Note 05 – Older people	Care-group-based
Health Building Note 06 – Diagnostics	Generic-activity-based
Health Building Note 07 – Renal care	Care-group-based
Health Building Note 08 – Long-term conditions/long-stay care	Care-group-based
Health Building Note 09 – Children, young people and maternity services	Care-group-based
Health Building Note 10 – Surgery	Generic-activity-based
Health Building Note 11 – Community care	Generic-activity-based
Health Building Note 12 – Out-patient care	Generic-activity-based
Health Building Note 13 – Decontamination	Support-system-based
Health Building Note 14 – Medicines management	Support-system-based
Health Building Note 15 – Emergency care	Care-group-based
Health Building Note 16 – Pathology	Support-system-based

Other resources in the DH Estates and Facilities knowledge series

Health Technical Memoranda

Health Technical Memoranda give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare (for example medical gas pipeline systems, and ventilation systems).

They are applicable to new and existing sites, and are for use at various stages during the inception, design, construction, refurbishment and maintenance of a building.

All Health Building Notes should be read in conjunction with the relevant parts of the Health Technical Memorandum series.

Activity DataBase (ADB)

The Activity DataBase (ADB) data and software assists project teams with the briefing and design of the healthcare environment. Data is based on guidance given in the Health Building Notes, Health Technical Memoranda and Health Technical Memorandum Building Component series.

1. Room data sheets provide an activity-based approach to building design and include data on personnel, planning relationships, environmental considerations, design character, space requirements and graphical layouts.
2. Schedules of equipment/components are included for each room, which may be grouped into ergonomically arranged assemblies.
3. Schedules of equipment can also be obtained at department and project level.
4. Fully loaded drawings may be produced from the database.
5. Reference data is supplied with ADB that may be adapted and modified to suit the users' project-specific needs.

Note

The sequence of numbering within each subject area does not necessarily indicate the order in which the Health Building Notes were or will be published/printed. However, the overall structure/number format will be maintained as described.

Executive summary

This Health Building Note sets out practical guidance on how to provide safe, effective isolation facilities for infectious patients (source isolation) that are simple to use and meet the needs of most patients on acute general wards.

This guidance describes:

- how a single-bed room with en-suite sanitary facilities can be used to provide effective isolation for patients with non-airborne diseases;
- how a ventilated single-bed room with en-suite facilities can provide an isolation room for patients who have an infection that can be spread by the airborne route.

It can be used for both new-build schemes and the upgrading of existing accommodation.

Room layouts are included as illustrative examples; other room configurations are possible.

It is advised that this Health Buulding Note be read in conjunction with:

- 'Infection control in the built environment' (DH, 2002), which provides information about how good design can prevent cross-infection in healthcare premises generally;
- Health Building Note 04-01 – 'Adult in-patient accommodation', which covers the planning and design of in-patient facilities for adults and includes space standards for bed areas (including isolation rooms and lobbies).
- 'Single-bed room: design manual', in Health Building Note 00-03 – 'Clinical and clinical support spaces', which provides detailed design information and layouts for single-bed rooms.

This document part supersedes Health Building Note 04-01 Supplement 1 (2005), specifically the guidance therein that relates to rooms used for source isolation. It does not supersede the guidance on protective isolation.

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Contents

1 Introduction

1.1 The key to effective isolation on acute general wards is the provision of single-bed rooms with en-suite sanitary facilities. Single-bed rooms reduce the risk of cross-infection for non-airborne diseases and help to lower the incidence of healthcare¬associated infections. Most patients requiring isolation on acute general wards can be isolated in single-bed rooms with en-suite facilities. All single-bed rooms in new-build hospitals and wards should have en-suite facilities so that they can be used to isolate patients, among other reasons. It is the Department of Health's policy that any new build or major reconfiguration should have as a minimum 50% single-bed rooms.

1.2 The infection control team should be closely involved with all aspects of planning for, and determining the provision of, isolation facilities. When undertaking a project, a multi-disciplinary approach should involve the:

- infection control team and clinical team;
- architect and designer;
- building contractor and mechanical/electrical maintenance service providers;
- in-house estates team.

1.3 In accordance with 'The Code of Practice on the the prevention and control of infections and related guidance' (2010), it is recommended that all registered providers put in place systems to manage and monitor the prevention and control of infection. These systems use risk assessments and consider how susceptible patients are and any risks that their environment and other users may pose to them.

1.4 The provision of isolation rooms that are switchable from positive to negative air pressure is not recommended because of the risk to people inside and outside the room in the event of the setting being incorrect.

1.5 The guidance on PPVL and negative pressure isolation suites in this document is based on a model that was validated by the Building Services Research and Information Association (BSRIA) and the University of Leeds. The complete validation process and results obtained will be available from BSRIA (see link in References section).

Exclusions

1.6 This Health Building Note does not describe the specialist facilities required in high security infectious disease units, isolation wards for cohorting groups of infectious patients, protective isolation for severely immuno-compromised patients, critical care areas and special care baby units. It focuses on single occupancy isolation rooms only.

2 Options for provision

2.1 This chapter describes:

- how a single-bed room with en-suite sanitary facilities can be used to provide effective isolation for patients with non-airborne diseases (see paragraph 2.2);
- how a ventilated single-bed room with en-suite sanitary facilities can provide an isolation room for patients who have an infection that can be spread by the airborne route (see paragraph 2.9).

Single-bed room

2.2 A single-bed room with en-suite sanitary facilities is a simple, cost-effective way to provide isolation, and will meet the needs of most patients on general wards. An example layout for a new-build single-bed room with en-suite facilities is shown in sheet 1 (Appendix 1).

2.3 Detailed design guidance and space standards are given in Health Building Note 04-01 – 'Adult in-patient accommodation' and 'Single-bed room' in Health Building Note 00-03 – 'Clinical and clinical support spaces'. Key considerations are the inclusion of:

- en-suite sanitary facilities;
- optional lobby – if a lobby is not provided, space is needed for personal protective equipment and its disposal;
- clinical wash-hand basin in the room and in the lobby, if provided;
- good patient observation facilities;
- design features that enhance patient comfort (for example, ability to see out of the room).

2.4 Openable exterior windows and suspended tiled ceilings are optional.

2.5 See also Health Facilities Note 30 – 'Infection control in the built environment'.

2.6 Some patients with infections need to stay in isolation in hospital for long periods. The number of visitors they receive and the length of time they can spend with them may be restricted. This means that patients who are already vulnerable, but not necessarily physically severely incapacitated, will be confined to the room for sometimes several weeks and can experience long periods of boredom.

2.7 Accommodation for these patients should be stimulating and as comfortable as possible. Designers should try to achieve a balance between the need for a clean environment and the comfort of patients. A number of publications describe in detail evidence that supports the concept that a therapeutic environment has a positive effect on a patient's general feeling of well-being; reduces the length of stay for many patients; reduces depression, confusion and aggressive episodes; and significantly increases a patient's level of satisfaction with the overall quality of their care (see Health Building Note 04-01 – 'Adult in-patient accommodation').

2.8 If patients are to stay in an isolation room, it is important that they are able to see staff from their beds. This reduces the psychological problems of isolation. Staff should also be able to see the patient in case of emergency. Observation windows should have integral privacy blinds or glass that can be obscured electronically, which can be controlled by both staff and patients. The sense of containment can also be reduced by providing outside views using windows with low sills.

Options for preventing the spread of pathogens that are transmitted by the airborne route

Note

The isolation room should be physically constructed so that undesirable air flow in or out is restricted. This is described as the "permeability" of the room, which in simple terms is a measure of how leaky it is. If air can leak between an isolation room and an adjacent area in either direction, then this presents a route for the transmission of an airborne infection (see also Appendix 2).

2.9 A ventilated single-bed room with en-suite facilities can provide an isolation room for patients who have an infection that can be spread by the airborne route. This includes chickenpox, measles and some cases of pulmonary tuberculosis. It is for local clinical risk assessment to decide which patients will need to be nursed in these facilities.

2.10 The two options are:

- a room with negative pressure ventilation (see paragraph 2.11) or;
- neutral pressure room with a positive pressure ventilated lobby (PPVL – see paragraph 2.21).

Negative pressure room

2.11 This room is at negative pressure to the corridor and other adjacent areas (except for its en-suite).

2.12 The robust direction of air flow is more important than the numerical value of the pressure differential (see paragraph 2.15, 'Basic design parameters').

2.13 The inflow of air into the room (negative pressure) prevents the escape of contaminated air to surrounding areas; the ventilation in the room dilutes airborne pathogens.

Room criteria

- A sealed solid integrated ceiling should be installed.
- Windows to the exterior should be unopenable and well-sealed.
- Service penetrations should be minimised to support the room being well-sealed.
- A transfer grille to en-suite facility should be provided.
- Doors are a critical part of the design. The door from the corridor to the patient's room should be well hung and open into the patient's room. It should be fitted with a door closer to ensure that the pressure regime is maintained. The door between the patient's room and en-suite should be well hung and swing both ways. It may be "undercut" or fitted with a transfer grille in its lower half in order to promote an inflow of air to the en-suite.

2.14 For space requirements, see Health Building Note 04-01 – 'Adult in-patient accommodation'.

Basic design parameters

2.15 The patient's room should have around 10 air changes per hour and should be compatible with patient comfort. Air flow should be fully mixed to ensure good dilution and removal of airborne pathogens from the room space. The pressure differential to surrounding areas should indicate a definite inward flow of air. Any value in excess of 5 pascals should be sufficient to achieve and maintain this condition. An extract should be provided in the patient's room.

Note

Careful positioning of the extract should be considered. If supply and extract are adjacent to each other, short-circuiting of air flow will occur and although the room may seem to have a suitable air change rate and pressure regime, it will be inefficiently ventilated and not well-mixed.

2.16 To be effective, the extract in the en-suite should be sized to handle approximately two-thirds of the total isolation room's extract requirements.

2.17 The en-suite facility should be sized according to the recommendations given in Health Building Note 04-01 – 'Adult in-patient accommodation'.

2.18 If the room has both mechanically supplied and extracted air, these should be interlocked so that, should the extract fail, the supply will cut out (otherwise the room would be under positive pressure). Appropriate standby provision should be identified (for example connection to the essential power supply or uninterruptible power supplies) to enable continuity of supply should a mains power failure occur (see Health Technical Memorandum 06-01 – 'Electrical services supply and distribution').

Monitoring and record keeping

2.19 The pressure differential between the patient room and corridor should be monitored continuously (for example, by using a differential pressure sensor). Failure to maintain a negative pressure should activate an alarm at a designated nurse station as well as in the estates department via a building management system. There should be a delay on the alarm to allow doors to be opened, resulting in a temporary zero pressure differential, to allow the transfer of a bed into and out of the room. Note that when the bed is moved into or out of the room, the patient is NOT in isolation.

2.20 A magnehelic pressure gauge should show the pressure differential between the patient room and the corridor. It should be mounted at eye level on the corridor wall adjacent to the entry door. The gauge should be clearly marked to identify the isolation room to which it refers.

Positive pressure ventilated lobby (PPVL) room

2.21 This is a single-bed room with a PPVL and en-suite sanitary facilities with extract ventilation (see sheet 2 of Appendix 1 for an example layout).

Room criteria

- One or more pressure stabilisers should be installed above the door between the lobby and the patient's room.
- A suitable extract system to the en-suite facility should be provided.
- A transfer grille in the lower section of the en-suite door should be installed.
- To support the room being well-sealed, the detail of the construction joints between elements of the building and service penetrations will be critical to achieving the air-leakage standard demanded. The joints should be carefully sealed as construction progresses and service penetrations minimised, as they will be inaccessible once the inner finish is applied (see Appendix 2 on air leakage).
- The door between the corridor and the lobby should open into the lobby and be fitted with a door closer. The door between the lobby and patient's room should open back into the lobby and be fitted with a door closer. This is to ensure that the closure of both doors is aided by the lobby pressure, thus maintaining the air flow direction and pressure regime of the suite.
- If bed entry to the suite is through the lobby, one-and-a-half-leaf door sets will need to be fitted. Space constraints may make it necessary to hang the half-leaf from parliament hinges so that it can be opened back against the corridor or the wall of the patient's room (see Appendix 1, sheets 2, 5 and 6). Once the bed has passed through the lobby, the half-leaf should be latched shut. Entry for personnel will be via the single door leaf. An oversized door should not be used in place of the one-and-a-half-leaf door set.

2.22 For space requirements, see Health Building Note 04-01 – 'Adult in-patient accommodation'.

Basic design parameters

2.23 The patient's room is to have 10 air changes per hour mechanical air change rate. The entry lobby should have a positive pressure of between 8 and 12 pascals with respect to the corridor. The en-suite facility is to have at least 10 air changes per hour and be at a negative pressure with respect to the patient's room. Table 1 gives nominal design values calculated for rooms of the size stated.

2.24 Modifying or failing to provide one element of the system will jeopardise the performance of the system as a whole.

2.25 An extract terminal should be fitted at high level in the en-suite facility.

2.26 A transfer grille should be fitted at low level in the door between the patient's room and the en-suite facility.

2.27 A pressure stabiliser of the balanced blade type, set to operate at 10 pascals, should be fitted above the door between the lobby and the patient's room. The stabiliser should be visible so that its correct operation can be seen. It should be of a style that will operate silently, and be correctly sized and positioned so that it does not cause a draught that would be uncomfortable for patients.

Note

It is critical to the correct function of this design concept that the stabiliser be fitted as described and the transfer grille in the en-suite door also be fitted as described. This will set up a cyclonic circulation in the patient's room and provide the desired dilution protection levels.

Table 1 PPVL isolation suite – ventilation parameters

Room	Parameter	Nominal design values
Lobby	Room volume Bed access lobby (5 m^2 × 2.7 m) Personnel access lobby (4 m^2 × 2.7 m)	13.5 m^3 10.8 m^3
	Pressure differential to corridor	Nominally 10 pascals
	Supply air flow (see Note 3)	Bed access lobby – 238 L/s Personnel access lobby – 208 L/s
	Air change rate	Bed access lobby – 63 per hour Personnel access lobby – 69 per hour
Isolation room	Room volume (19 m^2 × 3 m)	57 m^3
	Pressure differential to corridor	Nominally zero
	Room air flow	158 L/s
	Air change rate	10 per hour
En-suite	Room volume (6 m^2 × 2.7 m)	16.2 m^3
	Pressure differential to isolation room	Negative
	Extract air flow	158 L/s (if extract is fitted in the isolation room this reduces to approximately 100 L/s in the en-suite with approximately 58 L/s extract in the isolation room)
	Air change rate	At least 10 per hour

Notes

1. In this example, the design parameters are based on Health Building Note 04-01 – 'Adult in-patient accommodation'. The en-suite is sized to comply with BS 8300 accessibility requirements.
2. The air flow rates quoted do not include any allowance for construction leakage. Airtightness specifications are given in Approved Document L of the Building Regulations (2010). See also the Air Tightness Testing & Measurement Association's (ATTMA) 'Technical Standard L2: Measuring air permeability of building envelopes (non-dwellings)' (see Appendix 2).
3. These are typical values based on standard room sizes. The actual volume of air required will be the sum of the air required to provide 10 air changes per hour in the patient's room + the air leakage through the door between the lobby and corridor at a differential pressure of 10 pascals. (See Appendix 4 in Health Technical Memorandum 03-01 Part A for leakage rate for single and double doors at 10 pascals.)

2.28 A direct reading gauge showing the pressure in the lobby with respect to the corridor should be mounted at eye level on the corridor wall adjacent to the lobby entry door. The gauge and lobby entry door should be clearly marked to identify the isolation room to which they refer.

2.29 Door undercuts are not recommended.

Supply ventilation for PPVL rooms

2.30 The supply air handling unit (AHU) and distribution ductwork should be clearly marked to identify the isolation suite that they serve. Service, maintenance, cleaning and filter change of the system will be subject to a permit to work.

2.31 A G3 pre-filter and a final filter to at least F7 standard should be fitted in the AHU.

2.32 In order to future-proof the system, the supply terminal in the lobby should be of a type that can accept a HEPA filter.

Monitoring and record keeping 14371

2.33 A record of pressure differentials, observed and recorded once per nursing shift, should be made. Ward staff should be made aware of what to do if the readings are out of specification.

Extract ventilation – negative pressure and PPVL rooms

2.34 The extract fan unit should preferably be located outside the building so that all ductwork within the building is under negative pressure. Access and cleaning hatches should only be fitted where absolutely necessary. If fitted they should be of the

sealed type and marked with a biohazard symbol. If the fan has to be located inside the building, it should be as close as practicable to the outside. The extract fan motor should be mounted out of the air stream and should be capable of being changed without withdrawing the impeller or opening up the ductwork. The extract fan should draw its power from the essential electrical system.

2.35 Extract filters will not be required provided that the fan can discharge in a safe location 3000 mm above the building height. If extract filters are fitted, they should be in a "safe change housing" outside the building on the suction side of the fan. Extract filters, where fitted, should be of HEPA grade. Even if filtered, extract air should not be recirculated.

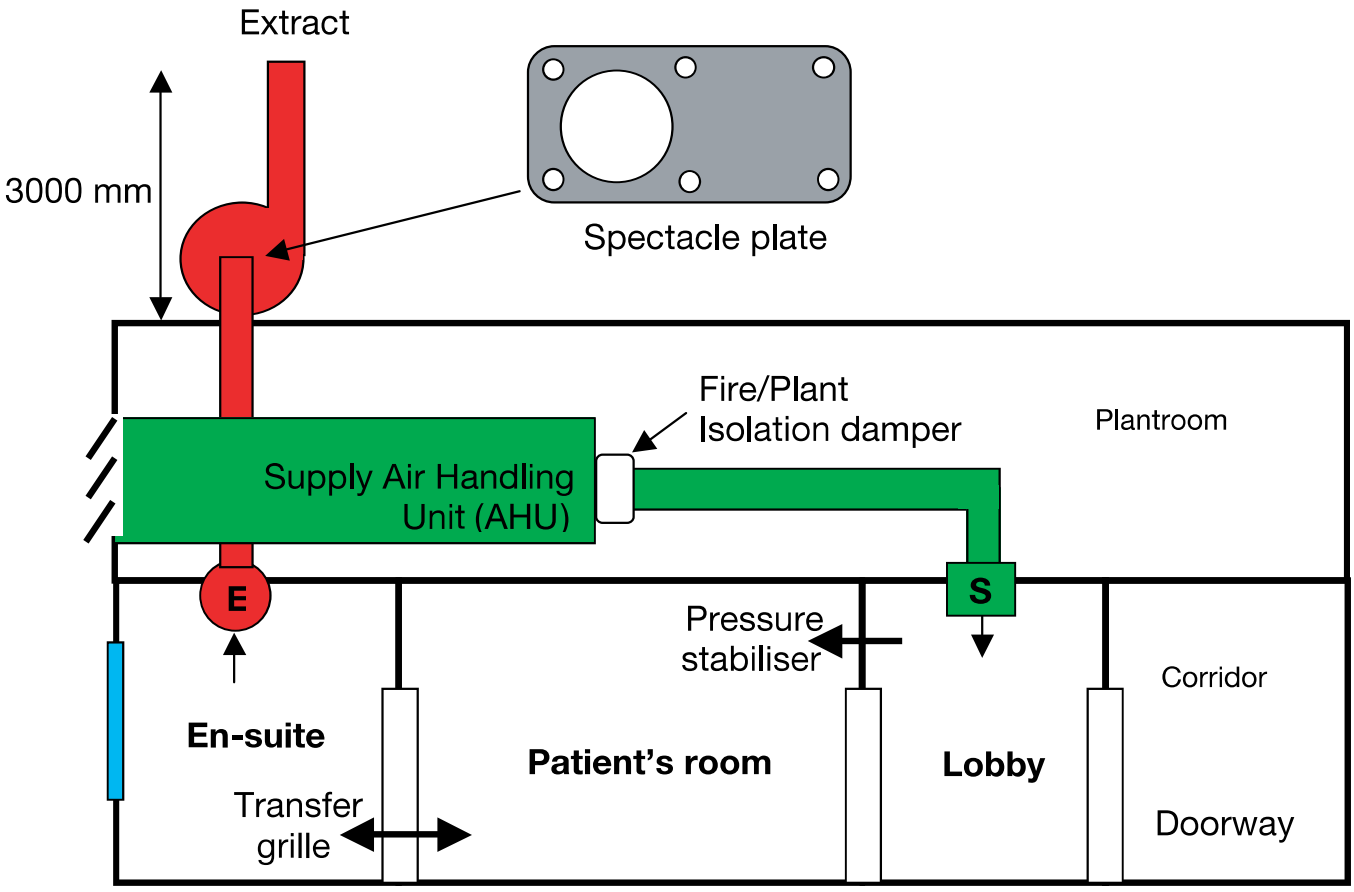
2.36 Extract ductwork, the fan and discharge stack should be clearly marked to identify the isolation suite that they serve. Service, maintenance, cleaning and filter change of the system will be subject to a permit to work.

2.37 Ideally each isolation suite should have its own dedicated supply and extract system. If two or more suites share a ventilation system, there will be an inevitable increase in the complexity of the system and a corresponding reduction in reliability and serviceability. Routine maintenance or breakdown of the ventilation system will result in failure of all suites that it serves; therefore, ideally each such isolation suite should have its own dedicated AHU.

2.38 In a high-rise building, a common supply and extract system may be the only feasible solution. In this case, run and standby fans would be required for the extract, and a duplicate supply unit may be considered necessary. The common supply and extract systems will need to be controlled to ensure a constant volume in each isolation suite branch regardless of the number in use.

2.39 Ductwork should be kept as direct and simple as possible.

Figure 1 Extract ventilation – negative pressure and PPVL rooms



Documentation

2.40 A logbook retained by the estates department will be required for each isolation room/suite. It should contain the following information:

- a schematic layout of the isolation room/suite and ventilation system serving it;
- information on the ventilation design parameters;
- a record of the actual ventilation performance at initial validation;
- records of the annual validations;
- records of any routine service and maintenance activities;
- records of any repairs or modifications.

3 Converting existing facilities

Note

Air permeability tests should be carried out during and following all refurbishment work.

3.1 En-suite single-bed rooms and isolation suites can be provided by converting bays and adapting existing single-bed room accommodation. The layout of existing facilities may impose constraints on design, however, and planning teams will sometimes have to resolve the conflict between what is desirable and what is achievable.

3.2 When converting existing accommodation into isolation facilities, the easiest and least expensive option is to adapt existing en-suite single-bed rooms. However, where existing single-bed rooms do not have en-suite facilities, the accommodation will need to be reconfigured (see below).

Converting an en-suite single-bed room

3.3 A typical layout for converting an existing en-suite single-bed room is shown in example layout sheet 3 of Appendix 1.

Converting a single-bed room without en-suite facilities

3.4 In an existing building, it may be possible to modify three adjacent single-bed rooms into two single-bed rooms each with en-suite facilities – see sheet 4 of Appendix 1.

3.5 The requirements for disabled access, as set out in Approved Document M of the Building Regulations 2010 and the Equality Act 2010, should be met.

Creating an en-suite single-bed room with ventilated lobby

3.6 When converting a single-bed room into an en-suite single-bed room with ventilated lobby, any suspended ceiling should be replaced with a sealed solid ceiling. If a single-bed room has a suspended ceiling to permit access to overhead services, a sealed ceiling with sealable access hatches could be installed or the services moved.

3.7 Access is through a single door via the lobby. The existing door-and-a-half for bed access only should be kept locked and have seals to minimise air transfer.

3.8 An option for reconfiguring two existing single-bed rooms to provide one en-suite single-bed room with ventilated lobby, with bed access through the lobby, is shown in sheet 5 of Appendix 1.

3.9 Where space restrictions mean that bed access through the lobby is not possible, an alternative layout gives bed access directly to the patient's room from the corridor – see sheet 6 of Appendix 1.

Converting a multi-bed bay

3.10 An existing four-bed bay may be converted to provide two en-suite single-bed rooms (see sheet 7 of Appendix 1).

3.11 In this configuration it is not possible to provide a normal observation window. As observation is critical, however, one option would be to provide fully-glazed lobby and bedroom doors, with integral privacy blinds, to enable observation from the corridor and to provide a view out for the patient.

4 Fire safety

4.1 Where isolation rooms/suites are provided for the purposes of preventing the risk of spreading healthcare-associated infections to other parts of a ward, the normal fire safety precautions for single-bed room accommodation apply.

4.2 In the case of an isolation room with a PPVL, the ventilation system should comply with Health Technical Memorandum 03-01 – 'Specialised ventilation for healthcare premises'. Where the ventilation system passes through a compartment wall, sub-compartment wall or cavity barrier, it should be fitted with fire and or smoke dampers in accordance with Figure 10 of Health Technical Memorandum 05-02 – 'Guidance in support of functional provisions for healthcare premises'. If the ductwork is fire-rated, the system only requires a fire damper at its junction with the AHU as shown in the diagram in Figure 1, 'Extract ventilation – negative pressure and PPVL rooms'.

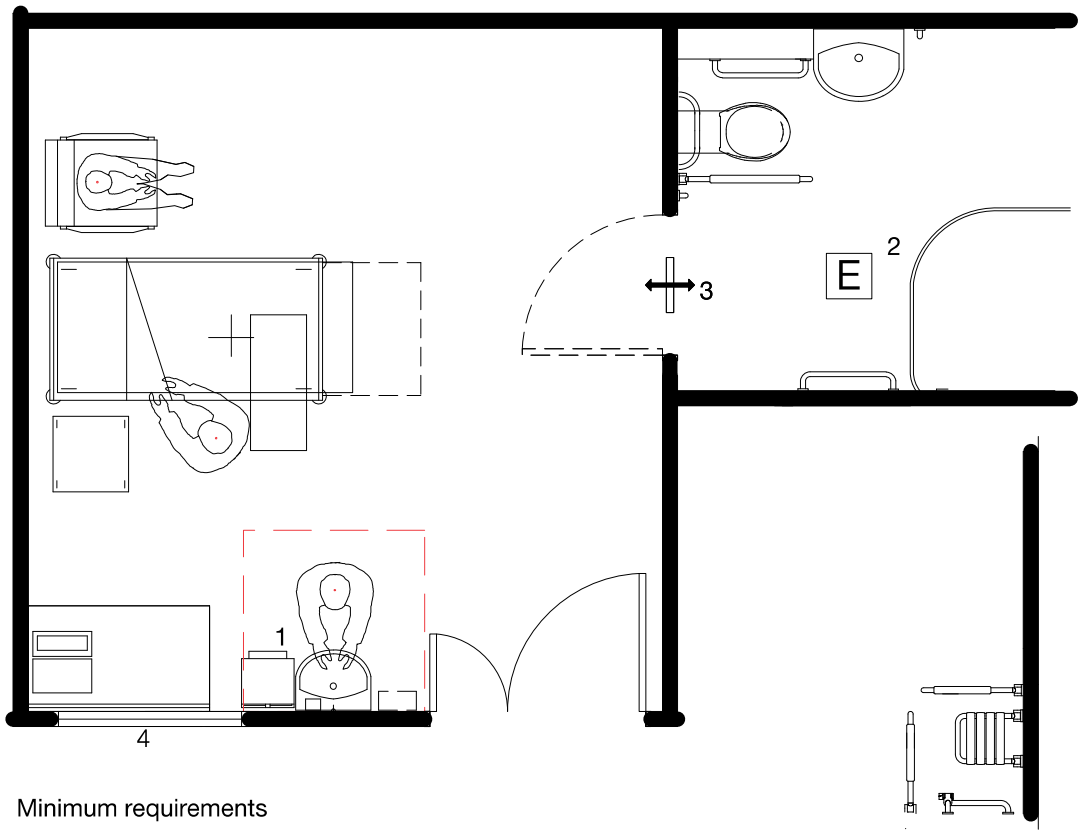
4.3 It is recommended that any discussions on fire safety should be discussed with the healthcare organisation's fire safety adviser, the building control authority and the local fire-and-rescue service.

Appendix 1 – Example room layouts

A1.1 The room layouts in this appendix are examples and are intended as a guide. Other room configurations are possible. Refer to 'Health Building Note 04-01 – Adult in-patient accommodation' and 'Single-bed room' in Health Building Note 00-03 – 'Clinical and clinical support spaces', which give definitive design guidance and space standards for multi-bed rooms and single-bed rooms with en-suite facilities.

A1.2 For guidance on the sanitary assemblies used in these layouts, see Health Building Note 00-10 Part C – 'Sanitary assemblies'.

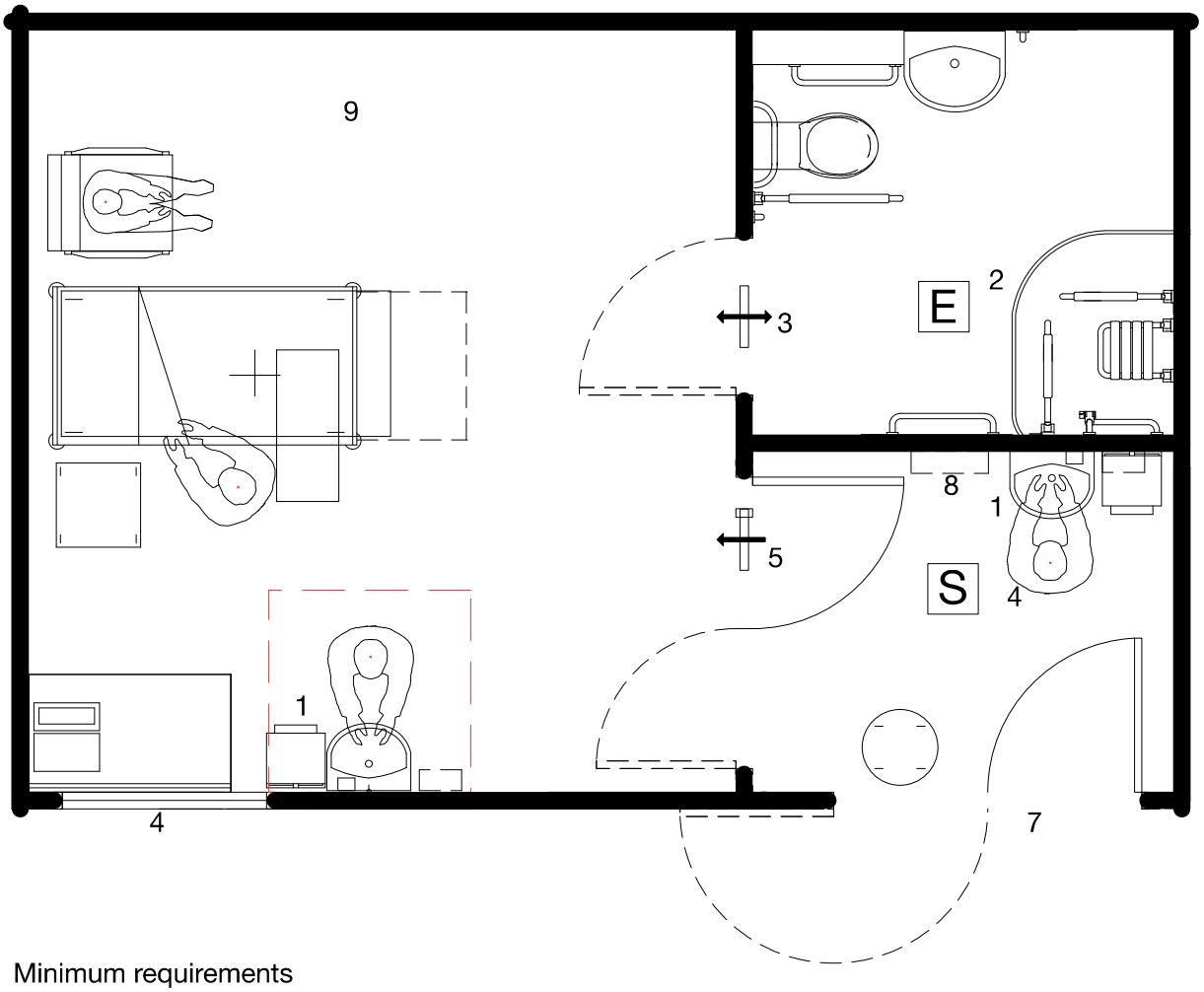
Sheet 1: New build single room with en-suite facilities



Minimum requirements

1. Clinical wash-hand basin
2. Provide suitable extract fan
3. Transfer grille to en-suite door
4. Observation window in corridor wall with integral privacy blinds to allow for staff observation and patient views out

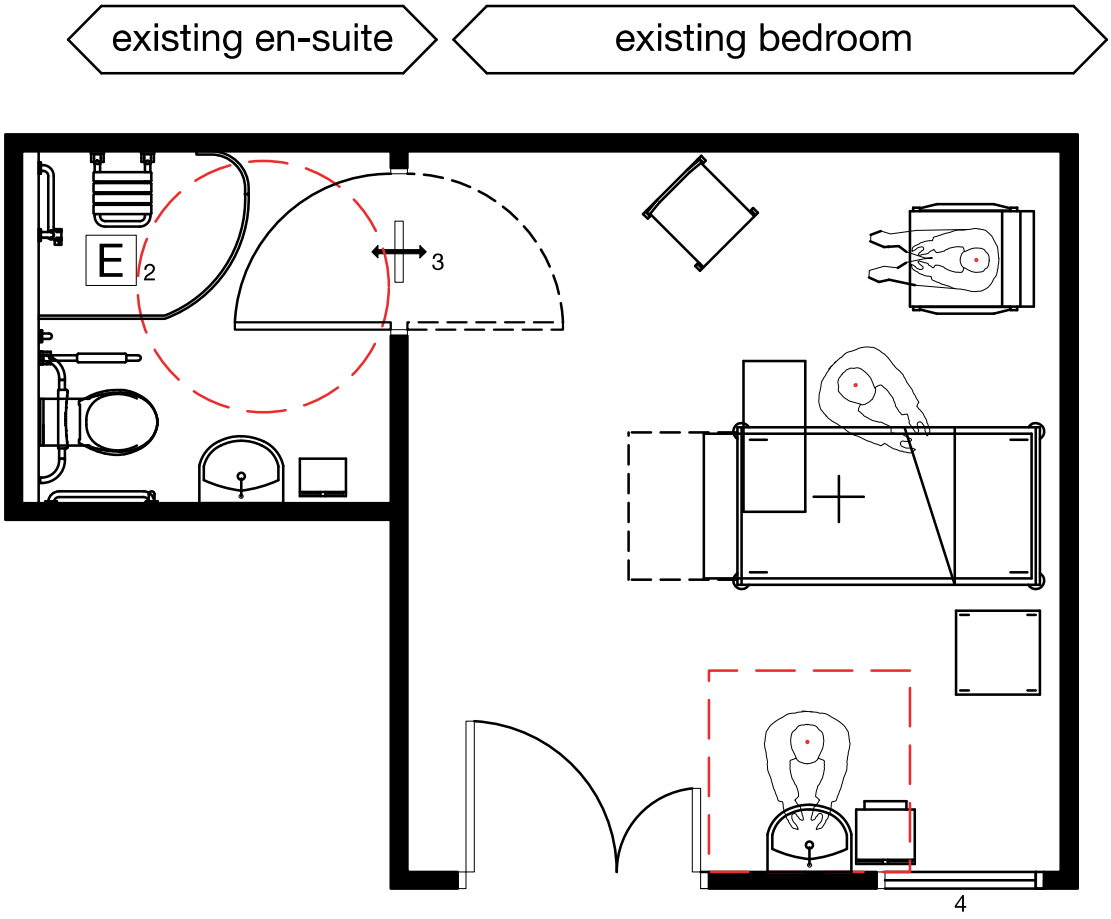
Sheet 2: New build single room with en-suite facilities and lobby



Minimum requirements

1. Clinical wash-hand basin
2. Provide suitable extract fan
3. Install transfer grille to en-suite door
4. Supply air
5. Pressure stabiliser
6. Observation window in corridor wall with integral privacy blinds to allow for staff observation and patient views out
7. Double door for personnel and bed access
8. Disposable apron dispenser
9. Ceiling to be sealed solid construction, external window to be sealed

Sheet 3: Existing single-bed room with en-suite facilities



Minimum requirements to upgrade existing facilities

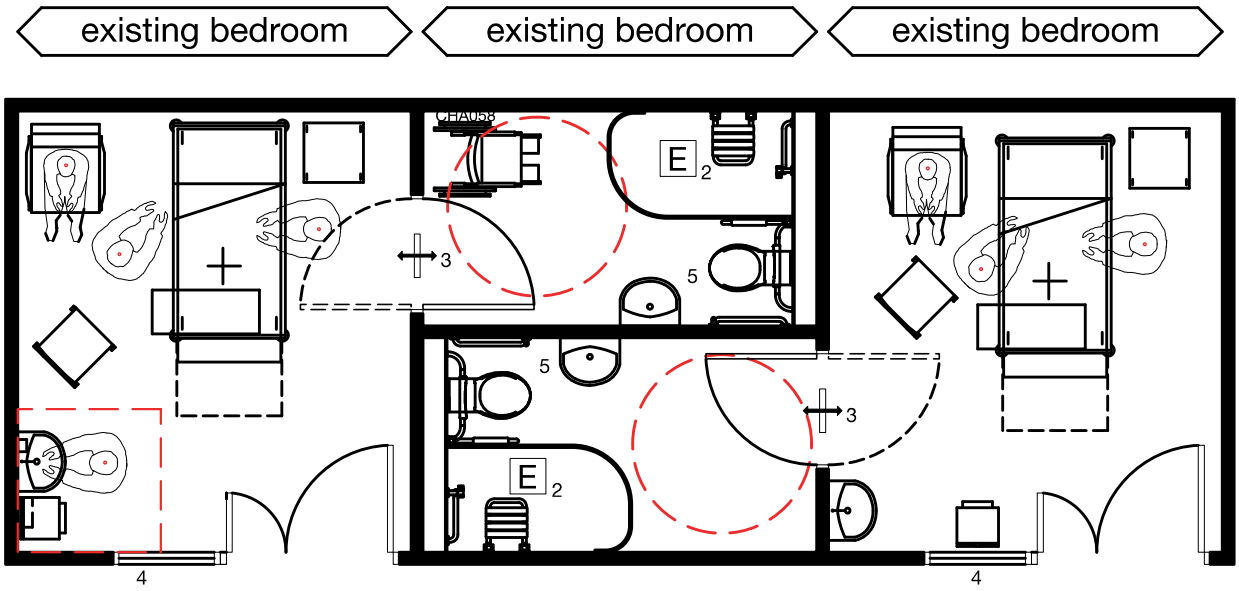
1. Add clinical wash-hand basin

2. Upgrade existing extract fan

3. Install transfer grille to en-suite door

4. Observation window in corridor wall with integral privacy blinds to allow for staff observation and patient views out

Sheet 4: Single-bed rooms without en-suite facility.
Upgrading three existing single-bed rooms to provide two single-bed rooms with en-suite facilities



Minimum requirements to upgrade existing facilities

1. Add clinical wash-hand basin

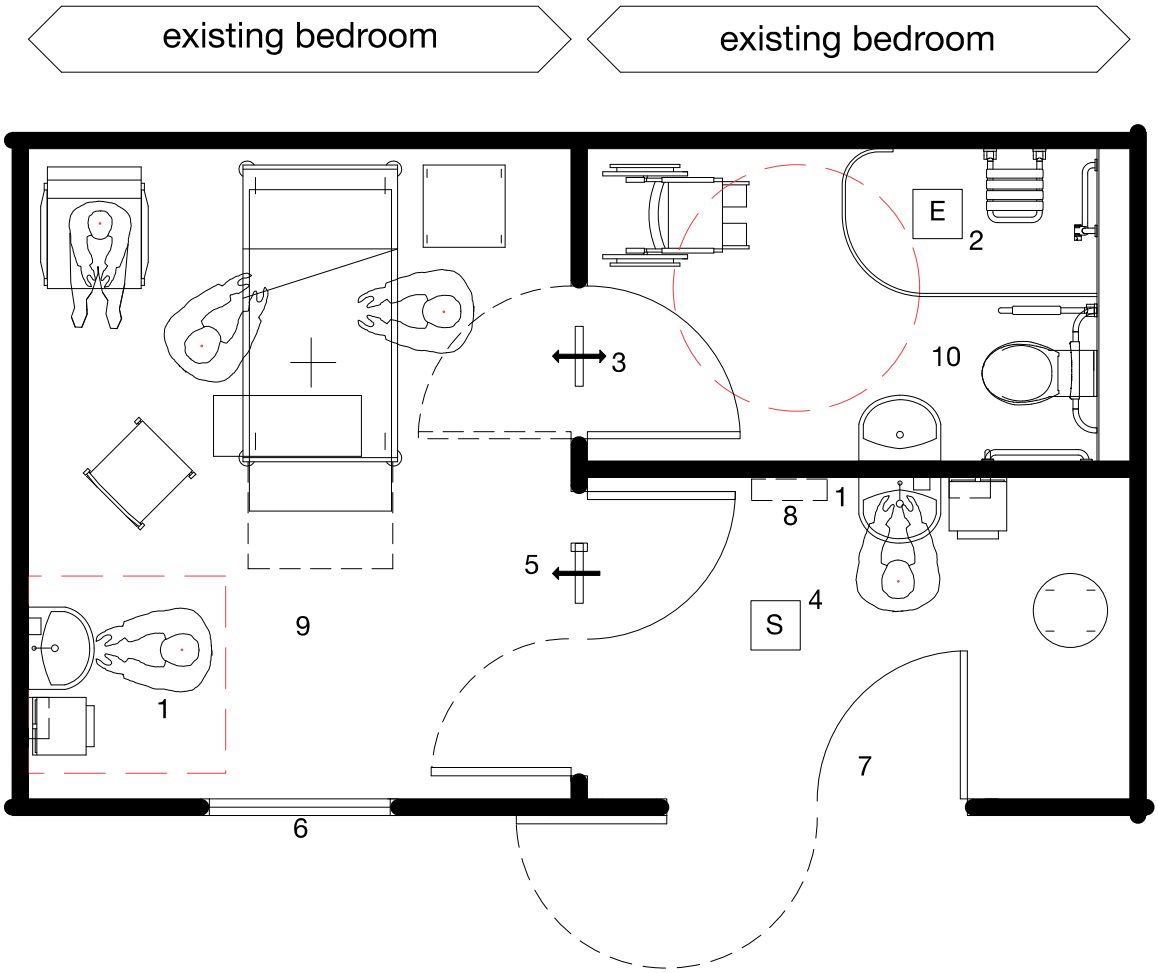
2. Provide suitable extract fan

3. Install transfer grille to en-suite door

4. Observation window in corridor wall with integral privacy blinds to allow for staff observation and patient views out

5. En-suite facility

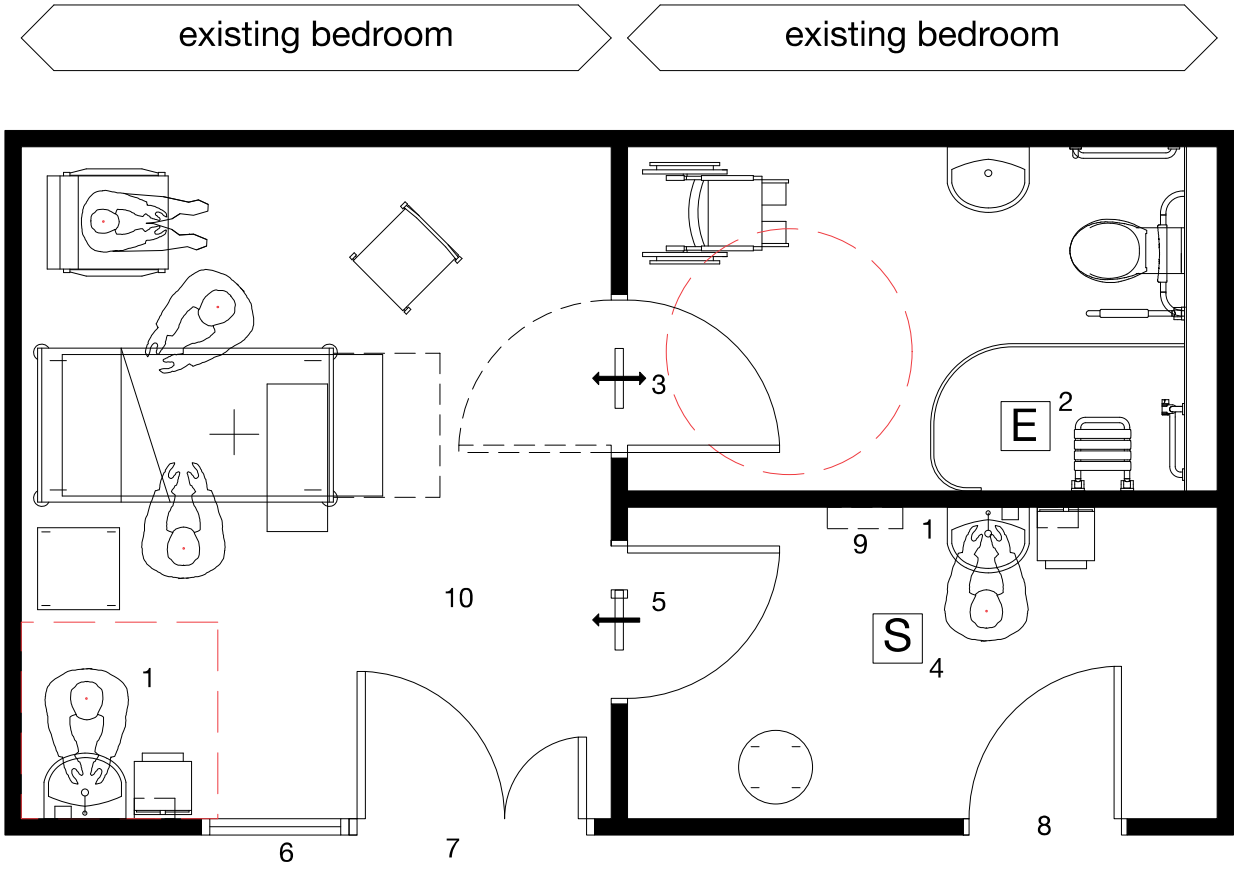
Sheet 5: Single-bed rooms without en-suite facility.
Upgrading two existing single-bed rooms to provide one single-bed room with en-suite facilities and alternative lobby



Minimum requirements to upgrade existing facilities

1. Add clinical wash-hand basin
2. Provide suitable extract fan
3. Install transfer grille to en-suite door
4. Supply air
5. Pressure stabiliser
6. Observation window in corridor wall with integral privacy blinds to allow staff observation and patients views out
7. Double door for personnel and bed access
8. Disposable apron dispenser
9. Upgrade ceiling to sealed solid construction, external windows to be sealed
10. En-suite facility

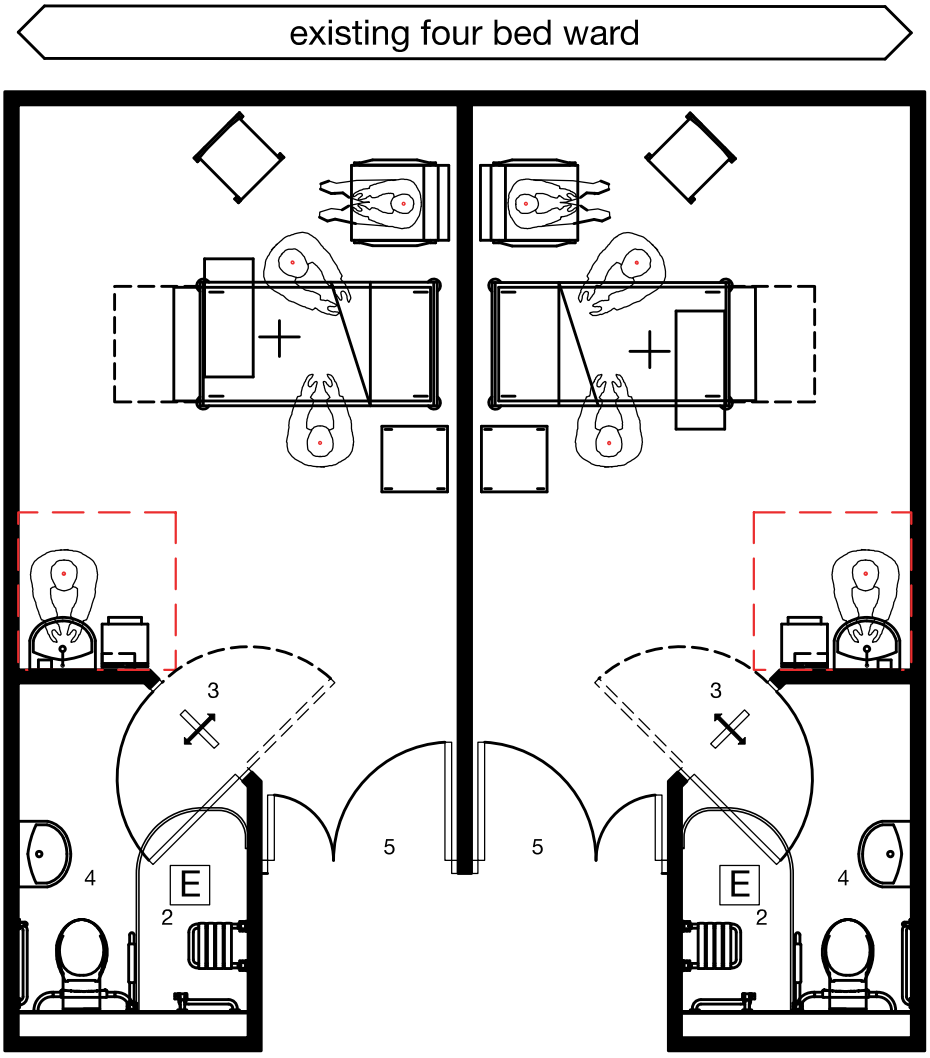
Sheet 6: Single-bed rooms without en-suite facility.
Upgrading two existing single-bed rooms to provide
one single-bed room with en-suite facilities and lobby



Minimum requirements to upgrade existing facilities

1. Add clinical wash-hand basin
2. Provide suitable extract fan
3. Install transfer grille to en-suite door
4. Supply air
5. Pressure stabiliser
6. Observation window in corridor wall with integral privacy blinds to allow for staff observation and patient views out
7. Existing door and a half for bed access only must be kept locked and have seals to minimise air transfer
8. Single door access via lobby
9. Disposable apron dispenser
10. Upgrade ceiling to sealed solid construction, external windows to be sealed

Sheet 7: Upgrading existing four-bed ward to provide two single-bed rooms with en-suite facilities



Minimum requirements

1. Clinical wash-hand basin
2. Provide suitable extract fan
3. Transfer grille to en-suite door
4. En-suite facility
5. Doors to be fully glazed, with integral privacy blinds, to allow staff observation and patients views out

Appendix 2 – Acceptance testing of isolation rooms/suites

Definitions

Isolation suite

A2.1 Includes the entry lobby, patient's room, en-suite facility and any storage or other area directly accessible from the patient's room or en-suite facility.

Isolation room envelope

A2.2 The isolation room bounded by a solid floor, solid ceiling and full-height walls that separate it from any other adjoining space or the outside.

Validation – isolation room air permeability

A2.3 Assessment of room envelope air leakage involves establishing a pressure differential across the envelope and measuring the air flow required to achieve that differential.

A2.4 Air permeability specifications are given in Approved Document L2A of the Building Regulations (2010). The standard for measuring air permeability is ATTMA's 'Technical Standard L2: Measuring air permeability of building envelopes (non-dwellings)' (see paragraph A2.XX 'Air permeability tests').

(Rationale: To ensure effective isolation, it is important that air leakage to or from adjacent areas is kept to a minimum. Construction gaps should be minimised and service penetrations sealed before the room is tested. There should be NO temporary seals other than those permitted (i.e. supply and extract ducts). The test pressures are significantly more than would be achieved under a ventilation fault condition within the isolation room. When in operation, the patient's room and en-suite are designed to be at a neutral or slightly negative pressure so the actual leakage between adjoining spaces should be insignificant.)

Validation and annual revalidation

Filtration test standards

A2.5 General and fine filter grades to BS EN 779 should be visually inspected to ensure that they are free from tears or other damage at the time of installation. They should be a good fit in their housing, with no obvious gaps that could allow air bypass.

A2.6 High efficiency particulate air (HEPA) filters, where fitted, should be certified by their manufacturer for conformity to BS EN 1822. When installed, their performance should be checked with a particle counter using the method set out in BS EN 1822.

Air permeability tests

A2.7 Air permeability tests should be carried out by an independent testing company that is a member of ATTMA. Air sealers should not test their own work. The report should be as described in ATTMA Technical Standard L2. See also CIBSE's 'Testing buildings for air leakage' (TM23, 2000).

A2.8 These tests should be carried out before initial commissioning and as necessary thereafter following works of refurbishment or when there is any doubt as to the actual performance standard of the room.

A2.9 As a minimum requirement, the air permeability should be no worse than that required by Approved Document L2A of the Building Regulations for the entire building. (This is a variable value with a minimum required air permeability of less than 10 $m^3.h^{-1}.m^{-2}$ at a reference pressure of 50 pascals.)

A2.10 Further clarification, specifications and test procedures can be obtained from BSRIA Test Standard BTS3 'Air permeability testing of isolation facilities' (forthcoming).

A2.11 Other tests may be necessary to check particular aspects of the specific installation. Where this is

necessary, reference should be made to Approved Document L2A of the Building Regulations.

System operating standard

A2.12 The room will be considered fit for purpose if, with the ventilation system operating and all doors closed, the following parameters are achieved:

- the patient's room has an air change rate of at least 10 per hour;
- the en-suite facility is at a negative pressure with respect to the patient's room;
- a failure of either the supply or extract fan will be indicated at a designated nurse station and the estates department.
- there is a positive pressure of between 8 and 12 pascals between the entry lobby and the corridor;

A2.13 For a PPVL:

- there is a positive pressure of between 8 and 12 pascals between the entry lobby and the corridor.

A2.14 For a negative pressure room:

- there is a negative pressure cascade from the corridor to the room.

A2.15 The room should be tested following initial commissioning and thereafter re-tested at least annually for conformity with this operating standard.

A2.16 These tests should include any pressure stabilisers and air pressure sensors. BSRIA Test Standard BTS2 'Test method for pressure stabilisers' (forthcoming) specifies a test procedure.

Record-keeping

A2.17 In addition to the commissioning and annual validation records, accurate and detailed monitoring records should also be kept.

References

Health Facilities Note 30 – 'Infection control in the built environment' (DH, 2002).

Health Building Note 04-01 – 'Adult in-patient accommodation'.

Health Building Note 00-03 – 'Clinical and clinical support spaces'.

Health Building Note 04-01 Supplement 1 (DH, 2005).

The Code of Practice on the prevention and control of infections and related guidance (2010).

The Code of Practice on the prevention and control of infections and related guidance PPVL validation research reports (forthcoming).

Health Technical Memorandum 06-01 – 'Electrical services supply and distribution'.

BS 8300:2009+A1:2010.

Building Regulations 2010: Approved Document. L2A: Conservation of fuel and power in new buildings other than dwellings.

Building Regulations 2010: Approved Document L2B: Conservation of fuel and power in existing buildings other than dwellings.

ATTMA 'Technical Standard L2 Measuring air permeability of building envelopes (non-dwellings)'.

Health Technical Memorandum 03-01 – 'Specialised ventilation for healthcare premises', Parts A and B.

Approved Document M of the Building Regulations 2010.

The Equality Act 2010.

Health Technical Memorandum 05-02 – 'Guidance in support of functional provisions for healthcare premises'.

Health Building Note 00-10 Part C – 'Sanitary assemblies'.

Approved Document L2A of the Building Regulations (2010).

BS EN 779:2012.

BS EN 1822 -1:2009.

CIBSE's 'Testing buildings for air leakage' (TM23, 2000).

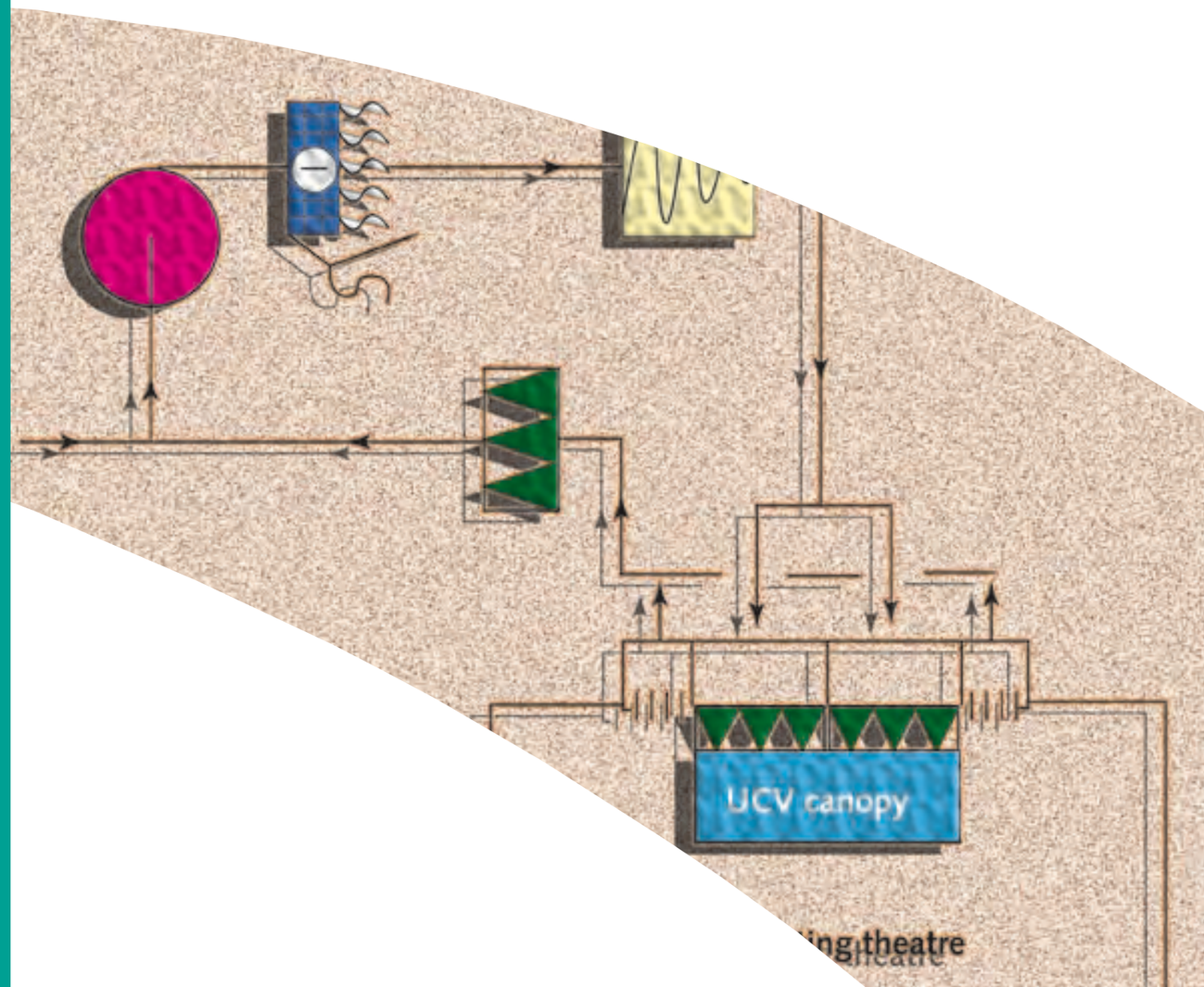
BSRIA Test Standard BTS3 'Air permeability testing of isolation facilities' (forthcoming).

BSRIA Test Standard BTS2 'Test method for pressure stabilisers' (forthcoming).

Department of Health

Heating and ventilation systems
Health Technical Memorandum 03-01: Specialised ventilation for healthcare premises

Part A: Design and validation



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Part A: Design and validation

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Preface

About Health Technical Memoranda

Engineering Health Technical Memoranda (HTMs) give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare.

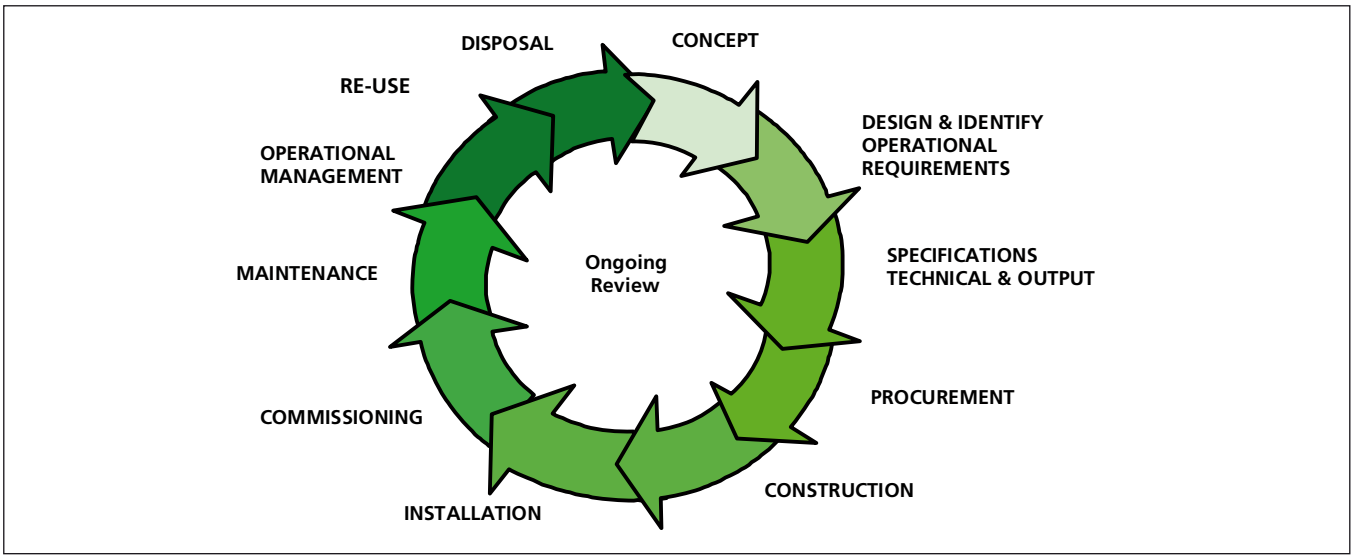
The focus of Health Technical Memorandum guidance remains on healthcare-specific elements of standards, policies and up-to-date established best practice. They are applicable to new and existing sites, and are for use at various stages during the whole building lifecycle.

main source of specific healthcare-related guidance for estates and facilities professionals.

The core suite of nine subject areas provides access to guidance which:

- is more streamlined and accessible;
- encapsulates the latest standards and best practice in healthcare engineering;
- provides a structured reference for healthcare engineering.

Figure 1 Healthcare building life-cycle



Healthcare providers have a duty of care to ensure that appropriate engineering governance arrangements are in place and are managed effectively. The Engineering Health Technical Memorandum series provides best practice engineering standards and policy to enable management of this duty of care.

It is not the intention within this suite of documents to unnecessarily repeat international or European standards, industry standards or UK Government legislation. Where appropriate, these will be referenced.

Healthcare-specific technical engineering guidance is a vital tool in the safe and efficient operation of healthcare facilities. Health Technical Memorandum guidance is the

Structure of the Health Technical Memorandum suite

The series of engineering-specific guidance contains a suite of nine core subjects:

Health Technical Memorandum 00
: Policies and principles (applicable to all Health Technical Memoranda in this series)

Health Technical Memorandum 01
: Decontamination

Health Technical Memorandum 02
: Medical gases

Health Technical Memorandum 03
Heating and ventilation systems

Health Technical Memorandum 04
Water systems

Health Technical Memorandum 05
Fire safety

Health Technical Memorandum 06
Electrical services

Health Technical Memorandum 07
Environment and sustainability

Health Technical Memorandum 08
Specialist services

Some subject areas may be further developed into topics shown as -01, -02 etc and further referenced into Parts A, B etc.

Example: Health Technical Memorandum 06-02 Part A will represent:

Electrical Services – Electrical safety guidance for low voltage systems

In a similar way Health Technical Memorandum 07-02 will simply represent:

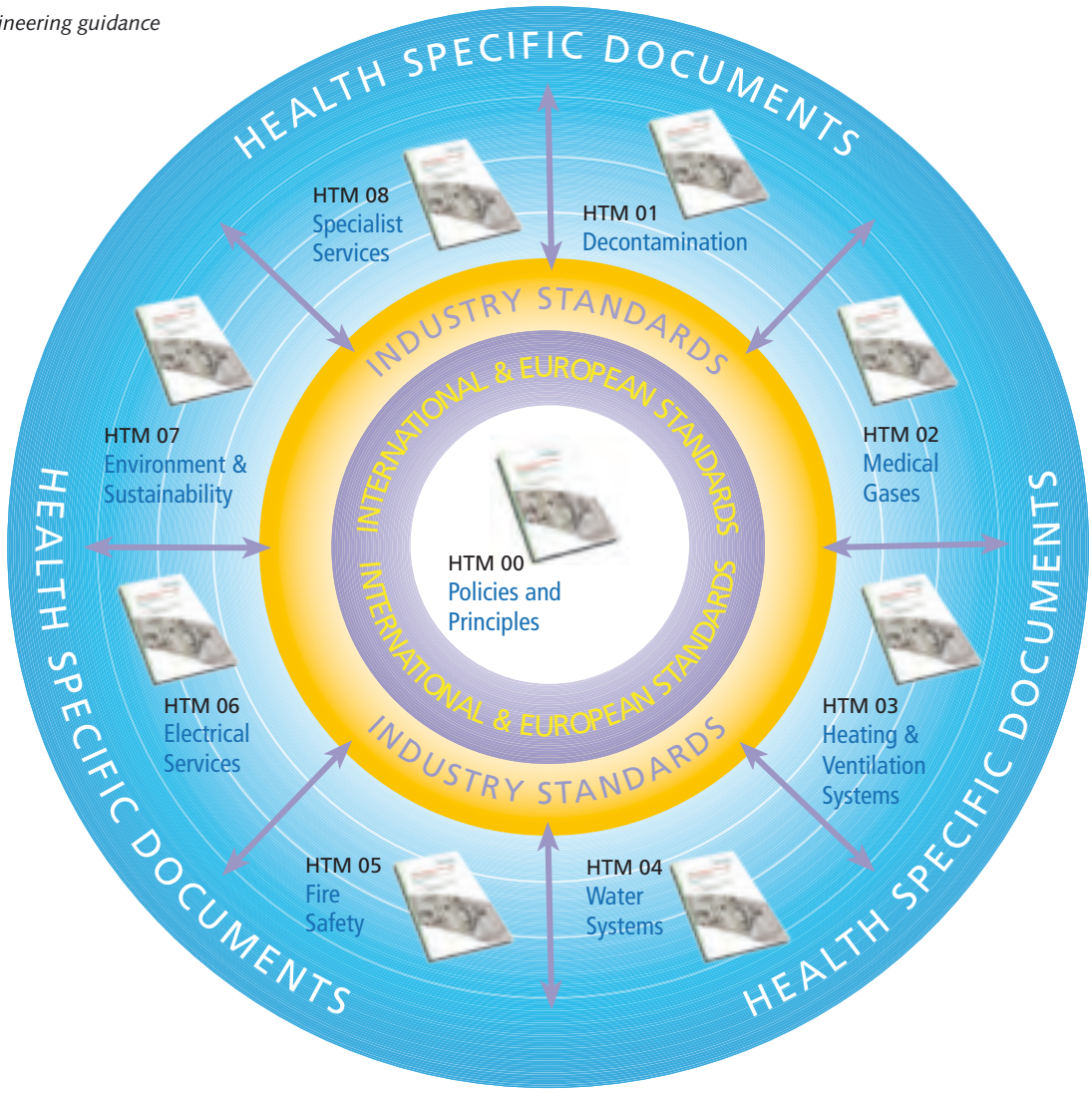
Environment and Sustainability – EnCO_2de.

All Health Technical Memoranda are supported by the initial document Health Technical Memorandum 00 which embraces the management and operational policies from previous documents and explores risk management issues.

Some variation in style and structure is reflected by the topic and approach of the different review working groups.

DH Estates and Facilities Division wishes to acknowledge the contribution made by professional bodies, engineering consultants, healthcare specialists and NHS staff who have contributed to the review.

Figure 2 Engineering guidance



Executive summary

Preamble

Health Technical Memorandum 03-01 – 'Specialised ventilation in healthcare premises' is published in two parts: Part A deals with the design and installation of ventilation systems; Part B covers operational management.

The document gives comprehensive advice and guidance on the legal requirements, design implications, maintenance and operation of specialised ventilation in all types of healthcare premises.

The guidance contained in this Health Technical Memorandum applies to new installations and major refurbishments of existing installations.

Health Technical Memorandum 03-01 supersedes all previous versions of Health Technical Memorandum 2025 – 'Ventilation in healthcare premises'.

Who should use this guidance?

This document is aimed at healthcare management, design engineers, estates managers and operations managers.

Main changes from Health Technical Memorandum 2025

This Health Technical Memorandum has been revised to reflect the current guidance on theatre suite layout and room sizes given in Health Building Note 26, Volume 1 – 'Facilities for surgical procedures', including the recommended air-change rates.

Other key issues

- It addresses the issues relating to patient comfort and the prevention and control of healthcare-associated infections. Specialised ventilation systems play a central role in these important areas.
- It looks at the methods of controlling the casual exposure of staff to anaesthetic substances.
- It outlines the design and acceptance testing of general and ultra-clean ventilation (UCV) systems.
- It sets out the minimum requirements for the design of air-handling units with regard to the control of *Legionella* and safe access for routine inspection and maintenance.

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Department of Health

Welsh Health Estates

NHS in Scotland

Health & Social Services, Northern Ireland

Health Protection Agency (HPA)

Building Research Establishment (BRE)

Building Services Research and Information Association (BSRIA)

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Howorth Airtech

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Weiss Klimatechnik

Sound Research Laboratories

NHS Security Management Service

Pennine Acute NHS Trust

Hospital Infection Society (HIS)

Central Sterilising Club

HEVAC – Air-handling Unit Manufactures Group

Contents

1 Introduction

Preamble

1.1 Health Technical Memorandum 03-01 – 'Specialised ventilation in healthcare premises' is published in two parts: Part A deals with the design and installation of ventilation systems; Part B covers operational management.

1.2 The document gives comprehensive advice and guidance to healthcare management, design engineers, estates managers and operations managers on the legal requirements, design implications, maintenance and operation of specialised ventilation in all types of healthcare premises.

1.3 The guidance contained in this Health Technical Memorandum applies to new installations and major refurbishments of existing installations.

1.4 Health Technical Memorandum 03-01 supersedes all previous versions of Health Technical Memorandum 2025 – 'Ventilation in healthcare premises'.

Ventilation in healthcare premises

1.5 Ventilation is used extensively in all types of healthcare premises to provide a safe and comfortable environment for patients and staff. More specialised ventilation is provided in primary patient treatment areas such as operating departments, critical care areas and isolation units.

1.6 It is also installed to ensure compliance with quality assurance of processed items in pharmacy and sterile services departments, and to protect staff from harmful organisms and toxic substances (for example in laboratories).

1.7 The sophistication of ventilation in healthcare premises is increasing. Patients and staff have a right to expect that it will be designed, installed, operated and maintained to standards that will enable it to fulfil its desired functions reliably and safely.

Reasons for ventilation

The Building Regulations require that all enclosed workspaces be ventilated by either natural or mechanical means. The following are some of the factors that determine the ventilation requirements of a workspace:

- human habitation (minimum fresh-air requirement);
- the activities of the department, that is, extraction of odours, aerosols, gases, vapours, fumes and dust – some of which may be toxic, infectious, corrosive, flammable, or otherwise hazardous (see the Control of Substances Hazardous to Health (COSHH) Regulations);
- dilution and control of airborne pathogenic material;
- thermal comfort;
- the removal of heat generated by equipment (for example catering, wash-up, sterilizing areas, electrical switchrooms, and some laboratory areas);
- the reduction of the effects of solar heat gains;
- the reduction of excessive moisture levels to prevent condensation (for example hydrotherapy pools);
- combustion requirements for fuel burning appliances;
- "make-up supply air" where local exhaust ventilation (LEV) etc is installed.

Mechanical ventilation systems are expensive in terms of capital and running costs, and planning solutions should be sought which take advantage of natural ventilation, provided the above criteria are met.

Ventilation – application examples

Requirement	Reason	Application
Statutory	Health and Safety at Work etc Act	Operating departments
	COSHH Regulations	Laboratories
	Local exhaust ventilation (LEV)	Pharmacies
		Areas containing identified biological or chemical hazards
		Areas containing oxygen-displacing gases
		Enclosed workspaces
		Workshops
Functional	Comfort	Situations where the quality of the environment for staff and patients is critical to their general performance and well-being
Clinical	Reduction of surgical site infection	Ultra-clean operating suites, conventional operating suites and treatment rooms used for all types of surgical procedures
		Obstetrics and maternity procedures
	Source and protective isolation	Isolation units for patients who present a biological, chemical or radiation hazard to others
		Isolation units for patients with a reduced immune system

Statutory requirements

Increased health risks to patients will occur if ventilation systems do not achieve and maintain the required standards. The link between surgical site infection and theatre air quality has been well established. Plants serving a conventional operating department, for instance, will be required to ensure the separation of areas within the suite by maintaining a specific direction of air flow between rooms, even when doors are opened. They will also maintain the selected operating department's environmental conditions regardless of changes in outside air conditions or activities within the space.

In addition, ultra-clean ventilation systems (which are designed to provide a zone around the patient that is effectively free of bacteria-carrying airborne particles while the operation is in progress) have been shown to significantly reduce surgical site infection in patients undergoing large joint replacement surgery. Their use for other forms of surgery may well be indicated.

Health and Safety at Work etc Act 1974

1.8 The Health and Safety at Work etc Act 1974 is the core legislation that applies to ventilation installations. As these installations are intended to prevent contamination, closely control the environment, dilute contaminants or contain hazards, their very presence indicates that potential risks to health have been identified.

COSHH

1.9 The Control of Substances Hazardous to Health (COSHH) Regulations 2002 place upon management an obligation to ensure that suitable measures are in place to protect their staff and others affected by the work activity. These methods may include both safe systems of work and the provision of a specialised ventilation system. In laboratories the requirements are often met by the provision of fume cupboards and microbiological safety cabinets.

1.10 The requirements to provide ventilation, implicit under the Health and Safety at Work etc Act 1974 and COSHH, have been made explicit by the Management of Health and Safety at Work Regulations 1999, the Workplace (Health, Safety and Welfare) Regulations 1992 and the Provision and Use of Work Equipment Regulations 1998, all issued as a result of European Directives.

1.11 Where specialised ventilation plant is provided as part of the protection measures, there is a statutory requirement that it be correctly designed, installed,

commissioned, operated and maintained. The local exhaust ventilation (LEV) section of COSHH requires that the plant be inspected and tested at least every 14 months by a competent person and that management maintain comprehensive records of its performance, repair and maintenance.

1.12 Certain substances have workplace exposure limits (WELs) set out in the Health and Safety Executive's (2005) Guidance Note EH40 – 'Workplace exposure limits: containing the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations 2002 (as amended)'. If specialised ventilation systems are provided in order to achieve these standards, they will be subject to the COSHH Regulations as above.

Fire regulations

1.13 The fire regulations require that, if ventilation ductwork penetrates the compartment or subcompartment of a building, it should be designed and installed so as to contain the spread of fire (see Health Technical Memorandum 05-02 – 'Guidance in support of functional provisions for healthcare premises' for further guidance).

Plants installed in units manufacturing medicinal products

1.14 Plants installed in units manufacturing medicinal products to the standards set out in the current European guide to good manufacturing practice (http://ec.europa.eu/enterprise/pharmaceuticals/eudralex/homev4.htm) may also be subject to particular legislation with regard to their operation in addition to that mentioned above.

1.15 Records should be kept of equipment design and commissioning information. The Health and Safety Executive, Medicines Inspectorate and other interested bodies have a statutory right to inspect them at any time. All records should be kept for at least five years.

Plants installed in laboratories

1.16 Specialised ventilation plants installed in laboratories dealing with research, development or testing, whether involving drugs, animals or genetically modified organisms, may be subject to particular legislation with regard to their operation in addition to that mentioned above. Further information is given by the Health & Safety Commission's Health Services Advisory Committee in:

- 'Safe working and the prevention of infection in clinical laboratories and similar facilities';
- 'The management, design and operation of microbiological containment laboratories'.

Note

If the ventilation plant has been installed to dilute or contain harmful substances (the definition of which now includes microorganisms), its failure may expose people to unacceptable levels of hazard. Proven failures can give rise to a civil suit against the designers and operators by the individuals who have been affected. This would be in addition to the actions brought as a result of breaching the statutory requirements.

Codes of practice and other guidance

1.17 All ventilation systems should conform to the principles set out in the Health and Safety Commission's Approved Code of Practice and guidance document 'Legionnaires' disease: the control of *Legionella* bacteria in water systems' (commonly known as L8), and Health Technical Memorandum 04-01 – 'The control of *Legionella*, hygiene, "safe" hot water, cold water and drinking water systems'.

1.18 The Department of Health publication 'The Health Act 2006: code of practice for the prevention and control of healthcare associated infections' is a code of practice that has been brought out to help NHS bodies to plan and implement how they can prevent and control healthcare-associated infections. It sets out criteria by which managers of NHS organisations are to ensure that patients are cared for in a clean environment and where the risk of healthcare-associated infections is kept as low as possible. Specialised ventilation systems often play a central role in achieving this objective.

This document deals with the healthcare-specific aspects of ventilation. Basic information on the design, installation, commissioning and testing of ventilation systems is contained in documents produced by the following (see the References section):

- the Chartered Institute of Building Services Engineers (CIBSE);

- International and British Standards (ISO and BS EN);
- the Building Services Research and Information Association (BSRIA);
- trade associations such as the Heating and Ventilating Contractors' Association (HVCA).

Design and validation process

1.19 It is essential, when undertaking the design of a specialised ventilation system, that the project be considered as a whole. The process model set out in Table 1 should ensure that all relevant factors are considered.

Table 1 Design and validation process model

Step	Question	Design statement and information required	Comment
1	Why is the system required?	Healthcare applications Statutory elements Non-healthcare applications	
2	What is the required system performance?	Room air-flow pattern Air-change rate Differential pressures Air quality Room air-condition Noise limits	
3	What are the constraints on the distribution system?	Ducts: Location, size, materials Dampers, access, insulation Fire considerations Room terminals	
4	What are the minimum requirements for the air-handling units (AHUs)?	Intake/discharge positions Legionella, health and safety Access, fire, electrical safety Leaks, insulation, cleanliness Filtration, drainage	
5	What control functions are required?	User control requirements Estates control functions Energy management Environmental conditions Control sequence logic Run, set-back, Off philosophy	
6	How will the system performance be validated?	Validation methodology Instruments used Design information required: • design air-flow rates • design air velocities • pressure differentials • noise levels • air quality • installation standard	
7	The system will only be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life.		
8	Handover to client[1]	Basic design information Commissioning results Validation report	

Note: 1. When new ventilation systems are accepted for use, full information as to their designed mode of operation together with recommended maintenance procedures should be provided as part of the handover procedure

Ventilation – terms in use

1.20 The terms "ventilation" and "air-conditioning" are often used interchangeably to describe the same equipment. A general explanation of the terms is given below.

Ventilation

1.21 Ventilation is a means of removing and replacing the air in a space. In its simplest form this may be achieved by opening windows and doors.

1.22 Mechanical ventilation systems provide a more controllable method. Basic systems consist of a fan and collection or distribution ductwork; more complex systems may include the ability to heat and filter the air passing through them.

1.23 Ventilating equipment may be required in order to remove smells, dilute contaminants and ensure that a supply of fresh air enters a space.

Air-conditioning

1.24 Air-conditioning is the ability to heat, cool, dehumidify and filter air. For full air-conditioning, humidification may also be provided. This means that the climate within a space being supplied by an air-conditioning plant can be maintained at a specific level regardless of changes in outside air conditions or the activities within the space. Air-conditioning equipment may be required in order to provide close control of "comfort conditions" within a space.

Specialised ventilation

1.25 In healthcare premises, certain activities will necessitate the provision of ventilation equipment with additional special features in order to achieve and maintain specific conditions. These may be needed in order to assist with the treatment of patients or maintain the health and safety of staff. The precise reason for providing specialised ventilation will depend upon the intended application. The list below indicates some of the more typical reasons:

a. to remove, contain or dilute specific contaminants and fumes;

b. to ensure the isolation of one space from another;

c. to preserve a desired air-flow path from a clean to a less clean area;

d. to provide control of the cleanliness of a space;

e. to provide close control of temperature;

f. to provide close control of humidity.

1.26 The following departments will usually have specialised ventilation requirements, either for a single room or throughout a suite of rooms:

a. operating department;

b. laser surgery unit;

c. operative imaging unit;

d. intensive treatment unit;

e. infectious diseases isolation unit;

f. wards housing immunocompromised patients;

g. manufacturing pharmacy;

h. specialised imaging, X-ray and scanning unit;

j. pathology containment laboratories;

k. mortuary and dissection suite;

m. research laboratories;

n. sterile services department;

p. emerging treatment technologies, including gene therapy and stem cell units.

1.27 Ventilation may be provided in a wide variety of ways. These will include:

- extensive purpose-built air-handling units housed in their own plantrooms;
- proprietary "packaged" systems often sited outside on a roof; or
- wall-mounted electric fans located at the point of use.

1.28 A fixed volume of air may be supplied, often expressed in terms of the resulting number of air changes per hour (ac/h), within the space being ventilated. Alternatively the volume of air supplied may be varied in order to maintain a specific pressure relationship between the area supplied and other surrounding areas. In some situations a combination of both methods may be adopted.

1.29 Modern plants should be fitted with the means to recover energy from the extract air without causing contamination of the incoming supply air.

1.30 Ultra-clean systems use the same basic plant and equipment as standard air-conditioning systems, but are in addition fitted with a terminal device that supplies the air in a unidirectional manner to the working area. Their standard of filtration will

be capable of delivering air with a very low particle count to the space that they serve.

Local exhaust ventilation

1.31 Local exhaust ventilation (LEV) is a term used to describe systems installed to prevent hazardous substances from entering the general atmosphere of the room in which they are being used. Their primary function is to protect staff from the effects of their work activity.

1.32 Simple LEV systems comprise a receptor or capture hood, extract ductwork and a fan. These are used to contain industrial types of hazard such as fumes from welding processes, gas discharges from standby battery banks and dust from woodworking machinery.

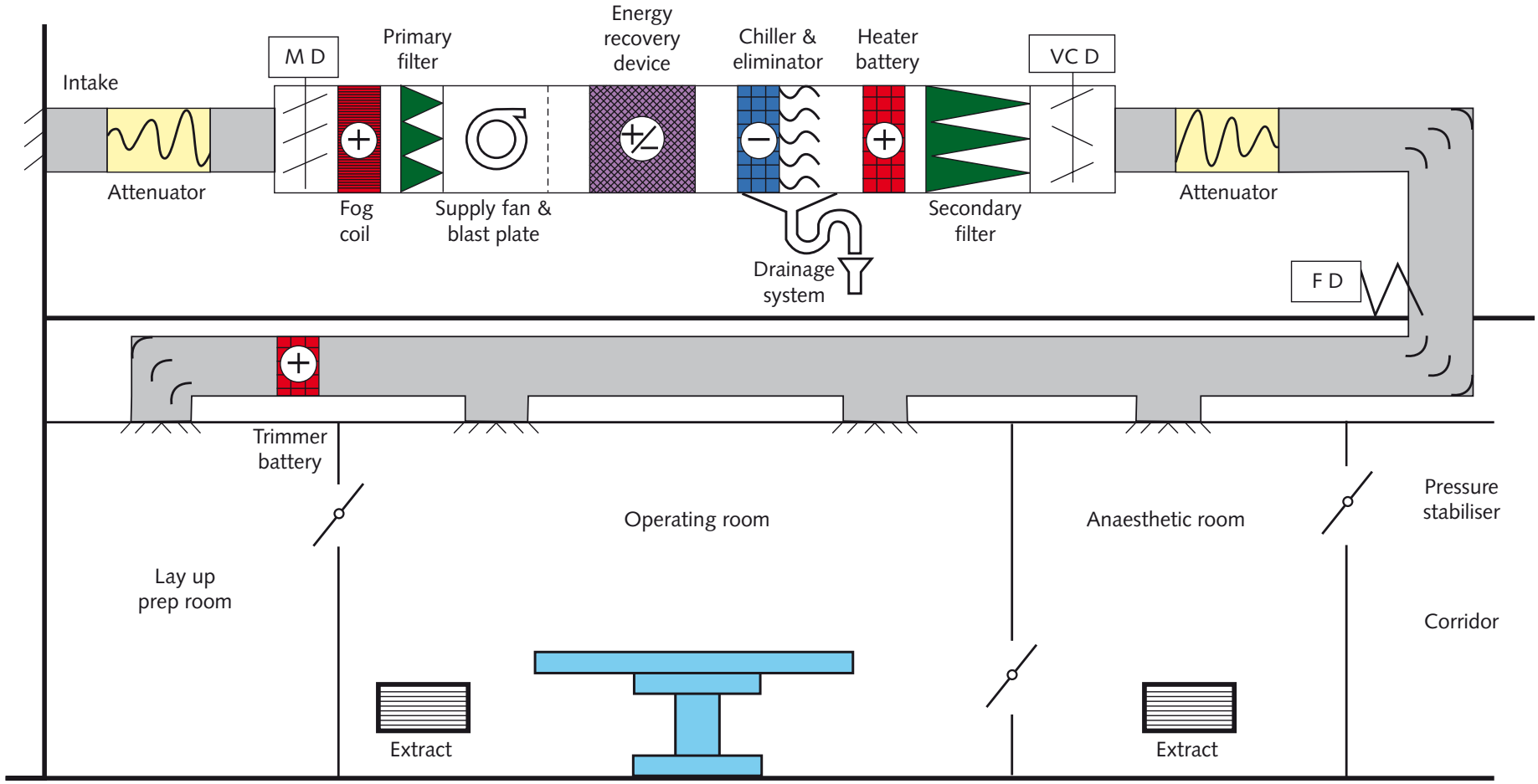
1.33 The vapour given off when large quantities of chemicals are decanted into ready-use containers and fumes from X-ray film processing units are examples of chemical hazards often controlled by LEV systems.

1.34 In laboratories, pharmaceutical manufacturing facilities and operating suites, LEV systems usually take the form of semi-open-fronted cabinets within which the hazardous substance is manipulated. These cabinets either have their own filtered air supply or are fed with air from the room. The air extracted from the cabinet is passed through a high-efficiency filter before being discharged either to the atmosphere or back into the room. Microbiological safety cabinets, laboratory fume cupboards, cytotoxic drug cabinets and fixed or mobile disinfection enclosures are all examples of this type of facility.

1.35 Mortuaries and dissection suites may have LEV systems incorporated within the dissection table, specimen bench and bone saw.

1.36 The layout of a typical plant that conforms to the regulations for healthcare applications is shown in Figure 1. For an explanation of the equipment used in the diagram, see Appendix 1.

Figure 1 Example of a typical operating theatre ventilation system



2 Provision of ventilation in healthcare buildings

2.1 Planning constraints caused by a building's shape and/or the functional relationships of specific areas will invariably result in some measure of deep planning, thus reducing the opportunity for natural ventilation.

2.2 However, ventilation costs can be minimised by ensuring that, where practicable, core areas are reserved for those rooms that need to have mechanical ventilation. Examples are:

- sanitary facilities, dirty utilities and those rooms where clinical or functional requirements have specific environmental needs; and
- those rooms where – for reasons of privacy, absence of solar gain etc – windowless accommodation is acceptable.

2.3 Other spaces appropriate to core areas are those which have only transient occupation and therefore require little or no mechanical ventilation (for example circulation and storage areas).

Natural ventilation

2.4 Natural ventilation is usually created by the effects of wind pressure. It will also occur if there is a temperature difference between the inside and the outside of a building. The "thermo-convective" effect frequently predominates when the wind speed is low, and will be enhanced if there is a difference in height between inlet and outlet openings.

2.5 Ventilation induced by wind pressures can induce high air-change rates through a building, provided air is allowed to move freely within the space from the windward to the leeward side. However, in most healthcare applications, internal subdivisions will restrict or prevent this effect.

2.6 It is almost impossible to maintain consistent flow rates and ensure that minimum ventilation rates will be achieved at all times. However, this variability is normally acceptable in such areas as office accommodation, staff areas, library/seminar rooms and dining rooms, where opening windows (of a design that facilitates natural ventilation) should be provided.

Note

If natural ventilation is "single-sided", it will usually only be effective for a three-metre depth within the space. Beyond that it will need to be supplemented by mixed-mode or forced ventilation.

2.7 Current guidance restricts the opening of windows for safety reasons; also, as many designs are top-hung, their ability to permit natural ventilation is limited. It may therefore be necessary to provide dedicated ventilation openings in the fabric of the building to allow a sufficient natural flow of air into and out of the space.

2.8 In all cases, excessive heat gain, indoor air-quality requirements or external noise may limit or preclude the use of natural ventilation.

2.9 Detailed guidance on natural ventilation can be found in CIBSE's (2005) Applications Manual AM10 – 'Natural ventilation in non-domestic buildings'.

Extract ventilation systems

2.10 Extract ventilation is required in sanitary facilities, dirty utilities and rooms where odorous but non-toxic fumes are likely; this is to ensure air movement into the space. A single fan/motor unit should be provided to meet this need. There is no healthcare requirement to provide a separate foul/dirty extract system.

2.11 WCs should have an extract rate as set out in Approved Document F of the Building Regulations. Where WCs are located in shower and bathroom spaces, the ventilation required for the WC will normally be adequate for the whole space.

Supply-only ventilation

2.12 Mechanical supply ventilation is required in areas where it is important to maintain a positive

pressure in order to prevent the ingress of less clean air (for example in units caring for immuno-compromised patients, aseptic suites in pharmacies, packing rooms in sterile services departments, operating theatres and theatre preparation rooms; air-change rates are given in Appendix 2).

Supply and extract ventilation

2.13 Mechanical supply and extract ventilation should be provided in rooms where there is a need to control room pressure in relation to adjacent spaces. Critical care areas, isolation suites and treatment areas are typical applications.

Comfort cooling

2.14 Cooling is very expensive in terms of energy costs and should be provided only where necessary to maintain a comfortable environment for staff and patient, or to ensure satisfactory operation of equipment. The imaging department in particular may require cooling to offset the equipment load.

2.15 Calculations and thermal modelling should be undertaken to ensure that, during the summertime, internal temperatures in patient areas do not exceed 28°C (dry bulb) for more than 50 hours per year.

2.16 Certain non-patient areas may also require cooling (for example laboratories and other areas that are subject to high heat gains from equipment).

2.17 Where deep planning of other continuously occupied spaces (for example offices) is unavoidable, there will also be occasions when acceptable levels of comfort can only be maintained by cooling.

2.18 Refrigeration plant should be of sufficient capacity to offset heat gains and maintain areas at a temperature that does not exceed the external design shade temperatures by more than about 3 K, taking into account the level of design risk for the application.

Air-conditioning

2.19 Owing to capital and running costs, full air-conditioning should be used only in essential areas. These include operating departments, critical care areas, manufacturing pharmacies and areas with particularly sensitive equipment.

Specialised ventilation

2.20 Owing to the nature and extent of activities carried out in healthcare buildings, there will be a need for a wide range of specialised ventilation systems. Information on systems for individual departments is given in Chapter 7.

Local exhaust ventilation

2.21 Wherever the escape of chemicals, toxic fumes, biological materials or quantities of dust into the general area would present a hazard to the occupants, LEV must be provided. This is a statutory requirement under COSHH.

Ventilation for general areas

2.22 Appendix 2 provides recommended air-change rates, temperatures and pressures for general areas requiring mechanical ventilation in healthcare buildings.

Acceptable methods

Use of natural ventilation

2.23 The airtightness of new buildings has improved to the point that infiltration through building leakage can no longer be relied upon to provide sufficient air flow. Attention must therefore be given to the provision of purpose-made ventilation openings to achieve the necessary flow rates. The air entering the openings may need to be controlled by motorised dampers linked to temperature and/or occupancy sensors in the ventilated space.

2.24 Internal partitions, fire compartment walls and closed doorways can often impede the flow path; when this happens, the process will be more dependent on single-sided ventilation. Nevertheless, even with this degree of compartmentation, acceptable ventilation may still be achieved without window openings, which would prejudice safety, security or comfort.

2.25 Some types of window (for example vertical sliding) can enhance single-sided air change by temperature difference, and these will improve the overall rate of natural ventilation in protected or sheltered areas where the effect of wind pressure is likely to be minimal.

2.26 Natural cross-flow ventilation is able to give reasonable air distribution for a distance of up to 6 metres inwards from the external facade, provided

that reasonably clear air paths are maintained. Beyond this distance – in areas where clear air paths cannot be maintained and in areas where high minimum air-change rates are specified – mechanical ventilation should be provided.

2.27 Further information can be found in Health Technical Memorandum 55 – 'Windows', BS 5925 and CIBSE's (2005) Applications Manual AM10 – 'Natural ventilation in non-domestic buildings'.

Mixed mode ventilation

2.28 Mixed mode ventilation is an assisted form of natural ventilation. Fans are fitted in purpose-made damper-controlled ventilation openings. Alternatively, a separate draw- or blow-through ventilation unit may be installed. In both cases the dampers and fans are controlled by temperature and occupancy sensors to ensure a minimum air-flow rate while taking advantage of natural ventilation effects when present.

2.29 Where natural or mixed mode ventilation is adopted with complex air paths, the designer should produce an air-flow diagram in order to ensure correct provision of air-transfer devices. CIBSE's (2000) Applications Manual AM13 – 'Mixed mode ventilation' gives guidance.

Mechanical extract ventilation

2.30 General extract systems can vary in complexity from a single wall-mounted fan to a ducted air system with dual extract fans.

2.31 Replacement air either is provided by a central supply system or enters the building through gaps in the structure or purpose-made openings. Unless special precautions are taken, the latter may result in an unacceptable level of draughts occurring in winter, and possible risk of unacceptable levels of noise transmission.

2.32 If individual systems are used, the ventilation can be operated intermittently, provided it continues to run for at least 15 minutes after the room is vacated (as with light-switch-operated fans in individual toilets).

2.33 If general exhaust systems are used, filtered and tempered replacement air should be provided via a central supply plant to adjoining lobbies or corridors, to prevent the risk of discomfort caused by the ingress of cold air. Fire compartmentation requirements must be maintained.

2.34 Information on specialised extract systems is given in Chapter 7.

Mechanical supply systems

2.35 Where mechanical supply systems are required, the fresh air should be tempered and filtered before being delivered to the space in order to avoid discomfort.

2.36 The air should be heated using a constant or variable temperature source, but generally only to the space air temperature. In most instances, the low pressure hot water (LPHW) heating system should offset any fabric loss so that set-back room temperatures can be maintained during unoccupied periods without the need for the ventilation system to operate.

Balanced ventilation

2.37 A balanced ventilation system is a combination of both a supply and an extract system of equal volume; either a single space or a whole building may be considered to be balanced.

2.38 A balanced system is necessary in instances where it is essential to maintain consistent air movement within an area (for example treatment rooms).

Cascade ventilation

2.39 In operating departments, it is normal practice to supply air to the operating room and allow it to flow through less clean areas – corridors, utility rooms etc (from where it is eventually extracted).

Recirculation systems

2.40 Air recirculation systems are normally used in HEPA-filtered clean rooms where the extract air is significantly cleaner than the outside supply and where odour levels are not significant.

2.41 Recirculation is also routinely used in the canopy section of ultra-clean operating theatre ventilation systems.

2.42 Where the designer is considering the installation of an air recirculation system, due account must be taken of:

a. minimum fresh-air-supply volume required by the Building Regulations Part F – Non-domestic Buildings;

b. prevention of contamination of supply air from vitiated air in extract systems;

c. prevention of stratification occurring within plenum chambers and mixing boxes, which may result in freezing of downstream coils;

d. ensuring sufficient velocities through control dampers (ideally 5–6 m/s) to provide suitable authority and good shut-off;

e. modulating control of mixing to provide optimum on-plant conditions;

f. use of "free cooling" by cycling the dampers to minimum fresh air when the enthalpy of the outside air is greater than that of the extract air under conditions when cooling is required.

Chilled beams

2.43 The use of chilled beams for the provision of heating, cooling and ventilation is increasingly common in healthcare premises.

2.44 Active chilled beams providing tempered, filtered air to the room can provide effective local control of environmental conditions.

2.45 Care should be taken in positioning chilled beams to ensure that cold draughts are avoided, particularly when used in the cooling mode. The control settings should ensure that the external elements of the beam are always above dew-point. Manufacturers of these devices are able to provide specific advice on the siting and design limits of their equipment.

2.46 Chilled beam units should be easily accessible for cleaning and maintenance.

Split comfort air-conditioners

2.47 Split comfort air-conditioners, room conditioners or cassette units are used increasingly where there is a small local requirement for cooling for operational purposes. They can provide an effective economic solution to cooling needs where a central refrigeration system is not practicable.

2.48 A fresh-air make-up system to the standard required by the Building Regulations Part F – Non-domestic Buildings must be provided.

2.49 Split units may be used for single applications or as multiple linked units that can independently provide either heating or cooling – all served by a single outdoor unit. These systems help to maintain a more precise temperature control across multiple rooms, with maximum energy efficiency.

2.50 Whether single or multiple systems are used, it is essential that the designer give due consideration to the source of electrical supply, location of the heat rejection unit, environmental effects to the refrigerant used and drainage provision for the cooling-coil condensate.

2.51 Recirculated room air affects indoor air quality and may increase the risk of healthcare-associated infection (HCAI). Split units should therefore not be used in critical care areas.

2.52 The units should be easily accessible for cleaning and maintenance.

Dilution ventilation and clean air-flow paths

2.53 Dilution ventilation has been used to control levels of hazardous substances in a space. This approach in itself is no longer considered acceptable. COSHH requires that known hazardous substances should be substituted for safe alternatives. If this is not possible, they should be controlled at source by using a closed system (such as an anaesthetic gas scavenging unit) or a protective enclosure (such as a fume cupboard). A good level of background ventilation will assist in diluting any casual release of the substance.

2.54 The exposure of staff to casual spillages of substances such as medical gases in anaesthetic rooms should in the first instance be dealt with by establishing a clean air-flow path. Air should be supplied at high level and extracted at low level directly behind the anaesthetic equipment position. The philosophy of establishing a clean air-flow path – from the air-supply point, to the staff, on to the patient, and out via a low-level extract – would also apply in recovery rooms and birthing rooms. A suitable air-change rate will provide background dilution ventilation as an additional safeguard. This approach ensures that "all reasonable steps are taken to prevent or control exposure (of staff) to the hazardous substance" as required by COSHH.

2.55 In operating theatres, patients will be on a closed breathing circuit in a room with a high air-change rate. Under these circumstances, the dilution effect would be considered sufficient to control any casual exposure to anaesthetic gases.

Mechanical ventilation systems

System selection

2.56 Natural ventilation is always the preferred solution for a space, provided that the quantity and quality of air required, and consistency of control to suit the requirements of the space, are achievable. If this is not the case, a mechanical ventilation system will be required.

Choice of central/local plant

2.57 Mechanical ventilation is expensive to operate – it should therefore be used only when the space being served requires ventilation. In addition, loads on air-conditioning plant are rarely constant owing to changes in solar gain, occupancy, the use of heat-generating equipment and lights. Therefore control of the supply-air temperature is critical.

2.58 If the ventilation loads throughout a department or building are in phase, or are not significant, a central plant with single zone control can be adopted. However, this is rarely the case, so the condition or quantity of supply air to different areas or zones of the building must be varied accordingly. This can be achieved by either providing individual plants to each zone or providing separate controls for each zone such as provided by a variable air volume (VAV) system. Where there is a high density of rooms with similar ventilation requirements in an area of a building or department, it is usually economical to combine them into a central system.

2.59 In large buildings, a choice between a single distribution system and multiple smaller systems may arise. Large distribution systems and their plant can have the advantage of lower operating costs, but require more space for vertical shafts. In general, very long runs of ducting should be avoided to prevent undue heat losses or gains, excessive leakage, and difficulties in balancing during commissioning. As the pressure losses in the long runs will be greater and a higher initial static pressure will be required, this will lead to a more expensive class of ductwork.

2.60 Multiple smaller distribution systems may be more expensive in capital and operating costs but they avoid long runs, large ducts and vertical shafts, and this may reduce overall building costs. They also provide a more robust service, as the failure of an individual system does not prevent the use of the rest of the building.

Zoning of the building

2.61 The efficiency and effectiveness of any ventilation or air-conditioning installation depends largely on the zoning and control of the installation. The factors to consider when determining the zoning of a ventilation system for a building or department are:

a. periods of occupancy;

b. fresh-air/ventilation requirements;

c. smoke control.

2.62 Where the ventilation system is not merely tempering the air, but also providing the heating and/or cooling requirements, the following additional factors will need to be considered:

a. internal or peripheral location;

b. orientation of windows;

c. variation in internal loads;

d. level of control required.

2.63 For single-zone plant in staff areas, local control (with a run-on-timer if required) is recommended, as the system can be turned off when the space is not in use, thus saving both thermal and electrical energy. Most supply and extract systems, conversely, are required to operate continuously while the department is occupied; thus some form of time or use control is necessary.

2.64 The control of individual plant items is covered in Chapter 4, with examples of typical control strategies in Chapter 5. For control of particular specialised ventilation and air-conditioning systems, see Chapter 7.

2.65 On rare occasions a duplicate standby air-handling plant may be justified. If installed, it must be provided with a gas-tight damper at its junction with the supply distribution duct so that no back-flow can occur. Standby plants can become sources of contamination if warm moist air is allowed to dwell within them. Their design and control system must ensure that this cannot happen.

3 Assessment of service requirement

Selection of design criteria

External design conditions

3.1 The most accurate data that is available for the summer and winter conditions at the site should be used. The Met Office can supply data for the United Kingdom (www.metoffice.gov.uk).

3.2 Healthcare ventilation systems will normally be "full fresh air".

3.3 Local adjustments, such as for height above sea level, exposure factor or other climate peculiarities, should be made as appropriate.

Internal design conditions

3.4 The design conditions selected within patient areas must strike a balance between the comfort requirements of staff and patients, who often have very different levels of clothing and activity.

3.5 Recommendations for the dry resultant temperature and humidity of individual spaces are shown on Activity DataBase A-sheets. Appendix 2 gives a summary.

Minimum fresh-air requirements

3.6 The dilution of body odours is the critical factor in determining ventilation requirements. Where natural ventilation or full fresh-air systems are used, all ventilation air will be fresh.

3.7 Where odour dilution is the overriding factor, it is recommended that 10 litres per second per person should be taken as the minimum ventilation rate.

3.8 In non-standard applications such as laboratories, aseptic suites, operating departments etc, the particular requirements for each area should be considered independently in order to determine the overriding minimum requirement for ventilation.

Limiting supply air conditions

3.9 For most applications in healthcare buildings, it is the temperature differential between the supply and room air, rather than the actual temperature of the supply air, which is the critical factor. The maximum recommended supply-to-room-air temperature differential is:

- summer cooling: –7 K
- winter heating: +10 K.

3.10 In areas that have high heat gains from equipment (for example critical care areas), the summer cooling temperature differential limit given above may result in excessive air-change rates. A differential of up to –10 K is acceptable in these circumstances, providing the supply-air diffusers are of a type that provide good mixing.

3.11 If a humidifier is fitted, it is necessary to keep supply-air humidity below 70% during winter in order to minimise the risk of condensation on cold surfaces.

Air purity

3.12 In healthcare premises, the standard of filtration will depend on the activities within the occupied spaces. With the exception of specialist areas (for example manufacturing pharmacies), aerobiological requirements are not stringent, and filtration is only required to:

a. maintain hygienic conditions for the health and welfare of occupants, or for processes such as food preparation;

b. protect finishes, fabrics and furnishings in order to reduce redecoration costs;

c. protect equipment either within the supply air system (that is, to prevent blocking of coils), or in the space itself to prevent dust build-up.

3.13 Given that almost all viable particles originate from the occupants of a space and not from the incoming air, dilution is the more important factor aerobiologically. Therefore, for general areas a G4 filter is suitable. More critical areas will require an F7 filter. High-efficiency particulate air (HEPA)

filters are required only in ultra-clean systems (information on filter grades is given in Chapter 4).

Humidity control requirements

3.14 Providing humidification is expensive in terms of plant, running costs and maintenance, and therefore its use should be restricted to where it is necessary for physiological or operational reasons.

3.15 Humidification was originally required for some healthcare applications (for example operating theatres) in order to control the risk associated with the use of flammable anaesthetic gases. The use of such gases has now ceased. Humidification is therefore no longer required unless there is a very specific application requirement.

Noise levels

3.16 Noise will be generated by fans, ductwork fittings, dampers and grilles. The specified maximum noise level will depend on the activities within the occupied spaces.

3.17 Attention must be given to the reduction of tonal components. High tonal components from air diffusers etc can seriously disturb concentration over longer periods even when the overall noise level is low. Broadband noise causes less annoyance.

3.18 Attenuation should be incorporated into the ductwork system or plant arrangement as necessary to reduce noise from fans and plant items in order to achieve acceptable limits within rooms at the design air flows.

3.19 The designer must also consider noise escaping to the external environment, and this must not be unacceptable to occupants of adjacent areas or buildings.

3.20 The overall noise levels should not exceed the values given in Health Technical Memorandum 08-01 – 'Acoustics'.

3.21 Plant noise is subject to the Control of Noise at Work Regulations 2005 and should not exceed 80 dB(A) within a plantroom. It should be reduced to lower levels where the plant is near to departments sensitive to noise.

Calculation of building loads

Air infiltration

3.22 CIBSE's (2006) Guide A – 'Environmental design' provides information and formulae for the calculation of air infiltration. Pressure testing enables the true infiltration rate to be established. In all cases the requirements of the appropriate section of the Building Regulations Part L2 must be met.

Summertime temperatures

3.23 The calculation method for determining the summertime temperature is described in CIBSE's Guide A. It is very important to select the time of day and time of year of peak loadings for the calculations. These will be dependent on the building orientation and proportion of solar to total heat gain. In establishing design values, the design risk – having regard to the function and occupancy of the building – should be considered.

3.24 Calculations and thermal modelling should be undertaken to see whether, during the summertime, internal temperatures in patient areas will exceed 28ºC dry bulb for more than 50 hours per year. It can generally be assumed that for a naturally ventilated building, the internal temperature will be approximately 3 K above the external shade temperature. For a building with simple mechanical ventilation, the internal temperature can never be less than the external shade temperature and will invariably be higher. The relationship between preferred indoor temperatures and mean outside temperature is discussed in CIBSE's Guide A.

3.25 Where calculations indicate that internal temperatures will exceed the selected design for a period that exceeds the building design risk, methods of reducing temperature rise should be implemented. Options include:

- reducing solar and casual gains;
- the use of chilled beams or ceilings;
- increasing ventilation rates; or
- providing mechanical cooling.

3.26 In some situations it may be possible to alter the thermal mass of the structure to "move" the peak temperature event time so that it occurs outside of the occupancy period.

Peak heating load

3.27 Peak heating local calculations are necessary on all mechanical supply systems to establish the size of heater-batteries and subsequently the central plant.

3.28 Where ventilation systems provide tempered air to spaces that have supplementary LPHW to offset the building fabric losses, the plant's heating load should be based on the design values of the external winter temperature and internal air temperature, and the calculated total air volume (including a suitable allowance for leakage).

3.29 Where the ventilation system is the only means of heating a space, an increase in load equivalent to the calculated fabric heat losses from the space should be added to the ventilation load. A check of supply temperature difference should be made. If it exceeds 10 K, the ventilation supply volume should be increased to suit.

Condensation risk

3.30 A check should be made to ensure that the selected air condition will not lead to surface condensation on low-temperature elements of the ventilated space.

3.31 Where there are local sources of moisture that would require excessive levels of ventilation to avoid condensation, the designer should consider the capture and removal of moisture at the source of the evaporation via an exhaust hood or similar device.

3.32 In intermittently heated buildings, it is necessary to consider the condensation risk at night set-back conditions as well as during normal operation. Calculation methods for this assessment are given in CIBSE's Guide A.

Peak cooling load

3.33 In addition to the base data of air-flow rates and temperatures, when calculating cooling loads, the designer must take into account:

a. solar cooling loads;

b. surface conduction cooling loads;

c. internal gain cooling loads;

d. cooling loads due to high-level humidity control;

e. method of control of internal conditions;

f. fluctuations in internal temperatures.

3.34 When the peak internal loads have been assessed and a suitable allowance made for non-coincidence, the supply temperature can be calculated.

3.35 Once the lowest required supply temperature of the air-handling unit (AHU) has been established, and an allowance made for temperature rise through the fan and ductwork (usually 1 K for low-pressure systems), the off-plant enthalpy can be established from a psychrometric chart or table.

3.36 The cooling loads for all plants on the chilled water system should be calculated at each of the individual peak times in order to accurately establish the required (diversified) capacity of the chiller.

Annual energy consumption

3.37 Annual energy consumptions of heating-only ventilation systems are simple to calculate, based on supply-to-external air temperature rise, and frequency of occurrence of external temperature data (see CIBSE's Guide A).

3.38 Minimum air volumes are usually fixed by the room loads or fresh-air requirements; however, the designer may increase air flow to some rooms or zones in order to balance loads (as detailed in paragraphs 3.42–3.71).

3.39 The method of zoning and control can significantly influence energy consumption.

3.40 The concept of load and plant operation charts is outlined in CIBSE's Guide A. The method requires the designer to establish the minimum and maximum loads on all zones across the range of external temperatures between winter and summer design conditions. Once the load chart is complete, the plant chart converts the loads to supply temperatures, which are then superimposed on external air temperatures.

3.41 When all temperatures for all zones are plotted on the plant operation chart, set-points and resetting schedules can be established. From this information, the outputs of individual heaters, coolers and humidifiers can be established at any given external temperature. When those loads are computed against annual frequency of occurrence of external temperatures (as given in CIBSE's Guide A), the annual energy consumption of individual elements, and thus the air-conditioning system, can be established.

Calculation of plant requirements

Air-supply volumes

3.42 The minimum air supply volume for a room is determined by the greater of the following three criteria:

a. the minimum fresh-air requirement;

b. the minimum supply volume for the room load as determined by the maximum heating or cooling supply temperature differential;

c. the desired air-change rate.

Plant sizing

3.43 Once the design air flow has been established, the cross-sectional area of the AHU can be calculated based on a maximum coil face velocity of 2.0 m/s.

3.44 In order to establish the length of the AHU, it will be necessary to refer to manufacturers' literature, ensuring all necessary access panels and components are included as detailed in Chapter 4.

3.45 The fan duty should be calculated by adding the resistances of all elements that contribute to the pressure drop of the index circuit.

3.46 The main elements that must be considered are:

a. inlet or discharge louvres;

b. plant entry and discharge;

c. attenuators;

d. components within the AHU;

e. duct-mounted heaters and filters (including a dust allowance);

f. ductwork distribution;

g. ductwork fittings including: fire dampers, volume control dampers, bends and sets, tees, changes of section;

h. air terminal device;

j. discharge velocity.

3.47 Where packaged AHUs are installed, the fan pressure drop is usually quoted as external plant resistance, and thus the designer does not need to calculate the resistances of individual plant items. The designer should, however, ensure that an allowance has been made for "dirty filter" conditions, and confirm whether the fan pressure quoted is fan total or static pressure.

3.48 Resistances of ductwork and fittings may be obtained from CIBSE's Guide A; however, the designer should exercise some care when using tabulated pressure loss information for fittings that are relatively close together.

3.49 Upon completion of the resistance calculation exercise, the designer should make allowances for calculation and construction tolerances as indicated in Table 2.

Table 2 Typical fan volume and pressure margins

Criteria	Low-pressure systems	Medium/high-pressure systems
Volume flow rate margin for leaking and balancing requirements	+5%	+5%
Total pressure loss margin: a. for increase in volume flow rate (above)	+5%	+5%
b. for uncertainties in calculation	+5%	+10%
Combined total pressure loss margin	+10%	+15%

Plantroom size and location

3.50 The ventilation plant and associated equipment should be positioned to give maximum reduction of noise and vibration transmitted to sensitive departments; and at the same time, achieve an economic solution for the distribution of services.

3.51 It is not recommended that noise and vibration generating plant be housed either directly above or below sensitive areas (for example operating or anaesthetic rooms) unless there is no alternative, in which case additional care and attention must be given to the control measures.

3.52 The plant must also be located so that it is remote from possible sources of contamination, heat gains and adverse weather conditions. The design should ensure that wind speed and direction have a minimal effect on plant throughput.

3.53 Safe access to and around plant is essential to facilitate inspection, routine maintenance, repair and plant replacement.

Provision of primary services

3.54 Where more than one air-handling plant requires cooling, remote central cooling plants with piped chilled water are preferred. In the case of a single

plant, a multi-stage direct expansion cooling coil with refrigerant piped from an adjacent compressor/condensing plant could be considered. If this option is selected, a refrigerant gas detector mounted in the base of the duct and an alarm system audible to the end-user will also need to be provided (as dictated by the COSHH Regulations).

3.55 Clean, dry steam is preferred for humidification, provided that the boiler water treatment does not render the steam unusable for direct humidification.

3.56 If a suitable supply of steam cannot be obtained from the steam main, a steam generator should be provided locally, or a self-generating humidifier installed. The location of a local steam generator is critical if condensate is to drain back into it.

Inlet and discharge sizing and location

3.57 Air intakes and discharge points should preferably be located at high level, to minimise the risks of noise nuisance to surrounding buildings, contamination and vandalism.

3.58 Intakes and discharges should be designed and located so that wind speed and direction have a minimal effect on the plant throughput.

3.59 Helicopter landing pads in the vicinity of ventilation intakes and discharges can result in large short-term pressure changes. This can cause pressure surges in supply systems and reverse air flows in extracts. Exhaust fumes from the helicopter may also be drawn into intakes.

3.60 Intake points should be situated away from cooling towers, boiler flues, vents from oil storage tanks, fume cupboards and other discharges of contaminated air, vapours and gases, and places where vehicle exhaust gases may be drawn in.

3.61 Where intakes have necessarily to be sited at or near ground level, the area around them should be paved or concreted to prevent soil or vegetation being drawn in. They should also be caged or located within a compound to prevent rubbish being left in the vicinity. The likely proximity of vehicle exhausts should be taken into account when determining the protected area around the intake.

3.62 The discharge from a general extract system must be located so that vitiated air cannot be drawn back into the supply-air intake or any other fresh-air inlet. Ideally, the extract discharge will be located on a different face of the building from the supply intake(s). In any event, there must be a minimum separation of 4 m between them, with the discharge mounted at a higher level than the intake.

3.63 Discharges from LEV systems should preferably be vertical and usually not less than 3 m above roof level. They should not be fitted with a cowl that could cause the discharge to be deflected downwards.

3.64 Each intake and discharge point should be fitted with corrosion-resistant weatherproof louvres or cowls to protect the system from driving rain (BS EN 13030, Class B).

3.65 It is recommended that louvres be sized based on a maximum face velocity of 2 m/s in order to prevent excessive noise generation and pressure loss.

3.66 The inside of the louvres should be fitted with a mesh of not less than 6 mm and not more than 12 mm to prevent leaves being drawn in and infestation by vermin.

3.67 The duct behind a louvre should be self-draining. If this is not practicable, it should be tanked and provided with a drainage system.

3.68 Cleaning access must be provided either from the outside via hinged louvres or by access doors in the plenum behind the louvre. Where a common plenum is provided, cleaning access should be via a walk-in door.

Heat-rejection devices

3.69 The design conditions given in Chapter 2 make no allowance for the elevated temperatures that can occur on the roof of buildings. Refrigeration condensers and cooling towers should, if practicable, be shaded from direct solar radiation, or the design should be adjusted to take account of the gain.

3.70 Air-cooled condensers should be the first choice for heat rejection from any refrigeration plant.

3.71 Evaporative cooling systems should not be used in healthcare premises unless limitations of space mean that they are the only way that the cooling load can be met. If they are used, guidance on preventing and controlling legionellae must be closely followed (see Health Technical Memorandum 04-01 – 'The control of *Legionella*, hygiene, "safe" hot water, cold water and drinking water systems'; and the Health and Safety Commission's Approved Code of Practice and guidance document 'Legionnaires' disease: the control of *Legionella* bacteria in water systems' (commonly known as L8)).

4 Air-handling unit design and specification guidance

General requirements

Location and access

4.1 AHUs should be located in an accessible area secured from unauthorised entry. Siting units in ceiling voids above occupied spaces is not appropriate.

4.2 Units located on roofs should have a safe means of access together with suitable precautions to prevent personnel or equipment falling or being blown off during maintenance activities.

4.3 Units located at ground level should be secured within a compound to prevent unauthorised access. Measures should be taken to exclude vehicles from the vicinity to ensure that exhaust fumes will not be drawn into intakes.

4.4 Units may have a working life of 25 to 30 years. It can be anticipated that over this period there will be a need to access every element within the unit for deep cleaning. It is also quite possible that the main fan and individual heater and chiller batteries will need replacement. Suitably positioned service connection joints and adequate spacing should permit these items to be withdrawn without the need to dismantle other installed plant or equipment. Batteries that are significantly wider than 1 m should be split to permit withdrawal from both sides.

4.5 It is essential that AHUs are positioned so that all parts are easily and safely accessible for routine inspection and service. If a unit is located against a wall or backs onto another unit, access to all parts must be available from the front. Units greater than 1 m wide should preferably have access from both sides or have access doors large enough to permit the full and safe entry of maintenance personnel.

4.6 The area around the unit should be tanked to prevent water penetration to adjacent areas, and should be adequately drained.

4.7 Fire precautions should be incorporated in accordance with Firecode (the Health Technical Memorandum 05 series). See also Chapter 3.

4.8 Combustion equipment must not be located in a fire compartment that houses air-handling equipment.

Technical requirements

4.9 The basic technical requirements of the whole of the ventilation system should meet the relevant clauses of Model Engineering Specification C04 – 'Mechanical ventilation and air-conditioning systems'. This document contains a menu of clauses that cover a wide range of applications, so it is important to select only those that are relevant to the specific application.

Note

At the time of writing, Model Engineering Specification C04 was due for revision in order to bring it into line with the revised standards set out in this Health Technical Memorandum. Where conflicts in specification arise, the Health Technical Memorandum takes precedence.

4.10 It is essential that the main plant/ductwork is located far enough from the floor to permit the correct installation of drainage systems for cooling coils, humidifiers and heat-recovery systems. Easy access for maintenance of drainage systems and their associated pipework must be provided.

4.11 Organic materials or substances that can support the growth of microorganisms must not be used in the construction of the plant or its distribution system. The Water Regulations Advisory Scheme's (WRAS) (2005) 'Water Fittings and Materials Directory' lists suitable materials for sealants and gaskets.

4.12 The plant and its distribution system must not contain any material or substance that could cause or support combustion.

4.13 Plants should have a high standard of airtightness. The double-skin method of construction with insulation sandwiched between two metal faces is recommended. The panels may be available in a variety of colours at no additional cost. This can aid identification by colour-coding of units in a plantroom (for example green for general ventilation; blue for theatres; red for laboratories and isolation facilities; grey for extract etc).

4.14 The inside of the plant should be as smooth as possible. Channels, rolled angles or formed sections that could trap or hold moisture should be kept to a minimum. If stiffeners are required, they should be fitted externally. If internal bracing has to be fitted, it must be of a design that will not trap or hold moisture.

4.15 Air flow across air treatment components such as filters, heat exchangers and humidifiers will be influenced by the pattern of the approaching air stream. If unsatisfactory conditions are created, the performance of the component will be reduced.

4.16 Access to items that require routine service such as filters, fog coils and chiller batteries should be via hinged doors. The doors should be large enough (for example 500 mm minimum) to allow easy access. Items requiring infrequent access, such as attenuators, may be via bolted-on, lift-off panels. All doors and panels should be close-fitting and without leaks.

4.17 Care should be taken during installation to ensure that electrical and mechanical services are not installed in positions that will reduce or impede access.

4.18 It can be difficult to turn off AHUs in order to inspect filters and drainage trays. Viewing ports and internal illumination will therefore facilitate routine patrol inspection of such items. Viewing ports should be at a convenient height. In double-stacked units, placing the viewing ports at the bottom of the access doors of the upper unit will remove the need to use temporary ladders or steps when carrying out patrol inspections.

4.19 Internal illumination should be provided by fittings to at least IP55 rating. Fittings should be positioned so that they provide both illumination for inspection and task lighting. All lights in a unit should be operated by a single switch.

4.20 Access to AHUs and items in the distribution system such as filters or heater/chiller batteries should be via fixed ladders and platforms or pulpit-style movable steps. The installation of distribution ductwork and other electrical or mechanical services should provide sufficient clearance to allow the pulpit steps to be easily wheeled into position.

AHU drainage system

4.21 All items of plant that could produce moisture must be provided with a drainage system. The system will comprise a drainage tray, glass trap, air break and associated drainage pipework.

4.22 The drainage tray should be constructed of a corrosion-resistant material – stainless steel is preferred – and be so arranged that it will completely drain. To prevent "pooling", it is essential that the drain connection should not have an up-stand and that a slope of approximately 1 in 20 in all directions should be incorporated to the drain outlet position. The tray must be completely accessible or, for smaller units, easily removable for inspection and cleaning.

Removable drainage tray

4.23 Each drainage tray should be provided with its own drain trap. The drain trap should be of the clear (borosilicate) glass type. This permits the colour of the water seal to be observed, thus giving an early indication of corrosion, biological activity or contamination within the duct. The trap should have a means for filling and incorporate couplings to facilitate removal for cleaning. It should be located in an easily visible position where it will not be subject to casual knocks. The pipework

connecting it to the drainage tray should have a continuous fall of not less than 1 in 20.

4.24 Traps fitted to plant located outside or in unheated plantrooms may need to be trace-heated in winter. The trace-heating must not raise the temperature of water in the trap above 5ºC.

4.25 Water from each trap must discharge via a clear air gap of at least 15 mm above the unrestricted spill-over level of either an open tundish connected to a foul drainage stack by way of a second trap, or a floor gully (or channel). A support should be provided to ensure that the air gap cannot be reduced. More than one drain trap may discharge into the tundish providing each has its own air break.

4.26 Drainage pipework may be thermoplastic, copper or stainless steel. Glass should not be used. The pipework should be a minimum diameter of 22 mm and have a fall of at least 1 in 60 in the direction of flow. It should be well supported and located so as not to inhibit access to the AHU.

Layout of AHU

4.27 The AHU should be arranged so that most items are under positive pressure. Any item of plant requiring a drain should be on the positive pressure side of the fan. A recommended layout is given in Figure 1.

4.28 A separate extract unit will generally be required for the area served by each supply unit.

4.29 An energy recovery system will normally be fitted between the supply and extract units.

Provision of dampers

4.30 Fire- or smoke-actuated dampers should be provided at the locations required by Health Technical Memorandum 05-02 – 'Guidance in support of functional provisions for healthcare premises' (see also paragraph 5(c) in Appendix 1 and paragraph 6.21).

4.31 Motorised low-leakage shut-off dampers should be located immediately behind the intake and discharge of each supply and extract system respectively. They should be of the opposed-blade type, opening through a full 90 degrees, and must close automatically in the event of power failure or plant shut-down to prevent any reversal of the system air flow.

4.32 The quality of motorised dampers is critical. They should:

- be rigid;
- have square connections fitted with end and edge seals of a flexible material; and
- have minimal play in linkages.

The leakage on shut-off should be less than 2%.

4.33 A manually operated isolating damper should be installed between the main AHU and its distribution system to enable the unit to be isolated when cleaning is in progress.

4.34 Some systems will require the fitting of a main volume control damper so that the design air-flow rate can be set at commissioning. The damper should be lockable in any position. If it will also be used for plant isolation, it should be capable of being reset to give the design air flow without the need for remeasurement.

4.35 Internal plant-isolating dampers are not required. Neither is the provision of fittings for shut-off plates between items within a unit.

Vibration

4.36 Vibration from a remote plantroom can be transmitted by the structure of the building, may be regenerated and may sometimes be magnified many times. Units should be selected to have the minimum vibration generation and to be installed on suitable anti-vibration mounts. Pipe and ductwork should incorporate anti-vibration couplings, preferably in two planes at right angles, as close to the vibration source as possible. Consideration should be given to the use of anti-vibration pipe hangers and supports.

Sequence of components

4.37 The following arrangement of plant components is typical, although in many instances not all elements will be required:

a. fresh-air intake;

b. motorised isolation/smoke damper;

c. frost/fog coil;

d. prefilter;

e. energy-recovery device;

f. attenuator (these may be located in the intake and discharge duct if they are of a suitable type – see also paragraph 4.166);

g. fan;

h. blast plate;

j. attenuator (see (f));

k. chiller battery;

m. eliminator;

n. heater-battery;

p. humidifier;

q. final filter;

r. manual isolation/volume control damper.

4.38 There may be instances where this arrangement is not appropriate, and the plant arrangement should be planned accordingly.

Fans

General requirements

4.39 The fan should be selected for efficiency and minimum noise level, but the overriding factor should be the selection of a fan characteristic such that the air quantity is not greatly affected by system pressure changes due to filters becoming dirty or due to external wind effects.

Acceptable types

4.40 Fans can be of the axial, centrifugal, cross-flow, mixed-flow or propeller type, depending on the requirements of the system.

4.41 Where used, centrifugal fans should preferably be of the backward-blade type. Alternatively, where noise levels are more critical and pressure requirements are lower, forward-curved blade fans are acceptable. For high-power applications, aerofoil-blade fans are appropriate.

4.42 In all cases the fan power performance requirements of the Building Regulations Part L2 must be met.

Selection

4.43 Generally, large ventilation systems will use centrifugal fans due to their efficiency, non-overloading characteristics and developed pressures.

4.44 Axial flow or propeller fans are generally only used in local through-the-wall systems or systems with very low-pressure requirements.

4.45 Cross-flow fans have very low operating efficiencies, and thus their use is restricted to applications such as fan-coil units.

Location and connection

4.46 Fans are normally positioned to “blow through” the central plant so that the cooling coil and humidifier drains will be under positive pressure.

4.47 The fan performance figures given by manufacturers in their catalogue data are based on tests carried out under ideal conditions, which include long uniform ducts on the fan inlet/outlet. These standard test connections are unlikely to occur in practice; the designer should therefore ensure as far as is practical that the fan performance will not be significantly de-rated by the system. This objective can be approached by ensuring that the fan inlet flow conditions comprise uniform axial flow velocities with low levels of turbulence.

4.48 Where the outlet duct is larger than the fan discharge connections, there should be a gradual transition, with a following section of straight duct having a length equivalent to three duct diameters.

4.49 The design of the fan inlet connection must be carefully considered to avoid swirl in the air stream. When the air spins in the same direction as the impeller, the performance and power consumption of the fan are reduced. When the air spins in the opposite direction to the impeller, power consumption and noise will increase with hardly any pressure increase. Air-stream swirl is usually induced by large variations across the fan’s inlet eye, caused by the air passing round a tight bend immediately before the eye.

4.50 Where a centrifugal fan is located with a free inlet, the clear distance between the suction opening and the nearest wall should be not less than half the diameter of the inlet. If two fans with free inlets are positioned within the same chamber, their adjacent suction openings should be at least one (inlet) diameter apart.

4.51 Airtight flexible joints should be provided at the fan’s inlet and outlet connections. They should be equal in cross-section to the points of connection, and be neither longer than 200 mm nor shorter than 100 mm.

4.52 For centrifugal fans, a diffuser screen/blast plate should be fitted immediately downstream of their discharge.

Supply fan drive arrangements

4.53 Where the fan drive is via a motor-driven belt and pulley, it should be external to the air stream. This arrangement has the following advantages:

a. the fire risk is reduced;

b. the drive is visible, so it is simple to check that the belt is still there;

c. particles shed from the drive belt are outside of the air stream;

d. if the belt slips, the "burning rubber smell" is not transmitted down into occupied areas of the premises;

e. noise generated by the motor and drive will not be transmitted along the ductwork;

f. waste heat is excluded from the system;

g. the drive may be through a V-belt or toothed belt and pulley. The latter has the advantage of eliminating belt squeal on start-up and has a longer service life. It is particularly suitable where the fan's drive motor is fitted with a soft start.

4.54 The drive train should be easily visible without the need to remove access covers. Protecting the drive train with a mesh guard is the preferred option. For weatherproof units designed to be located outside, the fan drive will be external to the duct, but enclosed. It should be easily visible through a viewing port with internal illumination and be accessible via a lockable hinged door.

4.55 For direct-coupled fan and motor units, the motor may be within the air stream, provided the motor windings are protected from over-temperature by a thermister and lockout relay.

4.56 For induction-drive "plug" motor arrangements (where the motor is fitted within the fan and is integral to it) and in-line axial fans with a pod motor, the fan/motor combination may be within the air stream, provided the motor windings are protected from over-temperature by a thermister and lockout relay.

Extract fan drive arrangements

4.57 Where the fan drive is via a motor-driven belt-and-pulley arrangement, it should be located external to the air stream.

4.58 The fan drive and motor may be located inside the duct within the air stream, provided the motor windings are protected from over-temperature by a thermister and lockout. The drive train should be easily visible through a viewing port, have internal illumination, and be accessible via a lockable hinged door.

4.59 Where the system air is explosive, aggressive or has a high moisture content, the extract fan motor must be located outside the air stream. This is generally achieved with axial fans by using a bifurcated unit.

Control

4.60 Fans in healthcare applications are generally either single- or two-speed. Where there is a requirement for two-speed operation, this is generally via a local user control (for example in a hood-extract system to provide a boost facility) or via a time schedule for energy saving during unoccupied periods.

4.61 Normally, only a single motor is required with a standby motor available for fitting as necessary, or fitted, but not belted. Twin, run and standby motors – with the standby being jockeyed around – are not required.

4.62 Where there is a specified requirement for standby fans, the system should incorporate an automatic changeover facility activated via an air-flow sensor. Fault indication should be provided.

4.63 In terms of start-up and operation, fans are increasingly becoming computer-controlled. Inverter-drive, variable-speed and soft-start systems are becoming a standard approach. Most healthcare applications require known amounts of air to be delivered while the system is in use. Constant-volume systems that deliver specified air-change rates are therefore the norm. Duct- or room-pressure-controlled, variable-speed systems have a very limited application in healthcare.

4.64 It is necessary to ensure that – should the computer control system or its software develop a fault – the fan can be switched to a direct-start, fixed-speed manual operation. This is particularly important for critical care systems serving operating suites, high-dependency care units of any type, isolation

facilities, laboratories and pharmaceutical production suites. Off-site software support is not a substitute for the ability of on-site staff to override automatic controls and keep the system operating in an emergency. Under these circumstances, actions that may shorten the life of the plant are considered of secondary importance to that of preserving the health and safety of patients and staff.

Heater-batteries

General requirements

4.65 Fog/frost heating coils are installed to protect the downstream filters from low-temperature, high-humidity intake air conditions. As they handle unfiltered air, they should be constructed of plain tubing without fins and be as near to the outside as possible to minimise condensation during cold weather. Access for cleaning will need to be provided to both sides of the coil.

4.66 Where steam coils are used for a fog/frost battery, they may be constructed using spiral-finned copper tube. As they will be prone to fouling, the tube layout and spacing should permit easy access for regular cleaning.

4.67 Main and branch heater-batteries should be constructed of solid-drawn copper-tube coils with copper fins, generally connected in parallel.

4.68 Where there is a wet heating system in the areas served, the main heater-battery should be sized for the ventilation requirements only, and not for the fabric loss.

4.69 Access for cleaning must be provided to both sides of all fog coils and heater-batteries.

Acceptable types

4.70 Electric, water or steam heater-batteries may be considered; however, electric heater-batteries are expensive to operate and, where there are alternatives, their use should be restricted to low-power use (for example trimming control).

4.71 Where steam-supplied heater-batteries are used, their control, venting and trapping systems should be designed so that a vacuum cannot occur within the coil. The condensate drainage arrangements should not allow pressure to build in the main, resulting in a back-up of condensate in the coil.

Location

4.72 Where possible, wet-trimmer heater-batteries should be located in plant areas.

4.73 Where it is necessary to locate auxiliary heater-batteries in false ceilings, consideration should be given to the use of electric heaters. If this is not practicable, a catch tray should be installed under both the battery and the control-valve assembly to protect the ceiling from leaks. A moisture sensor and alarm should be fitted in the tray. In any event, to facilitate maintenance access, auxiliary wet heater-batteries should be located above corridors or other non-critical areas and not above patient-occupied spaces.

4.74 Auxiliary fan-coil units should not be installed in the ceiling above an occupied space. They should be accessible for routine maintenance and cleaning without the need to cause significant disruption to the operation of the department that they serve.

Control

4.75 LPHW fog/frost coils should be controlled by an off-coil temperature sensor operating a motorised valve to provide a minimum plant "on temperature" of between 2ºC and 5ºC. The off-coil temperature of the frost coil is generally sensed by a serpentine thermostat downstream of the coil or upstream of the next plant item. This thermostat will shut the fan down if any part of the air stream is below the minimum set-point.

4.76 Steam-supplied fog/frost coils should be fitted with an on/off control operated by a temperature sensor mounted upstream of the battery. These are normally set to fully open the control valve when the outside temperature drops to +1ºC. This will ensure that there is no standing condensate in the base of the coil.

4.77 The main heater-battery should be controlled in the same manner under the dictates of either an off-coil temperature sensor or a room temperature sensor, depending on the plant configuration and method of control. Trimmer heater-batteries are generally controlled by one or more averaging temperature sensors within the room or rooms in the zone.

4.78 Heater-battery control valves should automatically close on system shut-down or fan failure. The control system should then automatically set to provide frost protection.

Cooling coils

General requirements

4.79 Cooling coils will need to be periodically cleaned or decontaminated. They must have good access both up- and downstream. Hinged access doors with viewing ports and illumination inside the duct should be provided both sides of the coil.

4.80 An eliminator will be required downstream of all cooling coils. The eliminator may take the form of an extension of the coil fins or be a separate device. If a separate device, it should be removable as a unit to permit cleaning of the coil face.

4.81 All cooling coils must be fitted with their own independent drainage system as specified above. A baffle or similar device must be provided in the drain tray to prevent air bypassing the coil. The tray should be large enough to capture the moisture from the eliminator, bends and headers.

4.82 Where coils are greater than 1 m high, intermediate drain trays are needed.

Selection

4.83 Cooling coils supplied with chilled water are the preferred option. For small loads or where chilled water is not available, direct expansion coils may be used.

4.84 Care must be taken to minimise electrolytic action resulting from condensation on the air side. Coils constructed from copper tubes with copper fins extended on the downstream side in the form of an eliminator, and electro-tinned after manufacture, are preferred. Aluminium fins should only be used if vinyl-coated.

4.85 All parts of the coil and its associated ductwork in contact with moisture must be manufactured from corrosion-resistant materials. Pressed-steel coil headers, even if treated, have been shown to be prone to corrosion over time and should not be used. Steel mounting frames and casings present similar problems, so stainless steel is preferred.

Location

4.86 Cooling coils in AHUs should be located upstream of the final filter.

4.87 Auxiliary fan-coil units should not be installed in the ceiling above an occupied space. They should be accessible for routine maintenance and cleaning without the need to cause significant disruption to the operation of the department that they serve. The drainage of such items is often problematic. If a suitable fall in the drain line cannot be achieved, a pump-out system must be provided.

4.88 Where any cooling coil has to be located above a ceiling, an external catch tray should be installed under the unit and its control valve assembly to protect the ceiling from leaks. A moisture sensor and alarm should be fitted in the catch tray. To facilitate maintenance access, coils should be located above corridors or other non-critical areas, but not above patient-occupied spaces.

Control

4.89 There are three basic methods of control for cooling coils:

a. **Temperature control.** A room or duct temperature sensor controls the cooling coil and heater-battery in sequence to maintain the desired room temperature. This is used where close control of room humidity is not required. If a suite of rooms is served by the same unit, the control sensor may be located in a common extract duct to achieve an "average" condition.

b. **Temperature and humidity control.** Room temperature and humidity sensors control the cooling coil, heater-battery and humidifier in sequence. The room temperature and humidity are kept within an acceptable range, with temperature taking precedence over humidity. It is usual to interlock the cooling coil and humidifier so that they cannot be on together.

c. **Full temperature and humidity control.** Room temperature and humidity sensors control the heater-battery, humidifier, cooling coil and a re-heater-battery in sequence to maintain a specific room condition regardless of the room load. This is very expensive in energy and can rarely be justified. In healthcare it is only likely to be considered for specialised research facilities.

4.90 It is usual to isolate the cooling coil upon selection of set-back operation. In addition, on system shut-down, low air flow or fan failure, the cooling coil must be isolated.

Humidifiers

Design need

4.91 Humidification was originally required for some healthcare applications in order to control the risk associated with the use of flammable anaesthetic gases. The use of such gases has now ceased. Humidification is therefore no longer required unless there is a very specific application requirement.

4.92 Operating-theatre AHUs do not generally require humidifiers, but provision for their retrofitting in terms of space provision and a capped drainage system should be provided.

4.93 Where humidification is required, it will be subject to the specific requirements set out below. These are intended to ensure that the unit will operate safely and not become a source of contamination.

General requirements

4.94 The most important requirement for a humidifier is to create complete mixing of the steam with the air. The manufacturers' instructions should be closely followed regarding minimum distances, which should be allowed before bends or other components. This is particularly important with respect to a filter mounted downstream. If it becomes saturated by the humidifier, organisms can grow through the filter and be released into the duct. These may then be carried on the air stream into an occupied space.

4.95 The section of ductwork containing the humidifier may need to be periodically cleaned. Hinged access doors with viewing ports and internal illumination should be provided. A label warning that the device emits live steam and should be isolated prior to opening should be affixed to the access door.

4.96 All parts of the humidifier and its associated ductwork in contact with moisture must be manufactured from corrosion-resistant materials; stainless steel is preferred.

4.97 The electrodes of self-generating electrode-boiler humidifiers should be stainless steel.

4.98 All humidifiers must be fitted with their own independent drainage systems as detailed above.

4.99 For self- and locally-generated steam humidifiers, the cleanliness of the water supply is essential for their safe operation. The water supply should be derived from a potable source. Chemical treatments must not be added to the water supply to humidifier units.

4.100 If the quality of the water supply to a self-generating humidifier unit cannot be assured, an ultraviolet (UV) system to control microbiological growth could be installed. However, given the limitations of UV systems, this will require high-quality water filtration to ensure the effective exposure of organisms to the UV irradiation. As with all water-treatment systems, the unit should be of proven efficacy and incorporate UV monitors so that any loss of transmission can be detected.

4.101 Provision should be made for draining down supply pipework and break tanks serving self-generating humidifiers during the seasons when they are not required in service. Isolation of the water supply should be at its junction with the "running" main to prevent the creation of a dead-leg. All parts of the system should be capable of being cleaned and/or disinfected as necessary.

Acceptable types

4.102 Only steam-injection manifold-type humidifiers are suitable for use within air-conditioning systems in healthcare facilities. Water-curtain, spray or mist humidifiers of any type should not be used.

4.103 Steam may be derived from the central steam supply provided that it does not contain any treatment carry-over, or may be generated locally either within or adjacent to the humidifier.

4.104 The introduction of steam should be by an appliance specifically designed to discharge dry steam into the air-conditioning system without objectionable noise or carry-over of moisture.

4.105 During the design stage, consideration should be given to the proposed methods for the regular cleansing of the humidifier(s) and their components.

Selection

4.106 The number and length of steam-injection manifolds to be used is dependent on various factors such as duct cross-sectional area, air velocity, dry-bulb temperature and manifold design. Guidance from the manufacturer should be closely followed.

4.107 A mains steam humidifier can be noisy and will be difficult to control if it is operated at an excessive steam pressure. It should be sized for an operating pressure of approximately 1 bar. The pipework

supplying it should be provided with a dirt pocket, pressure-reducing valve and steam trap installed as close as practicable to the humidifier so that the steam condition at entry is as dry as possible. A temperature switch on the condensate line (or equivalent design provision by the humidifier manufacturer) should be incorporated to prevent "spitting" on start-up.

4.108 Most operational problems with mains steam humidifiers arise because of back-pressure in the condensate discharge line, which will result in flooding into the duct. Unless the condensate from the device can be discharged and collected at atmospheric pressure, it should be discharged directly to drain.

4.109 Some steam generators incorporate a heated tank that requires regular cleaning and descaling. The design must allow the steam-supply manifold to be physically isolated from the air duct in order to prevent contamination of the air stream by cleaning agents while this is taking place.

Location

4.110 Careful siting of the humidifier lance is required to prevent the steam impinging onto the side(s) of the duct, condensing and generating excess moisture.

Control

4.111 Accurate humidity control can only be provided on single-zone systems or multi-zone systems with zonal humidifiers. In the former, humidity sensors control the humidifier for low-level humidity control and override the temperature controls to open the cooling-coil valve for high-level humidity control.

4.112 Multi-zone systems are more usually controlled by a minimum humidity sensor located in the supply duct(s) following the last heater-battery.

4.113 Overriding controls separate from the normal plant humidistat should be installed. Their purpose is to prevent excessive condensation in the conditioned space when starting up. A time delay should be incorporated into the humidifier control system such that the humidifier does not start until 30 minutes after the ventilation/plant start-up. In addition, a high-limit humidistat should be installed to limit the output of the humidifier so that the saturation in the duct does not exceed 70%. This humidistat is to control the added moisture; it is not necessary to install a dehumidifier to reduce the humidity of the incoming air if it already exceeds 70%. The humidifier control system should ensure that the humidifier is switched off when the fan is not running.

4.114 It is usual to isolate the humidifier upon selection of set-back operation. In addition, on system shut-down, low air flow or fan failure, the humidifier should be isolated.

4.115 If a water-supplied local steam generator is unused for a period exceeding 48 hours, it must automatically self-drain (that is, all water content must drain out – including that contained in the supply pipework – all the way back to the running main) and remain empty.

Filtration

General requirements

4.116 The purpose of filtration is to reduce the level of airborne contamination in an air stream. It is generally carried out in stages.

4.117 Filters must be securely housed and sealed in well-fitting frames that minimise air bypass. Air bypass significantly reduces filtration efficiency: the higher the filter grade, the greater the effect. Mounting frames should be designed so that the air flow pushes the filter into its housing to help minimise air bypass. Mounting frames that withdraw so that the filter can be changed without having to reach into the unit are preferred.

4.118 Neither the filter media nor any material used in the construction of the filters should be capable of sustaining combustion. The filter media should be such that particles of it do not detach and become carried away by the air flow.

4.119 Filters need to be readily accessible for replacement; therefore, a hinged access door should be provided. The upstream side of the filter should be visible for inspection through a viewing port with internal illumination.

4.120 All filters should be provided with a means of visually checking the differential pressure across them. Direct-reading dial-type gauges marked with clean and dirty sectors are preferred.

4.121 A complete spare set of filters must be provided to the client at handover.

Definition of filter terms

4.122 Particulate air filters are divided into four categories:

a. general ventilation filters graded G1 to G4;

b. fine filters graded F5 to F9;

c. HEPA filters graded H10 to H14;

d. ultra-low particulate air filters (ULPA) graded U15 to U17.

4.123 General filters are graded in terms of their "synthetic dust weight arrestance". This represents the percentage of a test dust captured by a filter. "Arrestance" provides a good indication of a filter's ability to remove the larger, heavier particles found in outdoor air. These are of a size to block finned batteries and large enough to settle out in the air distribution system (see Table 3).

Table 3 General filters

BS EN 779 grade (Eurovent grade)	% Arrestance	Notes and typical healthcare applications
G1 (EU1)	<65	Metal-mesh grease filter
G2 (EU2)	65 to <80	Coarse primary filter
G3 (EU3)	80 to <90	Primary air intake; Return air; Energy-recovery device protection
G4 (EU4)	>90	General-purpose tempered air supply

4.124 Fine filters are graded in terms of their "atmospheric dust spot efficiency". This is a measure of the filter's ability to remove the very fine staining particles found in outdoor air. It will indicate how "visibly" clean a filter will keep a ventilated space. The staining particles are approximately the same size as most common bacteria so it is also a rough measure of the filters' ability to remove them (see Table 4).

Table 4 Fine filters

BS EN 779 grade (Eurovent grade)	% Efficiency	Notes and typical healthcare applications
F5 (EU5)	40 to <60	General-purpose panel/bag filter
F6 (EU6)	60 to <80	Basic grade bag filter
F7 (EU7)	80 to <90	Medium grade bag or pleated paper Conventional operating theatre supply air
F8 (EU8)	90 to <95	High grade bag or pleated paper
F9 (EU9)	>95	Basic HEPA filter – level 8 clean rooms

4.125 High-efficiency filters (HEPA and ULPA) are graded in terms of their ability to capture their "most penetrating particle size" (MPPS).

4.126 High-efficiency filters self-select the particle that they are least able to trap, hence the MPPS. They are then tested against that size of particle.

4.127 These filters are designed to provide very high-efficiency filtration of particles in the sub-micron size range (see Table 5).

Table 5 High efficiency (HEPA) filters

BS EN 1822 grade (Eurovent grade)	% Efficiency at most penetrating particle size (MPPS)	Notes and typical healthcare applications
H10 (EU10)	85	Ultra-clean theatre terminal
H11 (EU11)	95	
H12 (EU12)	99.5	
H13 (EU13)	99.95	
H14 (EU14)	99.995	Pharmacy aseptic suite Category 3 room extract
U15–U17	–	Not generally used in healthcare

Selection

Primary filters

4.128 All filters should be of the dry type.

4.129 Panel filters are cheap and disposable with relatively low dust-holding capacity. They are generally used as prefilters to eliminate large particles which would otherwise clog or cause damage to the fan and finned heating and cooling batteries. Stainless steel frames that hold disposable pre-cut filter pads are more economic, create less waste and are therefore the preferred option.

4.130 General ventilation supply plant should incorporate primary air filters of grade G3, sized for a maximum face velocity of 2 m/s. Additional coarse prefilters may be justified where the intake air is exceptionally polluted. They are sometimes fitted as a temporary measure when building work is being carried out in the vicinity of the air intake.

Secondary filters

4.131 Where a higher standard of filtration is required, secondary bag or pleated-paper panel filters can be used. Rigid frame filters incorporating pleated-paper elements are preferred over bag filters for critical care applications such as operating theatres.

4.132 In urban or other areas of high atmospheric pollution, a higher standard of filtration may be justified to reduce the level of staining to internal finishes.

Extract air filters

4.133 Extract filtration will generally only be required where heat-recovery devices are installed. There are a very limited number of specialised applications (microbiological safety cabinets and similar LEV systems) where contaminated air is required to be filtered prior to discharge to atmosphere. If it is safe for staff to work in a room without wearing respiratory protective equipment, it is safe to discharge the room air to atmosphere without filtration.

Return-air filters

4.134 Return-air filters are used to reduce the load on HEPA filters in recirculating applications such as ultra-clean operating suite ventilation canopies and pharmacy aseptic suites.

High-efficiency filters – HEPA and ULPA

4.135 HEPA filters are expensive. Therefore, their use should be kept to a minimum. Applications requiring HEPA filters include the air supply to aseptic suites in manufacturing pharmacies and the discharges from microbiological safety cabinets.

4.136 If used, HEPA filters should be of the replaceable-panel type with leak-proof seals. They should be installed in a manner that permits on-site validation of the filter and its housing. This may involve the release of a dispersed oil particle (DOP) challenge smoke through an injection point upstream of the filter plus measurement of the DOP penetration across the downstream face. Alternatively, a particle-counting method may be used.

4.137 HEPA filters are sometimes fitted in extract systems to capture hazardous substances or organisms. Design provision must be made for the subsequent safe handling of contaminated filters by maintenance staff. This may be achieved by:

- sealing the hazardous substance into the filter before it is removed;
- providing a system to fumigate the filter to kill any organisms;
- housing it in a ”safe change” unit that permits the filter to be ejected into a bag and sealed without staff having to come into direct contact with it.

4.138 In view of the costs and problems associated with placing HEPA filters in extracts, it is recommended that a full risk assessment be carried out at the design stage. This should include defining the need for HEPA filters in an extract; validation of its performance at installation; the method of safely changing a contaminated filter; and its subsequent disposal.

4.139 ULPA filters are very expensive and are designed to remove particles below a size that are either surgically or aerobiologically significant. There would have to be exceptional circumstances in order to justify their use in healthcare ventilation systems.

Activated carbon filters

4.140 Activated carbon filters are able to remove gases and vapours from the air stream and are graded according to the range of substances they can

remove. They are not normally fitted in air-conditioning supply systems.

4.141 They are occasionally fitted retrospectively because the main air intake has been poorly sited and is drawing in traffic fumes. Where used, they must be protected by a particulate air filter.

4.142 Activated carbon filters are more commonly used in specialised fume-extraction systems when the location of the discharge means that dilution cannot be relied upon to disperse noxious fumes.

Location

4.143 The primary filter should be positioned on the inlet side of the supply fan, downstream of the frost coil. The secondary filter, when fitted, should be on the positive-pressure side of the fan. This will prevent air being drawn into the system after the filter and capture any particles shed by items of equipment within the AHU.

4.144 The filter installation must be arranged to provide easy access to filter media for cleaning, removal or replacement, with side or front withdrawal as required.

Control

4.145 Differential-pressure transducers should be provided to remotely monitor and alarm on excessive filter pressure drop. In critical care areas, dirty-filter indication lights should be provided at the point of use.

Energy recovery

General requirements

4.146 Energy recovery must be fitted to all healthcare ventilation systems. It may be omitted only where it would clearly be uneconomic (for example to a single WC extract system).

4.147 For systems in healthcare premises, a plate heat exchanger or "run-around coil" system is suitable. Thermal wheels may be used providing they are fitted with a purge sector. The small amounts of air leakage across these devices are not considered significant. Other systems such as heat pumps or heat pipes are also suitable. Selection should be based on the relative locations of the supply and extract units, ease of maintenance and practicality. Cleaning access will be required to both sides of any energy-recovery device.

4.148 The following are the minimum energy transfer efficiencies required for devices handling equal air volumes:

- run-around coil – 45%;
- plate heat exchanger – 50%;
- thermal wheel – 65%;
- any other energy-recovery device – 50%.

4.149 If a plate heat exchanger is chosen, the plates should be constructed of metal. An internal bypass is not always required but, if fitted, plastic should not be used for the internal dampers and drive gears.

4.150 Whichever energy-recovery device is chosen, the extract side will need to be protected by a G3 filter and provided with a drainage system (as described above) to remove condensate.

Location

4.151 Energy-recovery devices should be located downstream of the fog coil and prefilter, prior to the cooling coil or main heater-battery on the supply side. If heat pipes are selected, it may be possible to use them to replace the fog coil.

Control

4.152 It is essential to consider the control of both the energy-recovery device and the fog/frost coil when assessing the economics of recovery, as all energy provided by the frost coil will directly reduce the heat exchange of the recovery device. To this end, the off-coil setting of the frost coil should be the minimum possible to protect the primary filter (for example +2ºC).

4.153 The control of the energy-recovery device should be fully integrated with that of the main plant to ensure maximum economic benefit.

4.154 Plate heat exchangers and heat pipes can be self-controlling in the sense that energy will transfer across the device from the extract to the supply at winter design values and from the intake to the extract discharge at summer design values, thus obviating the need for a bypass and sophisticated control system.

Attenuation

General requirements

4.155 Noise is generated in an air distribution system by the fan, plant items and air flow. The ductwork is a very effective transmitter of this noise; hence, there is generally a need to limit the noise transmission to meet the requirements of the building. This normally involves the provision of sound attenuation treatment as part of the overall ductwork system design.

4.156 A thorough assessment of the design should be made to assess the noise impact. This should take into account the following primary factors:

- fan- and plant-noise generation;
- air-flow-generated noise in ductwork fittings and dampers;
- noise generated at grilles, diffusers and other terminals;
- noise break-in and break-out of ductwork;
- cross-talk and similar interference;
- the noise limitations for the building and surrounding areas;
- external noise generation.

4.157 A method of assessment of these factors and the sound attenuation requirements of ductwork systems is given in CIBSE's Guide B.

4.158 The fan is usually the main source of system noise. The sound power that it generates varies as the square of the fan pressure, and thus to limit the fan noise level the system resistance should be kept as low as economically possible. As a general rule, the selected fan should operate close to its point of maximum efficiency to minimise its noise generation. Where there is disturbance to the air flow at the fan inlet, the manufacturer's stated fan noise levels should be increased by up to 5 dB(A). More precise guidance on this aspect may be available from the manufacturers.

4.159 Fans radiate noise through both the inlet and outlet connections, and it may be necessary to provide attenuation to limit the noise from both of these connections. It is always preferable and more economic to control noise and vibration at source, or as close to source as possible. It should be noted that attenuators offer a resistance to air flow. The resistance must be included in the fan and ductwork calculations.

4.160 Provided care is taken in the design and construction of low-pressure systems to avoid significant noise generation in the ductwork, attenuation should only be needed to absorb fan noise.

4.161 Noise break-out from all equipment housed in the plantroom must be taken into consideration if control is to be satisfactory. Any ductwork within the plantroom after the silencer should be acoustically insulated to prevent noise break-in.

4.162 There is no complete means of control over external noise generation from sources such as road traffic, aircraft, factory and community noise. Consideration must be given to this at the design and planning stage.

Acceptable types and location

4.163 The noise levels produced by ventilation and other plant should be reduced by either lining the inside of the duct with sound-absorbing material or fitting bespoke attenuator units.

4.164 In supply systems, sound-absorbing material should not be applied to the inside surface of a duct system downstream of the final filter, owing to the risk of mechanical damage and the subsequent dispersal of the media into the ventilation system.

4.165 In supply and extract systems, sound-absorbing material should not be applied to the inside of a duct within 1 m of a fire damper. The material should be non-particle-shedding and fire-resistant (see Health Technical Memorandum 05-02). Where sound-absorbing material is applied in a section of duct that will be routinely exposed during maintenance activities, it should be protected from mechanical damage.

4.166 Bespoke attenuator units with a sound-absorbing in-fill suitable for the quality of air being handled and protected by a perforated sheet metal casing are the preferred option for critical systems. Absorption of moisture, dirt and corrosive substances into the "in-fill" and the release of fibrous particles into the air stream should be prevented by the use of a membrane. The membrane material should have a declared service life of at least 25 years. If these conditions can be met, the attenuator may be located in the supply ductwork downstream of the final filter. When so located, cleaning access should be provided at both ends of the attenuator unit.

5 Air distribution system

Air distribution arrangements

Ductwork distribution systems

5.1 Ductwork systems for ventilating and air-conditioning applications are referred to by their velocity or pressure category, that is, as low, medium or high velocity (or pressure) systems. HVCA limits are up to:

- 10 m/s or 1000 Pa in the case of conventional low-pressure systems;
- 20 m/s or 1750 Pa in the case of conventional medium-pressure systems; and
- 40 m/s or 3250 Pa in the case of high-pressure systems.

Note

High-pressure systems are disappearing because of the constraints of the Building Regulations, but existing systems may sometimes need to be altered or extended.

5.2 For normal applications in healthcare buildings, low-velocity systems are recommended; the use of higher velocities than those recommended may not be economical. Future trends are for even lower optimum duct velocities; however, velocities below 2 m/s are unlikely to be justified.

5.3 The site will often dictate the main routing of ductwork systems but, in general, the design should seek to make the layout as symmetrical as possible; that is, the pressure loss in each branch should be as nearly equal as possible. This will aid regulation and may reduce the number and variety of duct fittings that are needed.

5.4 Main distribution ductwork should not be routed above sleeping areas. Where there is no alternative route, additional acoustic insulation is required.

5.5 Where auxiliary air-conditioning units, fans, filters or trimming devices are installed in the distribution system, they must be independently supported and fitted with a suitable drainage system, where appropriate. If they are a source of vibration, they should be linked to the distribution ductwork via flexible connections.

5.6 The fan of an LEV system provided under the COSHH Regulations should be located outside the building so that all ductwork within the building is under negative pressure. Where the fan has to be within the building, it should be located as close as practicable to the outside, with an absolute minimum run of discharge ductwork within the building. This discharge ductwork will be under positive pressure, so it must not be penetrated by test holes or inspection hatches.

Ductwork materials and construction

5.7 The choice of duct material should take account of the nature of the air or gas being conveyed and the environment in which the duct will be placed.

5.8 Galvanised-sheet-steel ductwork is the most suitable and economical choice for normal ventilating and air-conditioning applications. Its inherent mechanical strength renders it resistant to casual damage both during the construction phase and throughout its service life when mechanical and electrical services around it are altered. It also readily withstands the impacts sustained when rotary equipment is used to clean it internally.

5.9 In instances where moisture levels and/or corrosive elements in the air being conveyed are very high, aluminium, stainless steel, PVC or GRP (glass-reinforced plastic) ducts should be used. Stainless or black steel are the only suitable materials for high-temperature ductwork.

5.10 In inherently wet areas, such as the base of fresh-air inlet ducts and some extract systems, the ductwork may require draining to prevent a build-up of standing water. The layout of the drains should be as specified in Chapter 4.

5.11 Where builders' work ducts or plenum chambers are used, these may be constructed of various materials. However, all such ducts must be

rendered and sealed to prevent dust-shedding. A greater allowance may need to be made for leakage.

5.12 Galvanised, black and stainless steel ductwork should be manufactured and installed to the current HVCA specification for sheet metal ductwork DW144, but excluding the use of bolt-through supports.

5.13 GRP and PVC ductwork should be manufactured and installed to the current HVCA specification for plastic ductwork DW154.

5.14 Flexible ductwork is unsuitable for air distribution in healthcare applications. It should only be used to make the final connection to a terminal (see paragraphs 5.53–5.54).

5.15 Where phenolic-board ductwork is considered, care should be taken to ensure that it is fabricated to a quality standard and installed strictly in accordance with the manufacturers' instructions. Its pressure rating and degree of support should be suitable for the application, and the duct should be fitted with mechanical protection where required.

5.16 The inside of the ductwork should be free from structural projections and as smooth as possible. Flanged gasketed joints between sections are preferred.

Fire aspects, damper types and locations

5.17 It is essential that all relevant fire aspects of ducting systems are agreed with the fire officer before the design is finalised.

5.18 Ductwork must be fire-stopped where it penetrates fire compartment walls, floors and enclosures, cavity barriers and subcompartment walls or enclosures, and must be provided with weatherproof collars where roofs or external walls are penetrated.

5.19 Fusible-link and automatically controlled fire dampers should be provided at the locations required by Health Technical Memorandum 05-02. The fire-damper mounting frame must be securely attached to the building fabric. Where a fire damper is not mounted directly in a fire compartment wall, it must be correctly supported and the ductwork between it and the firewall must possess the same fire rating as the firewall that it penetrates. The fire-rated portion of ductwork must not be penetrated by test holes or inspection hatches.

5.20 An access hatch should be provided adjacent to each fire damper so that its correct operation can be directly observed. The hatch must be suitably sized to permit inspection, testing and maintenance.

5.21 Smoke-diverting dampers must be provided on recirculation air systems to automatically divert any smoke-contaminated return air to the outside of the building in the event of a fire. It should be arranged such that the normal open smoke-diverting damper on the return-air branch to the input unit closes and all the return air is exhausted through the extract fan. Guidance is available in Health Technical Memorandum 05-02 and BS 5588-9.

Duct sections

5.22 Ducting is generally available in rectangular, circular and flat oval sections, although other sections may be manufactured for particular situations.

5.23 Rectangular ducting is most common on low-pressure systems for the following reasons:

- it can be readily adapted to fit into the space available;
- fittings are cheaper than those for circular or flat oval ductwork;
- it can be readily joined to such component items as heating and cooling coils, and filters.

5.24 When sizing ductwork, the designer should take into account:

- installation and operating costs;
- space limitations imposed by the structure and other services;
- operating noise levels;
- requirements of regulation at the commissioning stage.

5.25 For overall economy and performance, the aspect ratio should be as close to 1:1 as possible, since high aspect ratios increase the pressure loss, heat gains or losses and overall cost (for example, changing the aspect ratio from 1:1 to 1:4 can typically increase the installed cost of the ductwork by 40% and add 25% to the heat gains or losses).

5.26 Circular ducting is preferable for high-pressure systems and for systems operating at high negative pressures. In the latter case, additional stiffening rings may be necessary. Machine-formed spirally-

wound ducting and a standard range of pressed and fabricated fittings can sometimes make circular ducting more economical, particularly in low-pressure systems having a relatively low proportion of fittings.

5.27 Flat oval ducting provides an alternative to circular ducting, principally where there is a limitation on one of the dimensions in the space available for the duct run.

5.28 Other sections may be used, such as triangular sections to pass through roof trusses. Such sections present difficulties in the provision of fittings and connections to standard plant items, and are likely to be more expensive than traditional sections.

Standard ductwork fittings

5.29 All fittings should conform to current HVCA specification DW144. Wherever possible, long radius bends, large radius main branches, sub-branches with angles no greater than 45 degrees, and long-taper transformations should be used.

5.30 Fittings should be arranged with vanes in sub-branches connected directly to grilles and diffusers, and turning vanes in square bends (when used). When vanes are used, additional cleaning access will be required.

5.31 The number of duct fittings should be kept to a minimum, and there should be a conscious attempt to achieve some standardisation of types and sizes. Increasing the number and variety of fittings in a system can markedly increase its overall cost.

5.32 Bad design in relation to air flow can lead to vibrating flat duct surfaces, increases in duct-generated noise and pressure loss, unpredictable behaviour in branch fittings and terminals, and adverse effects on the performance of installed plant items (such as trimmer batteries).

Branches

5.33 There are many designs of branch and junction in use. The important features are that the flow should be divided (or combined) with the minimum interference and disturbance. Changes in duct sizes should not be made at the branch but at a short distance downstream (or upstream). A good dividing-branch design cannot be effective if the flow entering the branch is not uniform across the section.

Changes of section

5.34 The expansion of a duct section should be formed with sides having a total included angle of no more than 30 degrees, and preferably less than 20 degrees. If the angle of expansion is greater, the flow is not likely to remain attached to the walls of the duct, and large eddies will be formed with flow reversal at the walls. This leads not only to a high-pressure loss, but also to non-uniform velocity pattern at the outlet. Where there is insufficient space for a gentle expansion and a greater angle is necessary, internal splitters should be used.

5.35 A contraction in a duct section is less critical, but the total included angle of the taper should not exceed 40 degrees (or 20 degrees where the contraction is made on one side of the duct only).

5.36 The most economical way to change the section of a rectangular duct is to restrict the change of duct size to one side only. If the calculated reduction or increase to the side dimension is 50 mm or less, it is usually not economical to change the size at the position. The minimum size of a rectangular duct should be 150 mm × 100 mm.

Other fittings

5.37 Fittings that have abrupt changes in direction and sharp edges should be avoided, as this will increase turbulence, thus increasing pressure loss and causing noise generation. If the fitting leads to the flow preferentially attaching to one side of the outlet, a significant length of straight downstream duct is necessary before the next branch or fitting; this length should be greater than five equivalent diameters.

Thermal insulation

5.38 Thermal insulation is applied to ductwork to reduce heat exchange and to prevent condensation.

5.39 In a duct system, the air-temperature changes can be significant, especially when passing through untreated space, and these have the effect of reducing the heating or cooling capacity of the air and of increasing the energy input to the system. The heat transmission to and from the surrounding space can be reduced by effective insulation of the ducts.

5.40 Condensation can arise in ductwork systems conveying cooled air and, apart from creating conditions conducive to corrosion of ductwork, condensation affects the heat and vapour-resisting

properties of insulating materials themselves, which may induce further condensation.

5.41 In normal circumstances, the insulation thickness for heat resistance is sufficient to prevent surface condensation, but in extreme conditions the insulation thickness for vapour resistance may be greater than that for heat resistance. When cold ducts pass through areas that have a high dew-point, carefully selected vapour barriers should be applied externally to the insulation.

Noise generation within the ductwork

5.42 Noise is generated in ductwork at sharp edges, and by tie rods, damper blades, duct obstructions and sharp bends. This air-flow-generated noise becomes an important factor if it is about the same or greater level than the upstream noise level. (Air-flow-generated noise is often referred to as "regenerated noise".)

5.43 The noise level generated by the air flow in ductwork is very sensitive to the velocity. The sound power of this noise is approximately proportional to the sixth power of the velocity; that is, a doubling of the duct velocity will increase the sound power by a factor of 64. The duct velocities should therefore be kept as low as possible. In general, duct fittings that have lower pressure-loss factors in similar flow conditions will generate less noise.

5.44 Ductwork serving quiet areas should not be routed through noisy areas, where noise break-in can occur and increase the noise level in the ductwork.

5.45 Grille register and louvre noise should be kept to a minimum by selecting types that:

- have low noise-producing characteristics; and
- are without high tonal noise.

They should be fitted with acoustically-treated external inlet and outlet louvres.

5.46 Cross-talk attenuators may be necessary where noise intrusion between adjacent spaces can arise and where confidentiality is required. They will normally be of the "through-the-ceiling, up-and-over" type, and may include a fire damper if required.

Volume control damper locations

5.47 Manually-operated balancing dampers are needed generally:

a. in the main duct downstream of the fan;

b. in branches of zone ducts;

c. in sub-branch ducts serving four or more terminals;

d. at terminals not covered by (c) above.

5.48 Dampers integral with terminals should only be used for final trimming of air volumes; otherwise noise and air distribution problems may ensue.

5.49 Dampers in rectangular ducts should be single-bladed when the longer side is up to 450 mm, but be of the opposed-blade multi-leaf type when above this size. In circular ducts, iris-type dampers are recommended. Dampers must be accessible, and incorporate a position indicator and means of locking in the commissioned position. Dampers should be located as far away as possible from adjacent branches or plant items.

Cleaning and access door locations

5.50 Cleaning and access doors are required to facilitate access to plant items and ductwork components for inspection, maintenance, cleaning and replacement. They must be of sufficient size to permit safe access for the required functions. Consideration should also be given to the number of doors to be provided.

5.51 Recommended locations for access doors are given in current HVCA specification DW144. They are generally provided to give access to:

- every regulating damper;
- every fire and motorised damper;
- filters (to facilitate filter withdrawal);
- both sides of cooling/heating coils;
- humidifiers;
- fans; and
- motors and impellers.

5.52 Care should be taken when siting cleaning and access doors to ensure that no other services to be installed will prevent reasonable access.

Flexible ducting

5.53 Flexible ductwork may be used for final connections to grilles and diffusers, provided it is constructed to meet the fire precautions recommended in BS 8313. It must not pass through fire compartment or subcompartment enclosures, or through cavity barriers.

5.54 Flexible ducting will cause a significant frictional loss and may be difficult to clean without damage. It should never be used in lieu of a bend. Where installed, it should take the most direct route and be as short as possible, never exceeding 1 m in length.

Diffuser and grille selection and sizing

5.55 The effectiveness of all ventilation and air-conditioning systems depends on the methods by which air is introduced to, and vitiated air is removed from, the space. The usual results of poor air-terminal selection and/or positioning are:

- draughts;
- stagnation;
- poor air quality;
- large temperature gradients; and
- excessive noise.

5.56 Air can be supplied to a space in a number of ways, although any device can be broadly placed into one of two categories:

a. that producing a diffused supply; or

b. that producing a perpendicular jet.

Diffusers may be radial or linear, and normally utilise the Coanda effect (that is, adhesion of the air stream to an adjacent surface) to reduce the risk of excessive room-air movement. A perpendicular jet is formed by discharging air through grilles, louvres or nozzles, which are generally adjustable.

5.57 Supply air terminals can be incorporated into any room surface (for example floors, walls (high or low level) and desktop).

5.58 As they operate on the jet principle, the use of side-wall and linear grilles is restricted to areas where air-change rates are fewer than ten per hour. Perforated rectangular diffusers can provide acceptable conditions within the occupied zone at up to 15 air changes per hour. In areas where a higher air-change rate is required, square or circular ceiling-mounted diffusers should be used.

5.59 The performance of supply air-terminal devices is based on three criteria:

a. **throw** – defined as perpendicular or parallel distance from the terminal to the point at which the air velocity is 0.5 m/s isovel;

b. **spread** – defined as the width of the 0.5 m/s isovel; and

c. **drop** – defined as the vertical distance from the centre line of the terminal to the bottom edge of the 0.25 m/s isovel.

5.60 It is necessary to consider each of these parameters in both summer and winter conditions to ensure satisfactory operation of the air-terminal device, as warm jets behave very differently from cold jets.

5.61 A warm jet tends to rise until it attaches itself to a horizontal surface, while a cold jet falls. Care must be taken to ensure that this does not lead to unacceptable temperature gradients in winter, or excessive air velocities in the occupied zone in summer.

5.62 In order to ensure satisfactory air movement within a space, it is necessary to consider interaction between air movement from adjacent terminals and ceiling-mounted fixtures (light fittings etc), as well as interaction between air movement and room surfaces.

5.63 If the supply and extract terminals are too close, short-circuiting may occur; if they are too far apart, stagnant zones may be formed. Where two opposing air streams meet, the individual velocities must not be greater than 0.25 m/s.

5.64 Supply and extract grilles and diffusers should be fitted with opposed-blade dampers for fine balancing purposes.

5.65 Further guidance on the selection of grilles and diffusers is given in CIBSE's Guide B.

5.66 In operating theatres, supply terminals must be able to produce a down-flow movement of air in the operating zone, 1 m above floor level. The following supply terminals are acceptable:

- ceiling-mounted diffusers with fixed directional vanes that provide a downward turbulent air flow are the preferred option;
- plenum boxes fitted with perforated screens that produce a parallel downward flow;
- linear ceiling-mounted diffusers that provide a downward air curtain around the operating zone (additional supply terminals may be located within the area bounded by the linear diffusers to provide ventilation within the air-curtained zone).

5.67 Nozzles or jets of any type are not acceptable in an operating theatre. Side-wall-mounted linear

diffusers that utilise the Coanda effect to send air across the ceiling and "drop" it into the operating zone are not suitable.

Transfer grille – size and location

5.68 Air-transfer grilles in walls, partitions or doors form an integral part of the building's air distribution system. Modern doorsets have very low leakage rates, so cannot be relied upon to permit even quite small air flows. Failure to make adequate provision for air to move from room to room will result in excessive pressure differentials and "door whistle".

5.69 Transfer grilles are required in locations where there is a significant imbalance between the supply and extract rates in a room. They will relieve any pressure differential that may affect the operation of the spaces and/or the ventilation system, and permit air flow in a known direction.

5.70 Care needs to be taken to ensure that the positioning of transfer grilles does not interfere with the fire or smoke integrity of the building. In general, air-transfer grilles should not be installed within fire-resisting boundaries, although if this is unavoidable, they should be fitted with fire or smoke dampers.

5.71 Where installed, transfer grilles should be of the non-vision type and sized for a maximum face velocity of 1.5 m/s.

5.72 In photographic darkrooms, lightproof transfer grilles are recommended.

5.73 Cross-talk attenuators may be necessary where noise intrusion between adjacent spaces can arise and where confidentiality is required (see also paragraphs 5.42–5.46).

Pressure stabilisers – size and location

5.74 Pressure stabilisers are required in lieu of air-transfer grilles in areas where it is necessary to maintain pressure differentials between adjacent rooms to prevent reversal of air flows (for example in operating suites, isolation facilities and clean rooms (see also Chapter 7)).

5.75 Fire precautions for pressure stabilisers are the same as for transfer grilles. For sizing criteria, see Chapter 7.

5.76 Pressure stabilisers should be of the balanced-blade type, with the facility to make fine adjustments to the pressure setting. They should be silent in operation and give a seal as tight as practicable when closed. The materials of construction and method of assembly should allow for cleaning and disinfection.

5.77 Pressure stabilisers should be installed in a visible location so that their operation can be readily observed.

5.78 Cross-talk attenuators may be necessary where noise intrusion between adjacent spaces can arise and where confidentiality is required. In these cases, the pressure stabiliser and cross-talk attenuator should be mounted in a short length of ductwork within the ceiling void.

5.79 Pressure stabilisers may need to be fitted with a stand-off baffle on their discharge side to prevent a sight line in situations where a laser will be used. Baffles may also be required to preserve privacy or to prevent discharge air causing draughts or disturbing the air-distribution pattern in an adjoining room. They are also useful in low-level locations to prevent the air-flow path being obstructed by portable equipment.

Pressure stabiliser with stand-off cage

6 Automatic controls

6.1 Various options for control of single and multi-zone air-conditioning systems are given in CIBSE Guide B.

General requirements

6.2 The basic requirements for an automatic control system are as follows:

- facilities to start, set-back and stop the plant;
- facilities to control the volumetric air flow;
- facilities to control the system or room pressure;
- temperature control and indication;
- humidity control and indication;
- devices to monitor and indicate the plant's operating state;
- alarms to indicate plant failure, low air flow and filter state.

6.3 The control functions provided will depend on the purpose of the ventilation system.

6.4 There will also be a need to determine the control strategy in the event of a fire either within the zone being served or within an adjoining zone.

6.5 Designers should consider whether it is necessary for the supply and extract fans to be interlocked – either so that the supply fan will not operate unless air flow is established within the extract system, or vice-versa depending on the required pressures within the rooms being served.

6.6 The sequence switching of units in order to prevent transient reverse air flows will be particularly important in laboratories and pharmacies that contain fume cupboards, safety cabinets and other LEV systems.

6.7 Alarms should be provided to show "filter fault" and "low air flow". The "filter fault" alarm should be initiated by a predetermined increase of pressure differentials across the filter. The "low air flow" alarm should be initiated when the supply-air quantity falls to 80% of the design value.

Objectives of the control system

6.8 The primary objective of a ventilation or air-conditioning plant control system is to keep the space served within the required environmental control limits, at the appropriate times – regardless of external conditions or internal loads – and with the minimum energy consumption.

6.9 Control of most systems will be via a building management system (BMS). This will enable the operating conditions and control tolerances to be set and monitored. Often, it is not possible to accurately predict building load variation at the design stage. Information provided by monitoring the operation of the plant via a BMS will enable optimum set-points to be established and energy consumption reduced. The BMS may also be set to log the actual energy consumed by the system together with that recovered by the energy-recovery device. This will provide a useful check on overall operating efficiency and provide evidence that energy targets are being achieved.

6.10 A BMS incorporating self-adaptive control algorithms that automatically adjust the set-point to suit the usage and load is preferred. The provision of movement sensors within the controlled space in order to determine the actual occupancy will facilitate this process.

6.11 The failure of specialised ventilation systems can have grave consequences for the delivery of healthcare. Control systems should therefore be simple, robust and reliable.

6.12 Computer-software-driven control systems are becoming the norm in building services. However, healthcare ventilation systems need to be available for operation outside of normal working periods when software support is not available. Should the software fail, it will be left to site staff, who may have little knowledge of the control algorithms, to restart the ventilation system. It is therefore essential to ensure that a simple means of restarting critical systems in the event of a software failure is provided (see also paragraphs 4.62–4.63).

Location of controls

6.13 Whether within the plant, duct or room, sensors should be located to provide accurate measurement of the condition of the air being monitored.

6.14 Sensors and control items such as control valves should be located close to the element being sensed or plant item being controlled in order to minimise time lags within the system, which may create over-shoot of conditions beyond the design envelope and result in additional energy consumption.

6.15 There are practical advantages in locating all control valves for an AHU in a bank (at a convenient height) at one end of the unit. (This should not result in an additional control lag.)

6.16 Some applications require intermittent mechanical ventilation, frequently at a high air-change rate (for example in bathrooms and treatment rooms). Local controls to facilitate this mode of operation should be placed in a prominent position to encourage economical use.

6.17 Local controls that enable the user to select more than one mode of operation should be clearly labelled to identify the particular mode selected. Where the system allows different room pressures to be selected, a direct-reading pressure gauge should be fitted within the eye line of the users to provide an independent confirmation of the resultant mode of operation. A clear description of the selectable modes of operation should be mounted adjacent to the control switch.

Fire aspects

6.18 A fire control panel should be mounted at the entrance of the area that the ventilation serves. Access to the panel should be restricted to the fire officer and include independent on/off controls and an indication of the supply and extract systems.

6.19 In certain critical care areas, it is preferable to maintain the supply ventilation in case of a fire within the area. For example, in an operating department, while undergoing surgery, the patient cannot always be easily moved without significant risk. In the event of a fire in a staff or support area of the department, or adjoining zone, the continued supply of air to a theatre will maintain it at a positive pressure and protect the patient and staff from the effects of smoke. This will allow time for the patient to be stabilised so that he/she can be safely evacuated if necessary.

6.20 In all critical care areas, the ventilation system should continue to operate unless smoke starts to enter the AHU. A notice should be affixed to the fire control panel stressing the need to liaise with departmental staff before switching off fan units.

6.21 All supply AHUs should have a smoke sensor mounted in the main supply duct immediately downstream of the AHU. In the event of a fire in the AHU or smoke being drawn into the system from an outside source, it should cause the supply-air fire damper to close and shut down the AHU.

Time switching

6.22 Facilities to start, set-back and stop the plant should be provided in the plantroom. Remote start and set-back control and indication, if required, should be provided at a manned staff location (for example at the reception or staff base).

6.23 Many ventilation systems may be completely shut down when the area served is not in active use (for example operating theatres). Alternatively, where there is a need to maintain a background condition, the ventilation output can be reduced by "setting back" the system. This will significantly reduce energy consumption and extend the life of filters and other system components.

Start-up control

6.24 The plant's start control should contain a control logic that will start the plant in the sequence set out in the algorithms in Figures 2–5.

Set-back control

6.25 Where variable-speed controls are installed, the set-back facility for each plant should depress the control temperature to around 15°C; exclude any humidification and cooling from the system; and reduce the supply and extract air volumes to around 50%. The extract fan can also be turned off as long as the desired direction of air movement from clean to less clean will be maintained.

Use control

6.26 The installation of movement detectors allows for "use control" of ventilation systems. A simple control logic that reduces the system to a "set-back" condition if there has been no movement detected in the space for, say, 30 minutes and that switches the system "off" if no movement is detected for one hour is recommended for many applications,

Figure 2 Typical plant control algorithm – normal start-up sequence

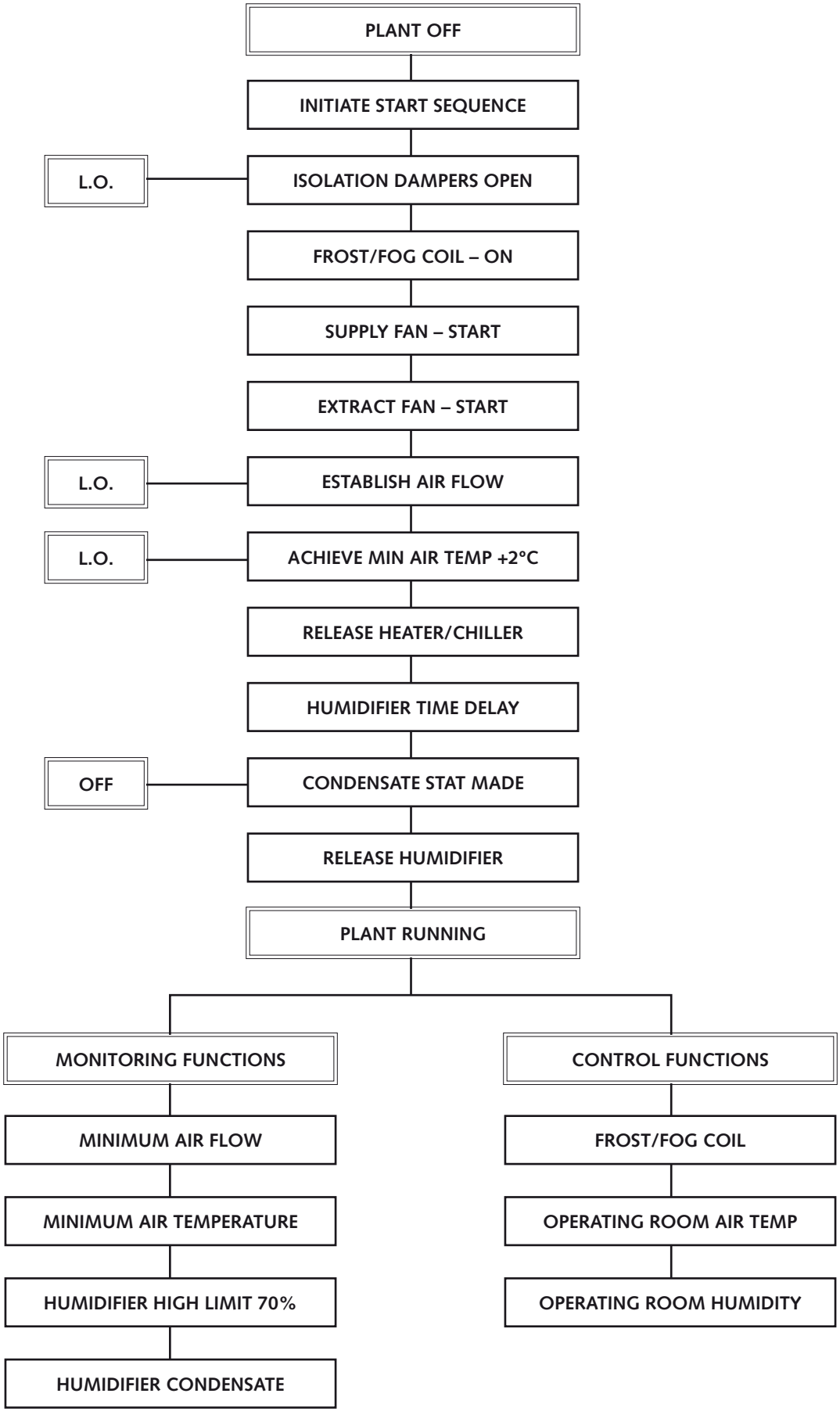


Figure 3 Plant control algorithm – normal shut-down sequence

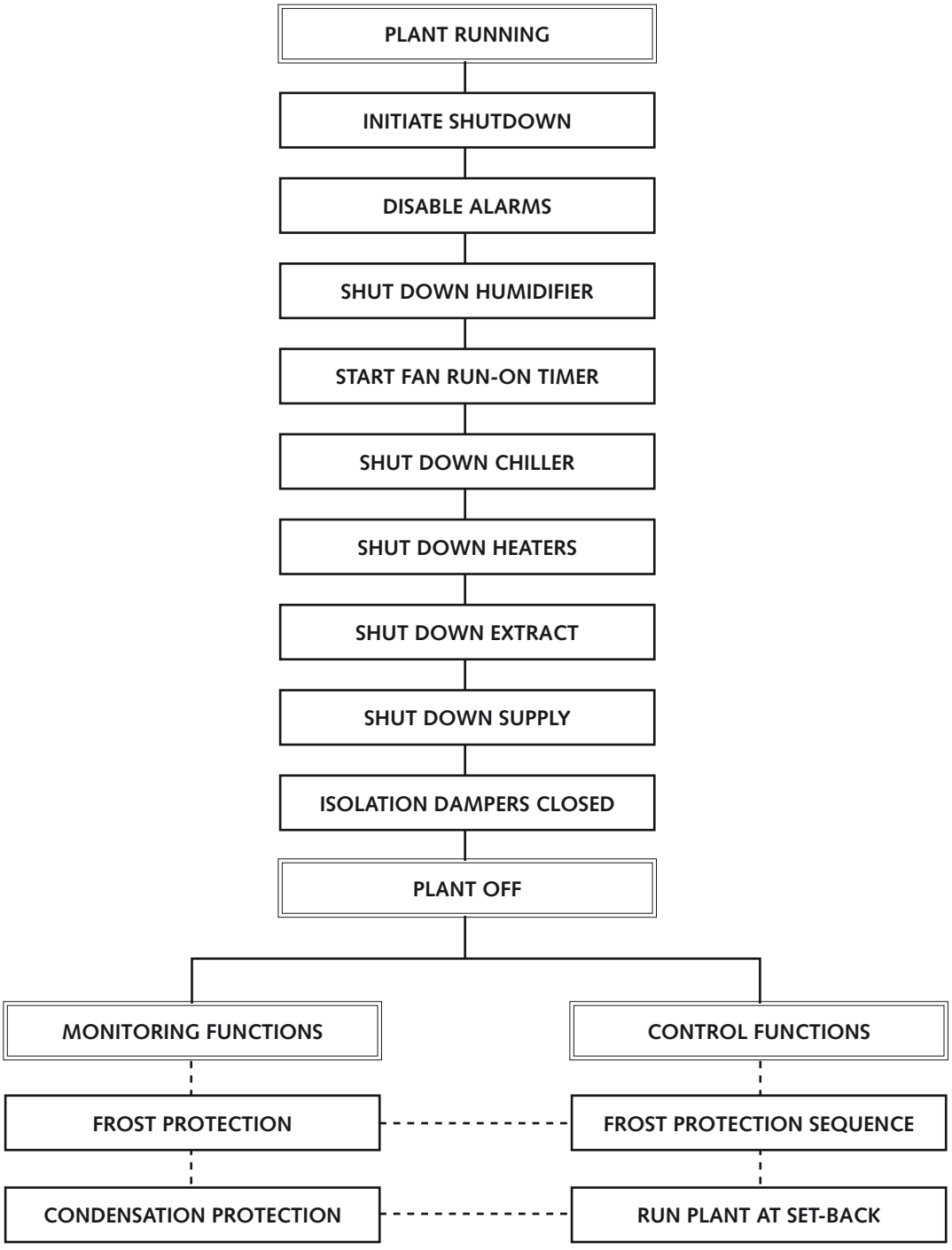


Figure 4 Plant control algorithm – set-back sequence

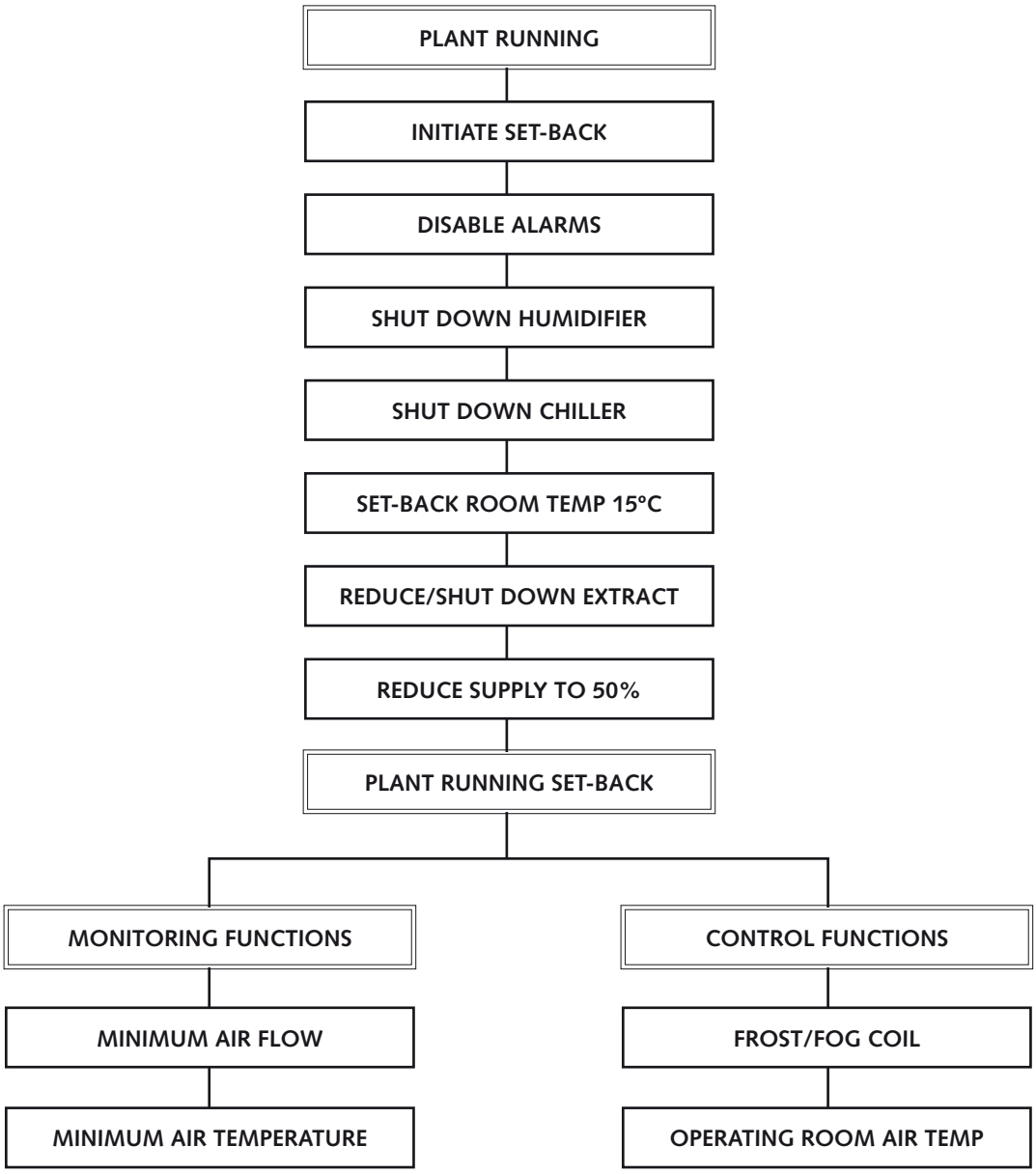
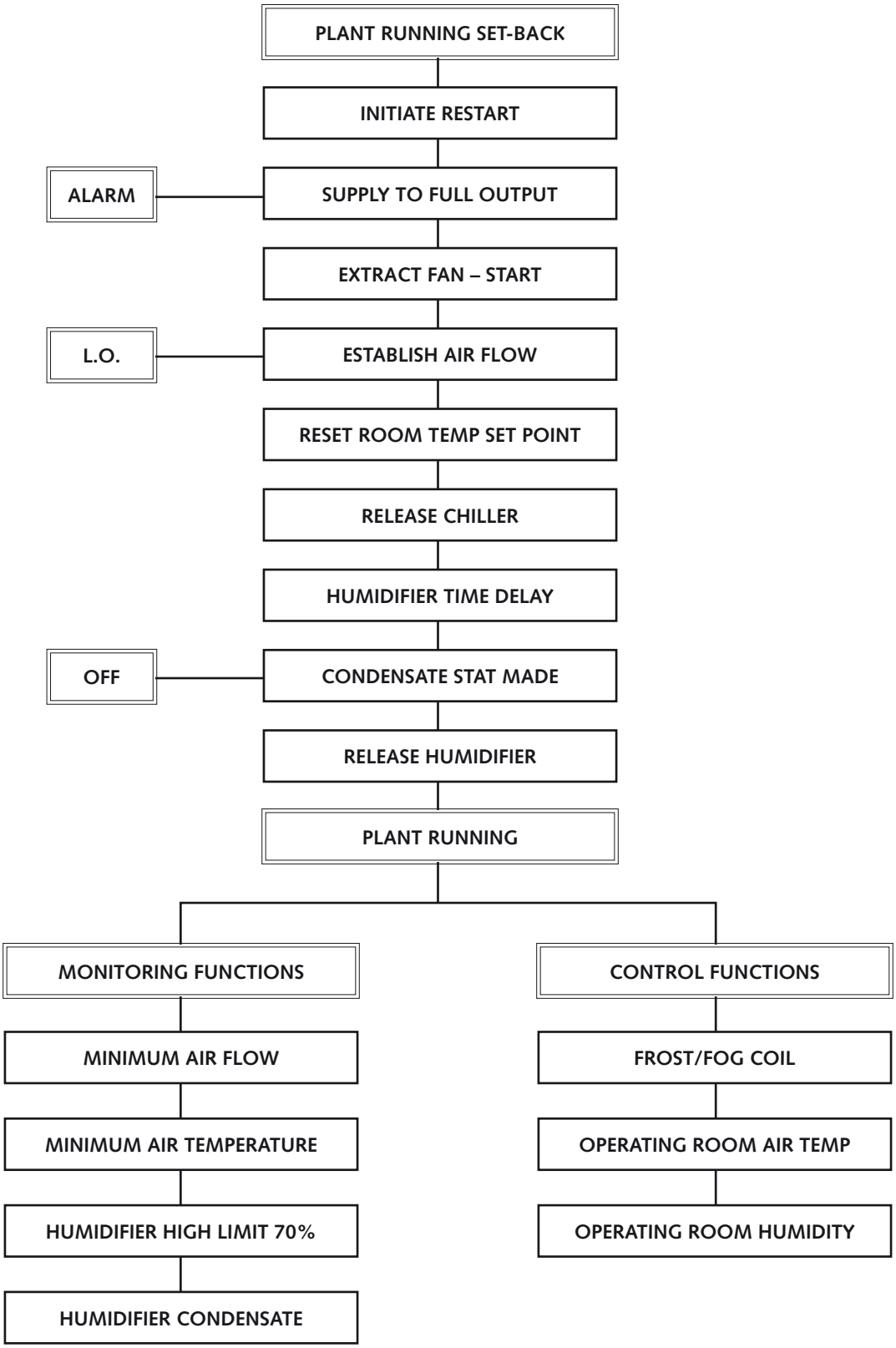


Figure 5 Plant control algorithm – restart from set-back



including operating suites (see paragraphs 7.31–7.90).

6.27 A variation on this can be provided by linking ventilation controls to the lighting. For example, in an operating theatre, the system may be off outside of working hours, could run at set-back when the general lighting is switched on, and increase to full speed when the operating lamp is switched on. As with movement detection, a 30-minute run-on should be provided at each stage when the lights are turned off.

6.28 Either of the above control strategies may be refined by linking to the BMS to provide a control logic related to normal working hours and associated "real-time" movement within the zone being controlled. This should result in significant energy savings.

Environmental control

Temperature control methods and application

General

6.29 All control valves must fail-safe, that is, close in the event of power or air-flow failure, with the exception of the fog/frost battery control valve, which should open upon power or air-flow failure.

6.30 Control valves should be located in an accessible position. Isolation valves should be provided to enable the control valve to be removed for service without the need to drain-down the system.

6.31 Care should be taken to ensure that the installation of control valves and their associated pipework do not obstruct access to the AHU inspection doors and hatches.

Room temperature control

6.32 The limits for room temperature set-point are generally between 16°C and 25°C depending on the particular application, and in some specialised instances (for example operating departments) are adjustable within a predetermined range by the user.

6.33 The selection of temperature set-point for each room or zone may be by a control facility in the room/zone or be carried out remotely at the control panel or BMS. Where the control device is mounted within the room/zone and is adjustable by the user, it should be marked either "raise" and "lower" or "+" and "–". It should control within a specified temperature range to suit the user requirement with a control tolerance of ±1 K. All other control set-points should be selectable either on the control panel or at the BMS interface.

6.34 Where local control is provided, an indication of temperature will be required locally or at a staff base (if appropriate) using an analogue or digital indicator. The indicator should be large enough to be read from the normal working position (for example at the operating table in a theatre). This may be mounted in a supervisory control panel, with the signal repeated on the main system control panel or BMS. It is important that this indicator displays the actual measured temperature and not the selected temperature.

Frost coil control

6.35 Steam-supplied fog/frost batteries must be operated as on/off devices with their sensor mounted upstream of the battery. This will give "open loop" control. A set-point of +1°C is recommended.

6.36 LPHW-supplied frost batteries should be controlled using the proportional mode. Their sensor should be located downstream of the battery to give "closed loop" control. A set-point of between 2°C and 5°C is recommended.

6.37 If the temperature downstream of the frost battery, as sensed by a serpentine thermostat, falls below the required set-point over any part of the coil, the plant must automatically shut down in order to prevent damage to the other batteries. The serpentine thermostat must not be in direct contact with the coil.

Off-plant control

6.38 The control logic must prevent the chiller and pre-heater being on at the same time.

Humidity control methods and application

6.39 In order to prevent excessive condensation when starting up from a total plant shut-down, a time delay should be incorporated into the control system such that the humidifier does not start until 30 minutes after the ventilation plant starts up.

6.40 Irrespective of the method of control, a high-limit humidistat should be installed to ensure that when the humidifier operates, the condition of the air in the duct does not exceed 70% saturated, particularly during plant start-up.

6.41 With certain types of steam humidifier, it may be necessary to install a thermostat in the condensate line from the humidifier's steam supply, to ensure that the steam at the control valve is as dry as possible before it is injected into the air supply.

6.42 The humidifier and cooling-coil control must be interlocked so that they cannot be on at the same time.

6.43 The humidifier control system should ensure that it is switched off with the fan. It is preferable to design the control system so that the humidifier is isolated for an adequate time before the fan is turned off so as to purge humid air from the system.

6.44 All control valves must fail-safe (that is, close in the event of power failure), and the humidifier must be interlocked with the low air-flow switch.

Multi-zone control methods and application.

6.45 Close control of all air-conditioning parameters may be difficult to achieve with multi-zone systems, since each zone will in theory require a reheater and humidifier to give total control of humidity, if that is what is required. In reality, such close control is rarely required. It is therefore usual with multi-zone systems to provide control of zonal temperature only, with humidity control, where fitted, being based on average conditions within all zones, or minimum conditions within one zone.

6.46 Where there is a requirement for close control of air-conditioning parameters in a number of zones (for example an operating department), separate plants should be provided for each zone in order to avoid the need for expensive over-cooling and reheating of individual zones.

6.47 The control of most multi-zone systems within healthcare premises is based on off-coil control within the central plant, with trimmer heater-batteries on individual zones.

Alarms and indication

6.48 Supply and extract systems should include indicator lamps on the control panels to confirm the operational status of each system. Where the usage is on a regular daily pattern, time control with a user-operated, timed manual override should be provided.

6.49 Where a system is provided for a particular space, the indicator should be in, or immediately adjacent to, that space, and local controls should be provided with labels clearly defining their function (for example isolation suites).

6.50 The "plant failure" and "low air flow" alarm should be initiated by a paddle switch or other device located in the main air-supply duct. This should operate when the air quantity fails to reach or falls to around 80% of the design value and will give indication of fan failure, closed damper, left-open access door, or any other eventuality that could cause a reduction of air quantity. Monitoring the current drawn by the fan motor is not a substitute for a sensing device that is directly affected by the air flow.

6.51 The "filter fault alarm" should be initiated by a predetermined increase of pressure differential across the filters, thereby indicating a dirty filter.

6.52 Direct-reading gauges or manometers should be installed across filters to give maintenance staff an indication of their condition.

6.53 Visual indication should be provided at a manned staff location (for example the reception or staff base), on the main control panel and on the BMS to show "plant failure" and "low air flow".

7 Specialised ventilation systems

7.1 This section contains design information for a range of healthcare ventilation applications.

7.2 The following departments will require a degree of specialised ventilation:

a. Operating departments:
   (i) treatment rooms;
   (ii) endoscopy, day-case and minimum invasive suites;
   (iii) cardiology and operative imaging suites;
   (iv) conventional operating theatres;
   (v) ultra-clean ventilation (UCV) operating theatres;
   (vi) barn theatres;
   (vii) recovery and ancillary areas.

b. Obstetrics:
   (i) maternity theatres;
   (ii) birthing rooms.

c. Critical areas and high dependency units of any type.

d. Isolation facilities:
   (i) infectious diseases units;
   (ii) bone marrow and other transplant units;
   (iii) chemotherapy and oncology units.

e. Sterile services departments:
   (i) wash rooms;
   (ii) inspection and packing rooms;
   (iii) storage rooms.

f. Pharmacy departments:
   (i) aseptic suites;
   (ii) extemporaneous preparation areas;
   (iii) radio pharmacies.

g. Pathology departments:
   (i) laboratories;
   (ii) Category 3 and 4 rooms.

h. Mortuary and post-mortem rooms:
   (i) mortuaries;
   (ii) post-mortem rooms;
   (iii) specimen stores.

j. Hydrotherapy units.

k. Burns units:
   (i) burns theatres;
   (ii) treatment rooms;
   (iii) isolation rooms;
   (iv) tissue banks.

m. Emerging specialties:
   (i) gene therapy units;
   (ii) stem-cell laboratories.

n. Infrastructure:
   (i) plantrooms housing combustion equipment;
   (ii) welding facilities;
   (iii) woodworking workshops;
   (iv) electric-vehicle charging areas.

7.3 Design information for many of these applications is given in this chapter and also in Appendix 2.

General information

7.4 The section on operating theatre suites is the most extensive and contains much information that is common to other applications. Where no specific guidance is given, the principles set out below should be followed:

a. The foregoing sections of the document contain general information on healthcare-specific

aspects of ventilation system design and specification.

b. A set of standard solutions for the design of general operating theatre suites to conform to past and new standards is given in paragraphs 7.31–7.90, and those for UCV theatres in paragraphs 7.91–7.147.

c. The CIBSE guides A and B contain basic information on ventilation design, which can be applied to most applications.

d. Where a British or European standard exists that is specific to the application (for example a clean room), it should be used as the basis of the design requirement.

e. Air should always move from clean to less clean areas. A hierarchy of room cleanliness is given in Appendix 3.

f. Differential pressure will prevent contamination between areas when doors are closed. Information on air leakage through closed doors and hatches for a range of differential pressures is given in Appendix 4.

g. The flow of air will prevent contamination between areas when doors are open. Information on air leakage through open doors and hatches for a range of differential pressures is given in Appendix 6.

h. If anaesthetic gases are used, 15 air changes per hour will be required.

j. A methodology for calculating a design solution for a non-standard suite of operating rooms is given in Appendix 8. This may be adapted as necessary to suit other less complex applications where air is required to cascade from clean to less clean areas.

7.5 The supply of air to a room has four main functions:

a. to dilute airborne contamination;

b. to control air movement such that the transfer of airborne contaminants from less clean to cleaner areas is minimised;

c. to control the temperature and, if necessary, the humidity of the space;

d. to assist the removal of, and dilute, waste gases where used.

7.6 Because of the complexities of controlling air-movement patterns, much design effort will be required for this aspect. It is important that the design makes the best possible use of the air available, as excessive supply air flows for the control of air movement should not be used. The amount of air supplied will be determined by the number of doors and desired air-change rate.

7.7 Airborne contaminants may enter a room via the following routes:

a. through the supply air;

b. shed directly by the room occupants;

c. as a result of work activities;

d. transferred from adjacent spaces.

7.8 Particles entering with the supply air can be controlled by the selection of suitable filter grades.

7.9 Particles shed directly by the room occupants can be controlled by:

a. restricting access to essential persons only;

b. the choice of the occupants' clothing;

c. the room's air-change rate.

7.10 Particles arising as a result of the work activity can be controlled by:

a. enclosing, semi-enclosing, or otherwise, the work-based source;

b. the room air-change rate.

7.11 The transfer of particles from adjacent spaces can be controlled by:

a. differential pressure;

b. clean air-flow paths.

7.12 Air-change rates are given in Appendix 2. These figures have been found to give sufficient dilution of airborne contaminants, provided the mixing of room air is reasonably uniform.

7.13 Downward-displacement turbulent air distribution is generally preferred. The supply and extract diffusers should be positioned to ensure that all parts of the room are actively ventilated and that, where necessary, staff will be in a clean air-flow path (see Chapter 5 for additional guidance on supply terminals).

7.14 Horizontal-flow room-air distribution with or without a Coanda effect can be a source of draughts and difficult to set up correctly. Its use should be confined to non-critical areas.

Air-movement control

7.15 The design of the system should seek to minimise the movement of contaminated air from less clean to cleaner areas. Transfer grilles enable air to pass in either direction between rooms of equal class and pressure. Pressure stabilisers operate in one direction only; they allow excess air to be directed to the area desired and assist in maintaining room-pressure differentials. When closed, they prevent significant reverse air flow.

7.16 The relative locations of supply and extract terminals and their design air-volume rates will determine the basic air flow between adjacent spaces. Transfer grilles and pressure stabilisers will permit and control the flow of air between spaces, ensuring a flow from the clean to less clean areas. Failure to provide such devices will lead to uncontrolled air flows when personnel move between rooms. It may also result in doors being held partially open by air pressure.

Temperature and humidity control

7.17 To achieve the required room conditions, supply flow rates are calculated conventionally, taking account of all heat and moisture gains and losses, and of maximum permissible temperature differences between the room and supply air. In most applications, the base heating load will be provided by a heating system. In critical systems, the room or suite being considered will be within the heated building envelope so the ventilation will be sized to suit the casual gains or losses.

7.18 Temperature differences of up to 10 K for winter heating and 7 K for summer cooling should not be exceeded (see paragraph 3.10).

7.19 It is acceptable for supply-air humidity to swing uncontrolled between 35% and 70% saturation.

Removal and dilution of waste anaesthetic gases

7.20 Anaesthetic gases are subject to workplace exposure limits. Waste anaesthetic gases must be contained and removed by a suitable gas-scavenging system. Some leakage from anaesthetic equipment and the patient's breathing circuit will occur with all systems, particularly during connection and disconnection, and from the interface with the patient. The air-movement scheme should ensure that this leakage is diluted and removed from the room. Anaesthetic agents are heavier than air; therefore, placing the supply terminal at high level with an extract at low level, adjacent to the anaesthetic-gas terminal units, will ensure that staff are in a clean air-flow path.

7.21 In birthing rooms, the use of anaesthetic gas is controlled on demand by the patient. This may result in significant leakage that – in order to reduce staff exposure – will need to be controlled by establishing a clean air-flow path. A supply at high level at the foot-end of the bed with extract at low level at the head-end will provide such a path.

Fire aspects

7.22 When considering the overall air-flow movement, careful thought needs to be given to the operation of the ventilation system, to limit smoke spread in the event of a fire.

Door protection

7.23 Air should flow from the cleaner to the less clean areas as shown in Appendix 3. There are several factors that affect the likelihood of reverse air flow through doorways:

- when a person passes through a doorway, both the passage of the person and the movement of the door flap cause a transfer of air between the areas separated by the door;
- when a door is left open, there is a transfer of air between the two areas separated by the doorway. This is caused by air turbulence, but is greatly increased by any temperature differential between the areas (a 1.4 m wide doorway may allow the transfer of 0.19 m^3/s of air in each direction when there is no temperature difference, but when the temperature differential increases to 2 K, the volume transferred may increase to 0.24 m^3/s).

7.24 In order to reduce the likelihood of contamination of a clean area by reverse air flow from a less clean area, two methods of door protection are used:

a. closed door protection – a pressure differential is created across a closed door so that any air leakage is from the clean to the less clean area. Appendix 4 gives details of closed-door leakage rates for a range of differential pressures;

b. open door protection – the pressure differential drops (see Appendix 6) and is effectively replaced by a flow of air through the doorway from the clean to the less clean area. The flow of air needs to be sufficiently large to ensure that significant reverse air flow cannot occur, and

will be related to the relative cleanliness of the areas being considered. Appendix 5 gives air-flow rates for open-door protection related to door/opening size and classification of the adjoining areas.

7.25 Pressure stabilisers enable the room's differential pressure to be set when the doors are shut, thus providing closed-door protection. When a door is opened, the stabilisers will close, forcing air to be directed through the doorway, thus providing open-door protection.

7.26 The recommended air-flow rates to achieve this are given in Appendix 4. Provided that the dilution criteria in Appendix 2 are met, the occasional small back-flows created (when two doors are opened simultaneously or when there is a high temperature difference across an open door) will have little effect on the overall air cleanliness of the affected room.

7.27 In applications where it is critical to maintain a specific air flow and/or pressure regime (for example isolation rooms), all windows in the zone should be locked shut or sealed. Trickle vents, if fitted, should also be sealed.

Systems design

7.28 The design of the ventilation system for an area depends on the overall configuration of the department. Where the department is served by more than one AHU, the control of the units may need to be interlocked so that reverse air-flow patterns do not occur.

7.29 Dual-duct high-velocity systems have advantages, but are noisy, costly, and may give rise to unacceptable values of humidity. Single-duct, low-velocity/pressure systems are preferred.

7.30 Extract grilles should be sited and balanced to promote air movement in the desired direction.

Operating department ventilation systems

7.31 The information given in this section relates to general operating suites. It is also applicable to other types of theatre suite such as maternity, burns, cardiac etc. The standard values given may need to be adjusted to reflect non-standard room sizes, pressure regimes and air-change rates.

7.32 A method of obtaining a design solution for non-standard theatres is given in Appendix 8.

Additional information for UCV theatres is given in paragraphs 7.91–7.147.

General

7.33 The supply of air to an operating room has four main functions:

a. to dilute airborne contamination;

b. to control air movement within the suite such that the transfer of airborne contaminants from less clean to cleaner areas is minimised;

c. to control the temperature and, if necessary, the humidity of the space;

d. to assist the removal of, and dilute, waste anaesthetic gases.

7.34 Because of the complexities of controlling air-movement patterns, much design effort will be required for this aspect. It is important that the design makes the best possible use of the air available, as excessive supply air flows for the control of air movement should not be used. The amount of air supplied to the operating room will be determined by the number of doors and desired air-change rate.

7.35 The detailed considerations upon which the supply air-flow rate is based are as follows.

Dilution of airborne bacterial contaminants

7.36 Airborne contaminants may enter an operating room via the following routes:

a. through the supply air;

b. shed by operating staff;

c. through surgical activities;

d. transferred from adjacent spaces.

7.37 Supply flow rates for the main rooms of the operating suite are given in Appendix 7. For the other areas where room sizes and activities vary from site to site, air-change rates are given in Appendix 2. These figures have been found to give sufficient dilution of airborne bacterial contaminants, provided the mixing of room air is reasonably uniform.

7.38 Downward-displacement air distribution is preferred, and may be either turbulent or parallel downward flow. For turbulent flow, supply-air diffusers should be positioned either in the centre of each quadrant of the ceiling or along a line between the centres of each quadrant. This should

ensure that all parts of the room are actively ventilated and that there will be adequate air movement at the operating table. Parallel downward flow is provided by a perforated plenum terminal centred above the operating table (see Chapter 5 for additional guidance on supply terminals).

7.39 Suspended, articulated pendants in theatres require significant structural steelwork in the ceiling void to cater for the loads imposed by the resulting bending moments. It is important to ensure that the void is deep enough to accommodate both the steelwork and the ventilation ducts. However, the location of the steelwork must not prevent a suitable layout of the ventilation ductwork and the appropriate positioning of supply air terminals – the correct ventilation of an operating theatre plays a significant role in controlling healthcare-associated infections and should not therefore be compromised by the need to facilitate the movement of equipment.

7.40 Horizontal-flow distribution with or without a Coanda effect can be difficult to set up correctly and is unlikely to be as effective in theatre applications. It should not be used in new installations; however, space constraints may force its retention or replacement when refurbishing existing installations. Where fitted, the supply grilles will require a means of directional adjustment.

7.45 For general operating theatres, the air supply is filtered in the AHU. Terminal or HEPA filters are not generally required.

Control of air movement within the suite

7.46 The design of the system should seek to minimise the movement of contaminated air from less clean to cleaner areas. Transfer grilles enable air to pass in either direction between rooms of equal class and pressure. Pressure stabilisers operate in one direction only; they allow excess air to be directed to the area desired and assist in maintaining room-pressure differentials.

7.47 The relative locations of supply and extract terminals and their design air-volume rates will determine the basic air flow between adjacent spaces. Transfer grilles and pressure stabilisers will permit and control the flow of air between spaces, ensuring a flow from the clean to less clean areas of the suite. Failure to provide such devices will lead to uncontrolled air flows when personnel move between rooms and doors are held partially open by air pressure.

Temperature and humidity control

7.48 Supply flow rates to achieve the required room conditions are calculated conventionally, taking account of all heat and moisture gains and losses, and of maximum permissible temperature differences between the room and supply air. In most applications the base heating load will be provided by a heating system, or the room being considered will be within the heated building envelope.

7.49 Temperature differences of up to 10 K for winter heating and 7 K for summer cooling must not be exceeded.

7.50 It is acceptable for the humidity to swing uncontrolled between 35% and 60% saturation.

Removal and dilution of waste anaesthetic gases

7.51 Anaesthetic gases are subject to workplace exposure limits. The air-movement scheme should ensure that staff are in a clean air-flow path (see paragraphs 7.20–7.21).

7.52 Air extracted from operating suites should not be recirculated, as it may contain malodorous contaminants; however, an energy-recovery system must be fitted in the extract in order to reduce the plant's energy consumption (see paragraphs 4.146–4.154).

Fire aspects

7.53 When considering overall air-flow movement, careful thought needs to be given to the operation of the ventilation system in order to limit smoke spread in the event of a fire. However, this is a highly staffed department with a low fire risk/load status, and these factors need to be recognised when developing the fire strategy. It is considered satisfactory to treat the complete operating department as a single fire compartment providing there are at least two exits from it. Over-compartmentalisation can lead to difficulties in establishing clean air-flow paths and room-air dilution rates, which in turn may lead to an increased risk of healthcare-associated infections. Staff areas within the department should be treated as a subcompartment (see paragraphs 6.19–6.21).

Door protection

7.54 Air should flow from the cleaner to the less clean areas as shown in Appendix 3. The factors that affect the likelihood of a reverse air flow through doorways are discussed in paragraphs 7.24–7.26.

7.55 It is not possible to design an air-movement scheme, within the restraints of the amount of air available, that will protect the operating room when two doors are simultaneously opened. The design process that has been used considers that each door is opened in turn and ensures that the direction and rate of air flow through any open doorway is sufficient to prevent any serious back-flow of air to a cleaner area.

7.56 Provided that the air-change rates in Appendix 2 are met, dilution will be sufficient to ensure that the occasional small back-flows created (when two doors are opened simultaneously or when there is a high temperature difference across an open door) will have little effect on the overall air cleanliness of the affected room.

7.57 The following general points should be taken into consideration during the design of operating suites:

- Number of exits – the fewer the number of rooms (and therefore doorways) leading from the operating room, the better, as traffic is reduced and less complicated air-movement control schemes are required.
- Scrub and hand-wash facilities – these may be a part of the operating room, often in a bay. The bay would count as a part of the operating room volume and should have a low-level active or passive extract to remove the moisture-laden air. Should a separate room be required for the scrub area, a door between the scrub-up room and the operating room is an inconvenience to scrubbed staff, and could be replaced by an opening that is wider than a normal single doorway. In this case, the scrub would not be considered a part of the operating room volume.
- If a shared scrub is provided for a pair of theatres, it should have an active extract to ensure that air flow is always into it from either theatre.
- If an alcohol scrub regime is employed, individual theatre scrubs may not be required and would be replaced by a common departmental pre-/post-operation scrub position in the corridor. This would require local extract to prevent a build-up of moisture.
- Preparation room "sterile pack store" (SPS) – if it is intended to lay-up instruments in the operating room, the preparation room will simply be used as a sterile pack store. The nominal room pressure can therefore be the same as that of the operating room and the air flow between the two rooms in either direction. Air supplied to the preparation room may be directed into the operating room either through a door-mounted transfer grille, or if no door is fitted, through the opening. Alternatively, stock ready-use sterile items can be located in a bay within the theatre. In this case a portion of the total theatre supply air should be provided in the bay to ensure it is actively ventilated.
- Preparation room "lay-up" – when the preparation room is used as an instrument "lay-up" room, it should be regarded as being of greater cleanliness than the operating room, and the design should minimise the transfer of air from the operating room to the preparation room. Air supplied to the room may be directed to the operating room through a pressure stabiliser, taking care not to compromise the air-flow pattern in the operating room. The air may also be directed into a corridor.
- Shared preparation rooms – if the preparation room is to be shared between two theatres, it should be at a higher pressure (35 Pa) than either of the theatres – even if it is only to be used as a sterile pack store. The doors to the theatres should be interlocked to prevent them both being open at the same time, and the stabilisers should be positioned to discharge into the corridor.
- Service corridor – if materials to be disposed of are placed in impervious material for transportation, it is not necessary to have a separate corridor for this purpose. However, a service corridor has many operational advantages in terms of the flow of materials through the theatre suite. It also permits routine service and maintenance access without compromising the use of adjacent theatre suites.

Standard air-movement control schemes

7.58 In previous versions of this guidance, standard air-movement control schemes were given that provided a range of design solutions to typical

operating-suite layouts. These were satisfactory design solutions for "standard" sized rooms within the suite, but were never intended to be universal for any sized room or suite. Health Building Note 26 – 'Facilities for surgical procedures' increased the recommended size of the operating room from approximately 35 m^2 to 55 m^2. Ancillary room sizes and air-change rates also increased. This meant that the original standard solutions were no longer appropriate for new-build installations.

7.59 Because of the resulting increase in the volume of air supplied to the theatre, provision needs to be made to either actively remove it or allow it to passively escape through pressure stabilisers. The increase in room size has also made the number and position of air-supply terminals critical to the effective ventilation of the room.

7.60 Four new standard solutions have been developed to reflect the current guidance on theatre suite layout and room sizes given in Health Building Note 26, as well as the general increase in air-change rates.

7.61 The most commonly used original standard solutions have been revised and updated. They have been retained in this guidance, as they will remain applicable to older theatre suites that are being refurbished to their original performance standards or are being converted from conventional to UCV theatres. They will also be applicable in existing operating departments where space constraints do not permit a complete upgrade to the latest standard of performance or where a pre-built "shell" is being fitted out.

7.62 It is important to recognise that in any situation where a non-standard room size or theatre suite layout is being considered, the designer must return to first principles when developing a solution. Examples of non-standard configurations are:

- cardiac theatres that typically have an operating room 50% larger than a normal theatre, a perfusion laboratory and no anaesthetic room;
- operating departments served by a central instrument lay-up preparation area rather than individual preparation rooms;
- balanced-flow theatres for infectious cases.

7.63 Appendix 8 contains a methodology for assisting the designer to arrive at a suitable solution.

7.64 The new and revised standard design solutions are as follows:

1 Typical conventional theatre – room sizes as Health Building Note 26.

2 Typical UCV theatre – room sizes as Health Building Note 26.

3 Health Building Note 26 illustrated conventional theatre.

4 Health Building Note 26 illustrated theatre with UCV terminal fitted.

5 Pre-2006 conventional theatre, single corridor (Health Technical Memorandum 2025; 1b).

6 Pre-2006 UCV theatre, single corridor (Health Technical Memorandum 2025; 1a).

7 Pre-2006 conventional theatre, two corridors (Health Technical Memorandum 2025; 5b).

8 Pre-2006 UCV theatre, two corridors (Health Technical Memorandum 2025; 5a).

7.65 Details of these standard solutions are given in Appendix 7, which contains diagrams showing the relationship of rooms and the various doors and transfer devices between them, **but these should not be regarded as architectural layouts**. The schemes have been developed using the calculation procedure described in Appendix 8. Important features of the solutions are:

- Zone trimmer heaters – a trimmer heater-battery is advocated when calculations indicate that the temperature differential between rooms may be greater than 2 K. Generally this will only be the case in the preparation room when designated as a lay-up, although they are sometimes required for anaesthetic rooms.
- The preparation room (sterile pack store)/operating room interface – these rooms are deemed to be of equal cleanliness, and thus a transfer grille is required between them, or the door can be replaced with an opening wider than a standard door.
- Preparation room (lay-up)/operating room interface – pressure stabilisers are recommended here to provide an air path when doors are closed, while preventing back-flow when a door is opened elsewhere.
- Operating room/anaesthetic room interface – pressure stabilisers, or in some cases carefully sized transfer grilles, are recommended here and also between the anaesthetic room and corridor. The amount of air being passed through the

anaesthetic room should not be so great as to cause an unacceptable draught.

- Operating room/clean and service corridors interface – pressure stabilisers combined with low-level active or passive extracts appropriately spaced to ensure air movement in all parts of the operating room.
- Operating room/scrub room interface – an opening is provided between these rooms. The flow of air through the opening provides protection and gives bacterial dilution within the scrub room; the air is then exhausted to the corridor via a pressure stabiliser.

7.66 Mechanical supply or extract ventilation is not normally provided in the scrub room; thus, when a door is opened elsewhere in the suite, the stabiliser will close, allowing the air to be redirected in order to help protect the doorway. If the scrub is a bay within the theatre or if its configuration is liable to cause (in air-movement terms) "dead areas", a combination of a suitably positioned pressure stabiliser and/or active extract should be provided to ensure air movement and to prevent a local build-up of moisture.

7.67 Any other scheme may be used and the standard solutions applied if the following conditions are met:

- room relationships in air network terms are as shown in the plans;
- door-gap measurements approximate to those given in Health Technical Memorandum 58 – 'Internal doorsets' (but see also Appendix 4);
- casual heat gains are accounted for;
- a trimmer battery is installed in the air-supply system to the preparation room;
- leakage through the structure is kept to a minimum.

7.68 It is recommended that every effort should be made to adopt one of the schemes described above.

Air terminals and air distribution within rooms

7.69 The selection and sighting of air diffusers is critical in establishing an efficient pattern of mixing. To this end, the diffusers selected must be fit for purpose. Diffuser designs that provide a downward-displacement turbulent air flow are the preferred option, for example:

a. ceiling-mounted circular "air-master"-style diffusers; and

b. square "four-way-blow" diffusers; or

c. similar designs to those in (a) and (b) (see paragraph 5.68).

7.70 Plenum-type laminar-flow-style diffusers with a footprint that encompasses the operating site are acceptable but may be prone to buoyancy effects as a result of temperature difference. Manufacturers' type-test data should be consulted to ensure that the terminal will achieve the required performance envelope. Note that these are not true laminar-flow systems in the strict sense of the word, but produce downward-displacement parallel-flow air distribution.

7.71 The diffuser equipment chosen should not cause "dumping", and it should provide a velocity 1 m above floor level at the operating position of between 0.2 m/s and 0.3 m/s.

7.72 In the operating room, the supply air terminals must be at high level and should all be adjustable for rate of flow, as well as being easily cleaned and silent in operation.

7.73 In order to ensure that all parts of the operating room are actively ventilated, there should be an air-out path on each face or in each corner of the theatre. This may be provided by a pressure stabiliser, transfer grille, or active or passive extract terminal. A minimum of three, but preferably four, air-out paths – approximately equally spaced – should be provided.

Automatic control

7.74 The automatic control of ventilation in operating suites needs to be simple and robust. Over-reliance on complex room pressure and flow relationships linked to automatic fan speed control are unnecessary and in the long term have been shown to be unreliable. Complex software algorithms that can only be accessed and interpreted by off-site specialists should not be used. Whichever control strategy is chosen, it is important that on-site staff have the facility to override the control system and keep the ventilation operating at least until the surgical procedure is complete (see also paragraph 6.12).

7.75 Theatre air-conditioning control sensors should be actively ventilated. They would typically be located in a sampling duct mounted in the surgeon's panel

and be accessible for cleaning and the removal of fluff and lint.

7.76 Wall-mounted passive-temperature and humidity sensors are not recommended.

7.77 Controls should be provided to enable operating department ventilation plants to be closed down when the operating suites are unoccupied (see also paragraphs 6.26–6.28).

7.78 When in the "off" mode, the control system should ensure that the ventilation plant is automatically reinstated if the space temperature falls below 15°C.

7.79 The theatre's control panel should include:

- plant status indication;
- clearly-readable temperature and humidity gauges; and
- a means of adjusting the set-point for temperature (see paragraphs 6.32–6.34).

The theatre's ventilation-plant status indication should also be located at the staff control base.

7.80 Where it is considered necessary to fit a humidifier, it should be selected to humidify to 40% saturation at 20°C during external winter design conditions. The cooling coil should be able to remove sufficient moisture so that 60% saturation at 20°C is not exceeded during external summer design conditions.

7.81 Each operating suite should be served by an independent supply and extract plant.

Ventilation of operating department ancillary areas

General

7.82 There are advantages in providing mechanical ventilation to all areas of the department. Maintaining operating-suite air-flow patterns is simpler; grilles and diffusers can be sited to eliminate condensation on windows. Where radiators or embedded wall or ceiling panels are installed, they should be confined to the corridors and staff-only areas of the department.

Ventilation requirements

7.83 Appendix 3 gives guidance on the operating department areas in descending order of cleanliness, and this should be considered in the overall design of the department ventilation systems. The specified flow rates of air through doors given in Appendix 5 for the operating suite are not necessary for other areas of the department; however, air-flow directions must be maintained from the clean to the less clean areas.

7.84 All windows in the department should be double-glazed and hermetically-sealed in order to ensure that the desired air-flow pattern is maintained under all external environmental conditions and to avoid infestation. Trickle vents, if fitted, should be sealed.

Systems design

7.85 The design of the ventilation system for ancillary rooms depends on the overall configuration of the department. The ancillary rooms' plant may need to be interlocked to the theatre suite's plants so that reverse air-flow patterns do not occur.

7.86 Extract grilles should be sited and balanced to promote air movement along the clean and access corridors towards the reception/transfer areas. This should not affect the air distribution in the operating suite(s).

Reception

7.87 The aim in these areas is to provide comfortable conditions, having regard to the movement-control requirements of the department as a whole. The number of air changes will depend on the particular design.

Sterile pack bulk store

7.88 The store needs to be maintained at a positive pressure in order to preserve the cleanliness of the outside of the packs; six air changes are recommended.

Recovery

7.89 The air-change rate in the recovery room will be rather higher than that needed merely to provide clean, comfortable conditions, as it is necessary to control the level of anaesthetic gas pollution; 15 air changes are recommended, with a balanced air flow.

7.90 The supply air terminals should be ceiling-mounted above the foot-end of the bed. Extract should be at low level (bed height or below) behind the bedhead or in the corners. This will establish a clean air-flow path so that all reasonable steps are taken to reduce the risk of staff inhaling anaesthetic gases exhaled by recovering patients.

Ultra-clean ventilation systems

General requirements

7.91 The design philosophy of a conventionally ventilated operating suite is based on the need to dilute contaminants and control both the condition and movement of air in an operating suite. Ultra-clean ventilation (UCV) is a means of significantly increasing the dilution effect by providing a large volume of clean filtered air to the zone in which an operation is performed and sterile items are exposed. Air is discharged above the operating zone and, while not truly laminar, its downward displacement purges the clean zone of any contaminants and particles generated within it. The air flow in and around the clean zone also serves to prevent particles originating outside the zone from entering. The resulting reduction in contaminants has been shown to significantly reduce post-operative sepsis following certain orthopaedic procedures.

7.92 The number of bacteria that are present in the air at the wound site and exposed surgical items is dependent on the operating team, their procedural discipline, choice of clothing and the type of UCV system. Ultra-clean air is defined as that containing not more than 10 CFU/m^3.

7.93 UCV systems are very successful in reducing contaminants at the wound site, so it is often considered that there is no need for complex air-movement control schemes in the rest of the suite. However, when designing the ventilation scheme, it should be noted that the users may switch the UCV terminal to set-back when non-orthopaedic surgery is taking place. This is because the high air-flow rate can cause increased moisture evaporation of exposed tissue, which may be detrimental to the surgical outcome. In recognition of this, the ventilation scheme should be capable of providing operating conditions to at least a conventional theatre standard throughout the suite with the UCV in set-back mode. It should also be remembered that suitable levels of ventilation will always be required in the peripheral rooms.

7.94 UCV systems can be designed and built from first principles; or a range of bespoke modular units of varying shapes and sizes are available, each manufacturer having a slightly different approach to UCV design. Some systems are fitted with partial or full walls to delineate the clean zone and direct a laminar or exponential downflow of air within it. Other designs utilise slotted linear supply terminals to produce an air curtain around the clean zone together with laminar-flow diffusers to provide a downward-displacement supply within it. **Notwithstanding any variation in the design philosophy, all UCV systems will be required to completely achieve the performance standards set out in Chapter 8.**

7.95 As with conventional theatres, each UCV operating suite should have its own dedicated AHU to the standard set out in Chapter 4.

7.96 To ensure operational flexibility and permit routine maintenance, AHUs should not be shared between suites.

7.97 In retrofit installations, site conditions may preclude individual AHUs for each suite. In these circumstances, an AHU may be shared between not more than two operating suites, providing each suite has its own control of temperature.

7.98 An accessible air-flow measurement test-point should be provided in the branch supply duct to each theatre so that the primary air volume to each UCV canopy can be determined.

7.99 In addition, the branch supply and extract should be capable of being physically isolated and the main air-flow rate reduced so that either suite can be taken out of use without detriment to operating conditions in the other.

7.100 An inherent feature of a UCV system is its large air flow, so it is essential to recirculate the air supplied to the operating theatre and/or to recover its energy in order to optimise operating costs.

7.101 The primary fresh-air volume supplied to a UCV suite will be the same as in a conventional suite, and it should be dispersed to the rooms in the suite in the same manner. This is an important aspect of the design. Requests by UCV suppliers for increased primary air-supply volumes should be resisted.

7.102 Laying-up in the clean zone is preferable for infection control reasons. Where a preparation room/sterile pack store is provided, a transfer grille should be installed in the preparation room/theatre door.

7.103 If the preparation room is intended to be used for laying-up instruments, a pressure stabiliser will be required between the preparation room and theatre. It should be fitted with a stand-off baffle

to prevent air transfer disturbing the ultra-clean air-flow distribution.

7.104 Separate scrub-up or disposal facilities are not necessary for air cleanliness, although operational policy may prefer such a provision. However, a separate anaesthetic room should be provided.

7.105 There is no aerobiological reason why two or more UCV systems should not be installed in a common area as long as adequate spacing is provided. This type of arrangement is known as a "barn theatre" and requires special design considerations and operational discipline.

7.106 The relative positions of the UCV units, temperature control range and location of doors and openings to other areas will all significantly affect the air flow at the operating positions.

Types of UCV system

Remote plant systems

7.107 In a remote plant system, all air-conditioning equipment is located outside of the operating room, except for the unidirectional air-flow terminal, terminal filter, air diffuser and the return-air grilles (see Figure 6).

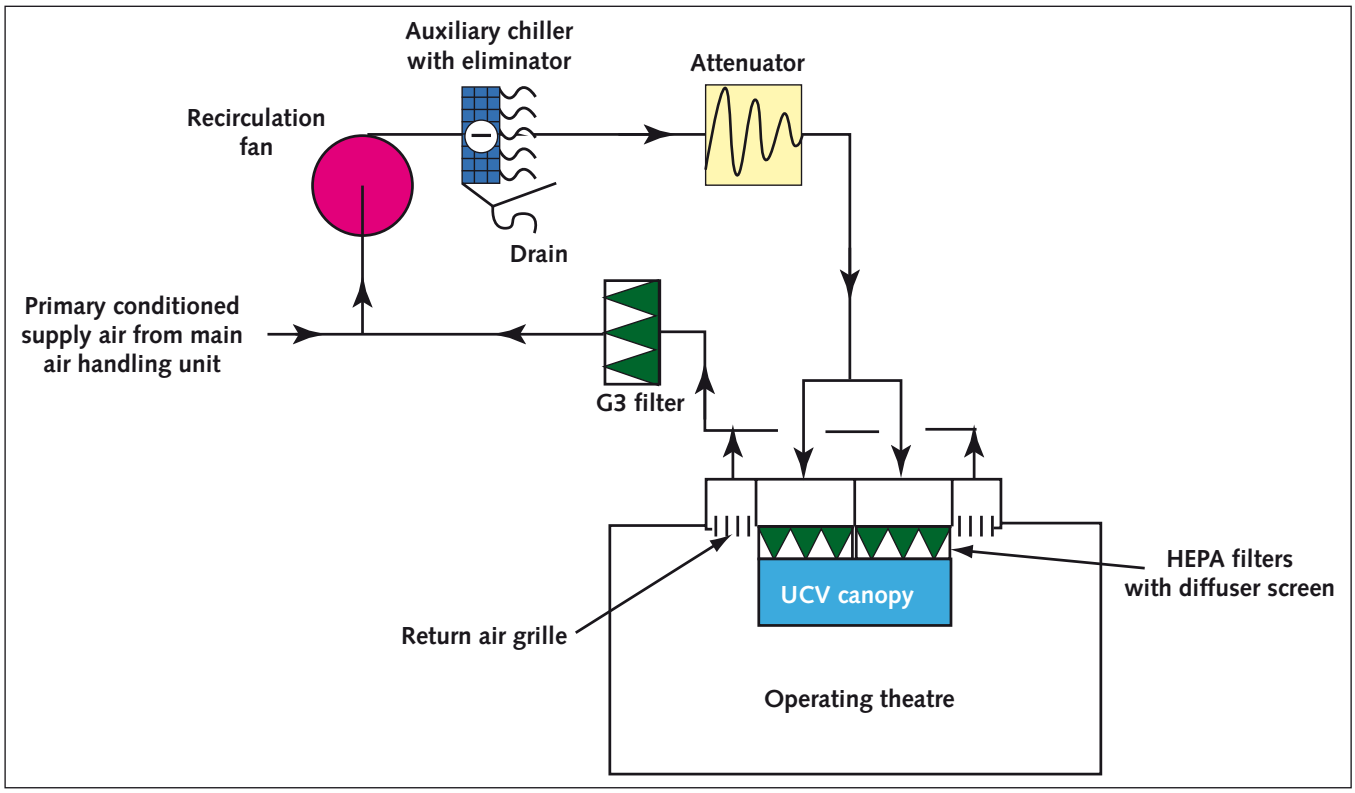
7.108 This arrangement is the preferred option for new installations as it has the following advantages:

- recirculation fans are located outside the theatre, thus reducing noise. Multiple recirculation fans can be replaced by a single fan unit with its drive out of the air stream;
- casual heat gains from recirculation fan(s), canopy lights, equipment and people within the theatre can be removed by a chiller battery in the return air stream. This will prevent heat build-up in the theatre;
- return-air filters can be changed without needing access to the theatre, making routine maintenance more feasible;
- the opportunity exists to locate HEPA filters in the primary supply duct rather than the theatre terminal. This will reduce the number of filters required and allow them to be changed without entering the theatre.

Modular systems

7.109 Modular systems are frequently used in retrofit applications. Vertical or horizontal units are available.

Figure 6 UCV theatre with remote air recirculation



7.110 Vertical-flow modular units comprise a ceiling-mounted air-terminal module containing return-air filters, return-air fans, final filter and air diffuser. Primary air is supplied by a remote air-conditioning unit at the volume and to the standard required for a conventional operating suite (see Figure 7).

7.111 Horizontal- or cross-flow modular units comprise a wall-mounted air-terminal module standing vertically to produce a horizontal flow of air and containing final filter/diffuser, return-air filters and fans. The module may incorporate a full air-conditioning unit or be supplied with fresh air from a separate primary air-conditioning system.

Vertical-flow UCV systems

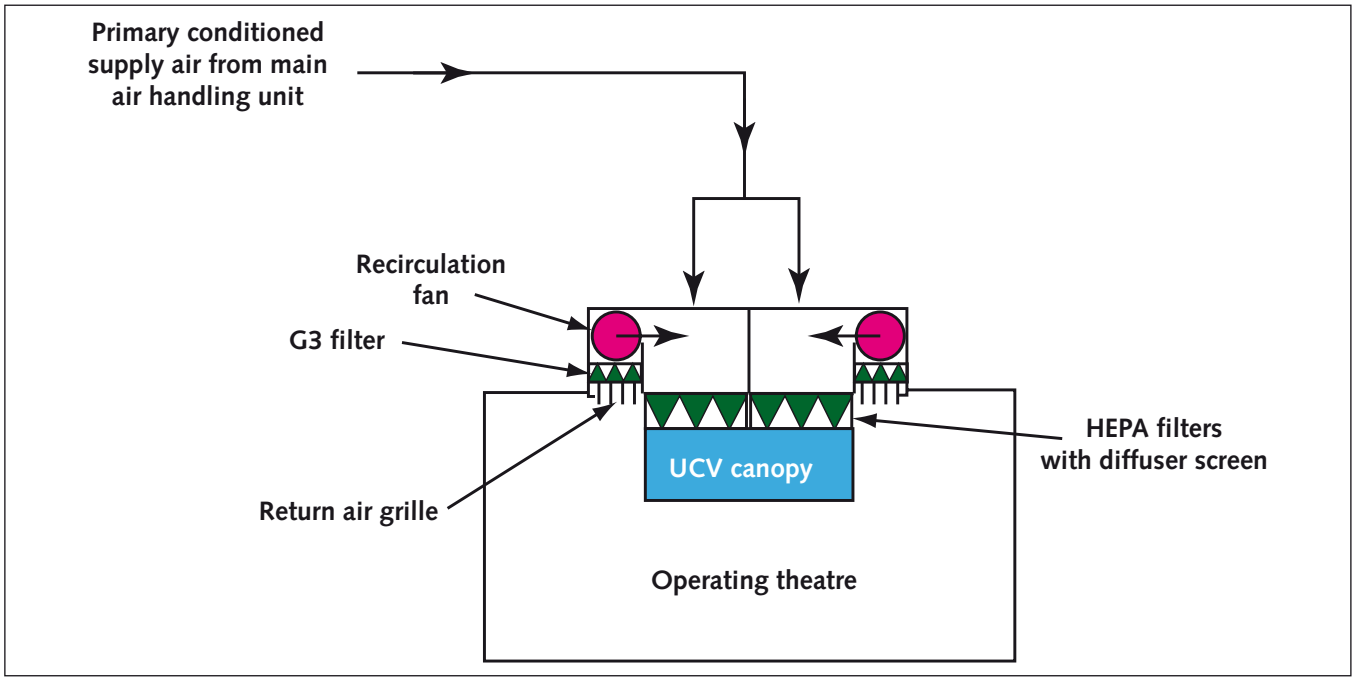
7.112 Vertical-flow systems have a superior performance and are more effective at reducing infection risks. Air-curtain or partial-wall systems are acceptable, but are known to be more susceptible to problems arising from performance deterioration, poor operating-team discipline and high occupancy rates than is the case with full-wall systems. A full wall is considered to be any wall terminating not more than 1 m above the finished floor level.

7.113 Because of the large volume of air being moved in a relatively small space, the siting of the return-air grilles can cause short-circuiting of the air discharged through the UCV terminal. If the return-air grilles are positioned at high level, partial walls should be provided to control short-circuiting. For a 2.8 m × 2.8 m terminal, the partial walls should be not less than 1 m from the operating room walls. The clearance should be increased proportionally for larger terminals (that is, 1.15 m for 3.2 m × 3.2 m units; and 1.25 m for 3.5 m × 3.5 m units). In all cases, the side walls should terminate at 2 m above floor level.

7.114 Siting the return-air grilles around the periphery of the theatre at low level will eliminate short-circuiting, remove the need for partial walls and give an improved air-flow path. In any event, there should be an air-out path on each face or in each corner of the theatre. These may be provided by combination of pressure stabilisers and passive or active low-level extract grilles. Failure to provide air-out paths on all faces of the theatre may result in the surplus air causing entrainment into the clean zone.

7.115 Vertical systems should have a clean zone large enough to encompass the operating site and all of the instrument trays likely to be needed for the surgical procedures to be undertaken. Ophthalmic and minor hand surgery would typically require a 1.4 m circular or rectangular terminal. For major orthopaedic procedures, a minimum size of 2.8 m × 2.8 m will be required. This is the area projected on the floor under the supply air terminal within the partial walls, full walls or air curtain. Any air outside this zone cannot be guaranteed to be ultra-

Figure 7 UCV theatre with modular system



clean although – given the dilution factor – the level of microbiological contamination will be much lower than the general level in a conventional operating room. The use of lines or a coloured area on the floor delineating the extent of the clean zone will assist staff and is therefore essential.

7.116 When upgrading an existing conventional theatre to an ultra-clean standard, the only solution may be the installation of a modular system. In these units, the heat gains from the return-air fans and terminal lights may warrant the inclusion of supplementary cooling within the module. However, issues of cooling-coil drainage, condensate removal and maintenance access within the space constraints of the module may make this option impracticable. The additional cooling load should then be accommodated by conditioning the primary air to compensate.

7.117 If an existing AHU is to be retained, it may require modification to ensure that it achieves the minimum standards set out in Chapter 4. The fan may need re-rating to accommodate the change in system resistance. The cooling coil may also need to be upgraded to cater for the increased load resulting from the return-air fans and terminal lights. Failure to make adequate provision for this may make the theatre unusable during prolonged warm spells.

7.118 A factor affecting air-flow pattern is the supply-air and room-air temperature difference. When the supply-air temperature is significantly above room temperature, buoyancy effects will reduce the volume of air reaching the operating zone. If it is anticipated at design stage that this will be a regular occurrence, a system incorporating full walls should be used. Demountable extensions that convert a partial wall to a full-wall unit are available.

7.119 Convection up-currents from the surgical team and operating lamp tend to counter the movement of clean air towards the operating site; hence, the air velocity reaching the operating level is critical. The minimum velocity given in paragraphs 7.120–7.121 has been selected to take account of these factors and is greater than the theoretical minimum value.

7.120 For all vertical UCV systems, the design discharge velocities will be as follows:

Air velocity 2 m above floor level:

- partial-wall system = 0.38 m/s average;
- full-wall system = 0.30 m/s average.

7.121 In order to ensure that the terminal quadrants are in balance, the average air velocity for each quadrant should not exceed ±6% of the measured average velocity for the terminal.

Air velocity 1 m above floor level:

- all systems = 0.2 m/s minimum within the operating zone.

7.122 Chapter 8 gives details of the method of measurement.

7.123 Variable-speed recirculation fans with differential-pressure control may be the most suitable solution for maintaining consistent performance and energy saving.

Horizontal UCV systems

7.124 Horizontal UCV air-flow systems have been shown to be less effective than vertical systems and are not the preferred solution. There may be occasions, however, where architectural, engineering, economic or workload considerations prevent the installation of a vertical-flow system and only a horizontal-flow system can be installed.

7.125 Horizontal- or cross-flow modular units comprise a wall-mounted air terminal standing vertically to produce a horizontal flow of air across the operating field. The terminal module contains the final filters, air diffuser, return-air grilles, filters and fans. The module may incorporate a full air-conditioning unit or be supplied with fresh air from a separate primary air-conditioning system. In the latter case, the return-air fan power may warrant the inclusion of a supplementary cooling coil within the module.

7.126 The system should have side-wall panels at least 2.4 m apart. The panels may fold to facilitate cleaning of the theatre. The minimum height of the terminal should be 2.1 m, and a deflector at the top of the filter/diffuser will be acceptable as an alternative to a full roof. These dimensions reflect currently available equipment and may impose operational constraints in addition to a lower level of performance common to these systems.

Note

In horizontal-flow systems, personnel working between the filter and surgical wound will disperse bacteria that are more likely to contaminate exposed surgical instruments and enter the wound. This may be minimised by the use of improved clothing and operating procedure to reduce dispersion of bacteria. The use of lines on the floor delineating the extent of the clean zone and hatching or colour-coding the "no-entry" zone between the air diffuser and patient will serve to prompt staff and are therefore essential.

7.127 The air discharge velocity as measured 1 m from the diffuser face should have a mean value of 0.4 m/s. Chapter 8 gives details of the method of measurement.

Filters

7.128 The main plant's primary and secondary filters should be to the standards and in the location set out in Chapter 4.

7.129 Terminal filters should be provided within the air-flow terminal or in the air supply to it. HEPA filters grade H10 (as specified in BS EN 1822) should be installed. There is no aerobiological benefit in fitting filters of a higher grade than this, although for practical reasons most UCV manufacturers recommend the fitting of H12-grade filters.

7.130 In some modular UCV units, the terminal filter is used as a pressure equaliser to balance air flow; filters of a higher grade with a greater pressure drop may be recommended by manufacturers. The increased resistance may affect the velocity of air reaching the operating level, and there will be penalties in terms of installed fan power and higher noise levels.

7.131 The final filters should be installed in a leak-proof housing in a manner that allows the terminal unit, filters and their seals to be validated. A challenge test should be carried out during commissioning to prove the effectiveness of the complete installation.

7.132 Where UCV units are constructed in sections, a means of measuring the pressure drop across the terminal filters in each section should be provided. The pressure test-points should be located outside of the partial wall, capped to prevent air leakage and accessible within the theatre without the need to open the unit's inspection panels. Alternatively, direct-reading pressure gauges should be fitted.

7.133 The UCV system will require a return-air filter to capture the relatively coarse particles that would otherwise significantly reduce the life of the final filter. This should be at least a G3 grade to BS EN 779. In remote recirculation systems, there may be advantages in fitting a higher grade return-air filter as it will reduce the load on the terminal HEPA filters and extend their life.

Noise level

7.134 If sound-attenuating material is used to line any portion of the inside of the UCV unit, it should be non-particle-shedding and fire-resistant (see Health Technical Memorandum 05-02).

7.135 The maximum noise level in an operating room fitted with a UCV terminal of any type should not exceed 50 NR. Chapter 8 gives details of the method of measurement.

Lighting and operating lights

7.136 CIBSE lighting guide LG2 and BS EN 12464-1 give detailed information on lighting requirements. Operating luminaires should comply with the photometric requirements detailed in relevant sections of BS EN 60601.

7.137 The position of the UCV light fittings and style of partial walls, where fitted, should neither adversely disturb the air flow nor result in significant spatial variations in illuminance levels.

7.138 In vertical units, specialised task lighting should be provided by toroidal, cruciform or small multiple dome-shaped luminaires, as they have good aerodynamic properties. The ideal luminaire will have a minimal effect on the air flow regardless of where it is positioned. Large-diameter saucer-shaped luminaires should not be used in vertical-flow systems as they will occlude the air flow in the critical central zone. It is important to consider the suitability of existing luminaires when retrofitting UCV systems.

7.139 In vertical UCV installations, a minimum of 2.75 m from floor to underside of the diffuser is required to allow for supporting mechanisms and lamp articulation. When upgrading existing systems, this dimension may not be achievable; however, when parked, the lowest point of the central light stem, luminaire and articulation arms should never be less than 2 m above floor level.

7.140 The traditional means of light support is a central column that passes through the UCV terminal and is rigidly fixed to the building structure. The position of the support therefore prevents air being supplied at the centre of the terminal. Separate supports displaced from the centre of the clean zone would lead to improved air flow.

Note

This approach was advocated in the 1994 version of this guidance but at the time of writing, no UK manufacturer has chosen to adopt this solution.

7.141 In horizontal units, the size or shape of the specialised task luminaire has little effect on the air-flow pattern.

Controls and instrumentation

7.142 The functions of the supply AHU and extract ventilation should be continuously monitored by a BMS control unit. The controls and instrumentation for the main plant are set out in Chapter 6.

7.143 UCV systems will additionally require:

- a set-back facility that can reduce the air supplied through the UCV terminal to a volume that equates to an amount not less than 25 air changes per hour of the operating room's gross volume whilst still leaving the supply AHU operating at full speed;
- a facility to turn off the entire system, the supply AHU and the UCV terminal (an emergency stop is not required);
- a read-out sufficiently large to be clearly visible from the operating table that shows the temperature of the air being supplied by the UCV terminal;
- a read-out sufficiently large to be clearly visible from the operating table that shows the relative humidity of the air being supplied by the UCV terminal;
- a red indicator light that will illuminate when either the supply AHU or the UCV terminal fails; either or both are switched off or the AHU and UCV terminal are at set-back;
- an amber indicator light that will illuminate when the UCV terminal is at set-back and the supply AHU is running;
- a green indicator light that will illuminate when both the supply AHU and UCV terminal are operating at full speed;
- a blue indicator light that will illuminate when the UCV terminal's HEPA-filter resistance causes the air delivered to fall below 80% of the design flow rate.

See Table 6.

7.144 The switching devices and indicators should be incorporated in the surgeon's panel and their functions clearly labelled. In retrofit installations, an auxiliary panel for the UCV may be the most practical option. If fitted, it should be mounted adjacent to the surgeon's panel and their control functions interlocked as necessary.

7.145 When a system is designed to have partial walls with full-wall extensions, a volume control facility may be incorporated to allow the system to be run with reduced velocity when the demountable full walls are in place. It is the responsibility of the user to ensure correct operation of the system. To assist

Table 6 Indicator-light logic table

AHU	UVC terminal	Indicator light	Comment
Off or Fault	Off or Fault	Red	Ventilation not operating at a suitable level to commence surgical procedures
Off or Fault	On (set-back)		
Off or Fault	On (full speed)		
On (set-back)	Off or Fault		
On (full speed)	Off or Fault		
On (set-back)	On (set-back)		
On (full speed)	On (set-back)	Amber	Ventilation provided to at least conventional theatre standard
On (full speed)	On (full speed)	Green	Full UCV standard conditions
–	–	Blue	HEPA-filter resistance causing low air flow

the user, an explanatory notice should be included on the theatre's control panel.

7.146 A direct-reading gauge should be fitted in the theatre to show a representative pressure drop across the final filters. If the UCV control box is located out of the theatre and has a means of manually adjusting the return-air fan speed, it should also be fitted with a direct-reading differential-pressure gauge. The means of adjusting the return-air fan speed should be lockable to prevent casual adjustment. The direct-reading gauges should be fitted with a means of indicating the correct operating pressure range.

7.147 The UCV-unit manufacturer's control box should be located in an accessible position, preferably in the operating department adjacent to the operating theatre that it serves. A service corridor, if provided, is an ideal location. The control box should be clearly labelled with the identity of the operating theatre that it serves.

Extract systems

7.148 Extracts may be provided for a variety of reasons including:

- simple odour control (for example in a WC or mortuary);
- to receive and remove moisture-laden air (for example in a kitchen);
- as part of a combined supply/extract balanced system (for example in an operating suite);
- to capture a hazardous substance at source (for example a safety cabinet).

7.149 Devices that use an inflow of air to control exposure of staff to hazardous substances are classified as LEV systems under the COSHH Regulations.

7.150 An LEV system may comprise a self-contained unit incorporating its own carbon filter such as a simple bench-top fume cupboard. Alternatively, it may be a complete ventilation system comprising a make-up air supply, multiple-exhaust-protected workstations, branch and central extract ductwork, duplex extract fans and a high-level discharge terminal. It may also incorporate a special filtration system appropriate to the hazardous substance being controlled. Such systems could be required for workshops containing woodworking machinery or large centralised pathology laboratories housing multiple safety cabinets, cut-up benches, fume cupboards and specimen stores.

7.151 Typical LEV systems found in healthcare premises include:

- microbiological safety cabinets and Category 3 containment rooms;
- fume cupboards and plate-staining equipment;
- welding-fume extracts;
- woodworking-machinery dust collectors;
- battery-charging bay extracts;
- powered plaster and bone saws;
- pharmaceutical preparation cabinets and tablet machines;
- dissection benches, cut-up benches and some specimen stores;
- isolation facilities for medium- and high-risk infectious diseases;
- dental furnaces, grinders and polishers.

7.152 General design information and guidance for LEV systems is produced by the Health and Safety Executive (HSE) as HS(G)37. Information on the design and installation of microbiological safety cabinets is given in BS5726 and that for fume cupboards is given in BS EN 14175. Their recommendations should be closely followed.

7.153 LEV systems are statutory items that are subject to an independent inspection and test at least every 14 months.

Hood extract systems

Special requirements

7.154 Extract canopies are required over steam-and-heat-emitting appliances, for example sterilizers, and catering and washing equipment.

7.155 Perimeter-drain gulleys and corrosion-proof grease eliminators should be provided on kitchen hoods.

Typical arrangements

7.156 An air-flow velocity of 0.25 m/s to 0.5 m/s is suitable to collect and remove evaporation of steam and cooking vapours. Excessive velocities are wasteful of power and generate noise.

7.157 The lowest edge of the canopy should be 2 m above finished floor level, with a minimum of

300 mm overhang beyond the edge of the equipment on all sides.

7.158 A compact arrangement of equipment (but with access for maintenance) will minimise the canopy area and hence reduce the air volume necessary to achieve the optimum capture velocity.

7.159 Hoods required for the control of heat gain and vapours may be connected to the general extract system when it is convenient to do so, but where non-corrosive ductwork materials are necessary, a separate discharge is preferred.

7.160 Lighting and internal divider plates are often included in the perimeter of large canopies; however, built-in shelving systems are not recommended as they interfere with the air flow and constitute a maintenance problem.

Control of hood extracts

7.161 Provided that it does not interfere with the operation of the department when not in use, the ventilation system for the hood extract and any associated supply make-up can be shut down. To this end, local or automatic-use control should be provided.

Bench extract systems

Special requirements

7.162 Bench extract ventilation is required in departments such as pathology and mortuary where activities involve the release of malodorous fumes or hazardous substances. Where hazardous substances are being controlled, the system should be designated an LEV.

7.163 Processes that produce hazardous vapours, fumes, dusts or vapours should be enclosed or semi-enclosed in a suitable cabinet or exhaust-protected workstation.

Typical arrangements

7.164 Each ventilated position will usually be accommodated in a continuous run of benching, which should not be more than 650 mm from front to rear and which should be provided with a continuous upstand at the rear. Each position should have a 1200 mm × 150 mm linear extract grille mounted on a purpose-designed plenum box (incorporating guide vanes as necessary), with its face flush with the upstand. The bottom of the grille should be as close as practicable to the level of the working surface (usually 75 mm above, to allow for cleaning). The minimum velocity across any part of the grille should be 1 m/s. The grille should be readily demountable to allow for cleaning.

Control of bench extract systems

7.165 Provided that it does not interfere with the operation of the department when not in use, the ventilation system for the bench extract and any associated make-up supply can be shut down. However, a run-on timer with a minimum setting of 30 minutes must be provided. To this end, local or automatic-use control should be provided.

Safety cabinet and fume-cupboard extract systems

7.166 Safety cabinets and fume cupboards are devices that use an inflow of air to control exposure of staff to hazardous substances. The units, their exhaust systems, filters, fans and discharge terminals are all classified as local exhaust ventilation (LEV) systems under the COSHH Regulations. The make-up air system to a room that contains an LEV system should also be considered as an essential part of the system and be included in the LEV classification.

7.167 Information on the design and installation of microbiological safety cabinets is given in BS5726 and that for fume cupboards is given in BS EN 14175. Their recommendations should be closely followed. The Advisory Committee on Dangerous Pathogens (ACDP) publishes 'The Management, Design and Operation of Microbiological Containment Laboratories' covering the general environment in which they are used and operational considerations.

Special requirements

7.168 The supply-air system should not distort the unidirectional and stable air pattern required for fume cupboards and microbiological safety cabinets. In general, supply-air ceiling diffusers should not discharge directly towards fume cupboards or safety cabinets, unless the terminal velocity is such that the air-flow pattern of the cabinet is unaffected. The design should ensure that high air-change rates and/or the opening and closing of doors do not have any adverse effect on the performance of safety cabinets or fume cupboards. A damped door-closure mechanism may help.

7.169 In order to safeguard the user, all safety cabinets and fume cupboards must be fitted with a clear indication that they are operating correctly. Direct-reading gauges or falling-ball indicators are preferred (in addition to electronic pressure indicators). The system should be set to audibly alarm if the face velocity falls below the minimum safe operating level.

Arrangements for safety cabinet installations

7.170 A Class 1 microbiological safety cabinet must be specified for routine work involving Group 3 pathogens. It should be housed in a Category 3 containment room. Information on containment rooms is issued by ACDP in 'The Management, Design and Operation of Microbiological Containment Laboratories'.

7.171 Siting and installation of microbiological safety cabinets are of particular importance because:

- protection afforded to the operator by the cabinet depends on a specific and stable unidirectional air flow through the open front;
- protection to the environment by the cabinet depends on HEPA filters. The exhaust air should never be considered as totally free from microbiological hazard.

7.172 Extract air from a microbiological safety cabinet is HEPA-filtered prior to discharge to the outside. The extract ductwork should as far as practicable be kept under negative pressure while inside the building.

7.173 Current standards permit the installation of microbiological safety cabinets with integral fans, provided that the extract ductwork can be kept short (that is, less than 2 m); such an installation, however, is likely to be noisy and is not recommended for use in new buildings.

7.174 The discharge from the cabinet should be fitted with a back-draught damper. In multiple installations where several cabinets discharge into a common extract and discharge duct, it must be possible to isolate each cabinet from the system when not in use.

7.175 Roof-level discharge, wherever practicable, is preferred since it removes much of the uncertainty over air re-entering the building through ventilation inlets and/or windows. In such an installation, the extract fan should be situated separately from the cabinet and close to the discharge outlet, to maintain the duct within the building under negative pressure. The discharge point on a flat roof should be through a 3 m high terminal. This is required to safeguard staff who may need to periodically access the roof for maintenance. This requirement will also be applicable to fume-cupboard discharges.

7.176 Where this is impracticable, discharge into the room via a double HEPA filter has been accepted; the preferred method, however, is to discharge above the roof line as above.

Arrangements for fume-cupboard installations

7.177 The primary factors which contribute to the effective performance of fume cupboards include:

- an adequate volume of supply air;
- an effective exhaust system to promote the safe dispersal of waste products to atmosphere.

7.178 The air velocities through sash openings must be sufficient to prevent hazardous materials from entering the laboratory while avoiding excess flow rates that interfere with the investigation process. The design velocity must be maintained irrespective of whether the sash opening is varied or whether doors or windows are open or closed. Variable air volume (VAV) cupboards are available, which will offer a reduction in energy costs.

7.179 The possibility of a fire or explosion which may not be contained by a fume cupboard must always be considered. A fume cupboard should not, therefore, be sited in a position where exit to an escape route will necessitate passing directly in front of it.

7.180 Fume-cupboard fans should be installed as near as possible to the termination of the duct, thus maintaining the maximum amount of ductwork at negative pressure.

7.181 Where there are adjacent buildings with opening windows, or where down-draughts occur, it may be necessary to increase the height of discharge ducts in order to achieve adequate dispersal. In complex locations, air-flow modelling or wind-tunnel tests may be required to determine the optimum height of the stack (see also paragraph 7.174).

7.182 Fume cupboards for certain processes must have separate extract systems; however, if permissible, individual fume-cupboard exhaust systems may discharge via non-returning dampers into a single

collection duct rather than having a large number of separate stacks. The collection duct should:

- have a large cross-sectional area to minimise its effect on individual exhaust systems;
- be open to atmosphere upstream of the first connection; and
- be designed to discharge a total air volume at least equal to the combined individual extract systems.

7.183 Individual fume-cupboard extract systems, discharging either directly to atmosphere or into a collection duct, do not require duplex fans. However, a collection duct designed to provide dispersal of effluent from a number of individual extracts should have duplex fans with automatic change-over.

7.184 Some fumes are particularly corrosive, so the choice of material for the ductwork and type of extract fan fitted should reflect the nature of the fume being conveyed.

Control of extract systems

7.185 It is desirable to provide local control of safety cabinets in order to maximise the life of the HEPA filter and to permit the sealing of the cabinet and room for fumigation if spillage occurs.

7.186 To cope with the risk of an accident or spillage outside safety cabinets, a panic button should be provided to switch off the supply to that area and to discharge all extracted air to atmosphere.

7.187 In pathology departments, it is necessary to have one or more microbiological safety cabinets and one or more fume cupboards available for use at all times, including weekends; therefore, local overriding controls for all these items and any associated ventilation plant will be necessary.

Plantroom ventilation

General requirements

7.188 Plantrooms need to be ventilated to maintain acceptable temperatures for satisfactory operation of the plant and controls, and for maintenance activities. In the case of plantrooms housing combustion equipment, a secondary function of the ventilation is to provide make-up air for the combustion process.

7.189 The air required should be introduced into the space through inlets positioned to minimise the discomfort to occupants. It should be ensured that they are not blocked, closed deliberately (except in the case of fire shutters if required) nor rendered inoperative by prevailing winds.

Typical LEV discharge stacks

7.190 Plantroom ventilation air should not be used for any other purposes, such as make-up air for extract. Where the plantroom contains combustion equipment, the appliance pressure must not fall below the outside air pressure.

7.191 Specialised healthcare air-handling equipment must not be located in a fire compartment that houses combustion equipment.

7.192 Statutory regulations for plantroom ventilation are contained in the Building Regulations Part J, and further guidance in given in the CIBSE Guides A and B.

7.193 Plant noise is subject to the Control of Noise at Work Regulations 2005 and should not exceed 80 dB(A) within a plantroom. It should be reduced to lower levels where the plant is near to departments sensitive to noise.

Assessment of ventilation levels

7.194 Ventilation requirements must take into account all heat sources within a plantroom and, where there are large glazing areas, solar gains. The ventilation rate should limit the maximum temperature within the plantroom to 32°C.

7.195 As the level of equipment operating during mid-season and summer is often lower than winter conditions, and the cooling effect of the outside air is reduced, it is necessary to calculate the minimum volume for each season of operation, and the inlet and outlet grilles or fan sizes should be chosen to cater for the largest seasonal air volume.

7.196 Replacement air should not be drawn through pipe trenches or fuel service ducts. Where metal ducts penetrate walls and floors, effective sealing should be provided to confine the ventilation to the boiler room and to meet fire protection requirements. Penetration of fire-barrier walls by ventilation ducts should be avoided if possible.

7.197 Fire dampers in plantroom ventilation ducts should be electrically interlocked with the boiler plant.

7.198 Care must be taken to prevent any noise generated in the plantroom emerging from natural or mechanical ventilation openings to the detriment of the surrounding environment. Particular care is necessary with mechanical flue draughts and fan-diluted flue systems.

7.199 Information on required air volumes in contained in the CIBSE Guides A and B.

7.200 Where combustion plant is installed, the high-level (outlet) openings should be sized to cater for the total ventilating air quantity, and the low-level (supply) openings sized to cater for the total combined ventilating and combustion air quantity.

Choice of ventilation system

7.201 Ventilation air may be introduced and exhausted by either natural or mechanical means or a combination of both; however, where possible, natural systems are preferred.

7.202 Generally, small installations at or above ground level should have their combustion and ventilation air provided by natural means, employing both high- and low-level openings.

7.203 Basement, internal and large installations at or above ground level will usually require a combination of natural and mechanical ventilation. If the air-flow rate is difficult, both supply and extract may require mechanical means.

7.204 Whether natural or mechanical, the system should be designed to avoid both horizontal and vertical temperature gradients. Both inlet and outlet openings should be placed on opposite or adjacent sides of the building to reduce the effect of wind forces.

7.205 Where mechanical air supply is employed, electrical interlocks with the boiler plant should be provided to prevent damage in the event of failure of the supply fan(s) once the air volume is established.

7.206 The necessary free opening areas for a naturally ventilated plantroom may be calculated using the method in the CIBSE Guides A and B.

7.207 A combined natural and mechanical ventilation system should allow for natural extract at high level, to take advantage of convective forces in the room, with mechanical supply at low level. The high-level natural ventilators should be sized to cope with the total quantity of ventilation air, as above.

7.208 To prevent leakage of flue gases and to ensure that the flue draught is not impeded at any time, air pressure in the boiler room must not exceed the prevailing outside pressure. Therefore, the fan duty should exceed the calculated total combined combustion and ventilation air quantity by at least 25%. Fan-powered inlets should be arranged to flow outside air into the space at a point where cross-ventilation will ensure pick-up of heat without causing discomfort to occupiers.

7.209 Where it is impractical to provide sufficient natural ventilation to remove the heat emitted by the plant, both mechanical supply and extract will be required.

7.210 The high-level extract should be sized to cater for the total ventilating air quantity, and the low-level supply should exceed the total combined combustion and ventilating air quantity by at least 25%, as above.

Ventilation of hydrotherapy suites

General requirements

7.211 In a hydrotherapy suite, heat recovery should be via a heat pump.

7.212 The quantity of supply air should be calculated as 25 L/s per square metre of wetted surface, with the wetted surface taken as 110% of the pool water surface area.

7.213 A recirculation plant is recommended with fresh air make-up to the standard required by the Building Regulations Part F – Non-domestic Buildings. In practice this may need to be increased to control condensation.

7.214 As far as practicable, recirculated pool air should be provided to the ancillary changing and recovery accommodation, with the only extract from the toilets, laundry/utility room and pool hall.

7.215 Supply air to the pool hall should be introduced at high level and directed towards the perimeter to mitigate condensation, with extract air taken from directly over the pool.

Control of hydrotherapy pool installations

7.216 The supply and extract fans should be interlocked so that the supply fan does not operate until flow is established within the extract system.

7.217 Time-clock control should be provided, with a local override switch to extend the normal operating period as required.

7.218 Night set-back temperature (in the range of 21–25°C) and high humidity control (in the range of 60–75% sat) should be provided to override the time-clock in order to prevent condensation. The exact set-points should be ascertained post-installation.

7.219 A remote indication panel should be provided in the pool hall, giving a visual display of the pool water and pool air temperature.

8 Validation of specialised ventilation systems

Definitions

Commissioning. Commissioning is the process of advancing a system from physical completion to an operating condition. It will normally be carried out by specialist commissioning contractors working in conjunction with equipment suppliers. Commissioning will normally be the responsibility of the main contractor.

Validation. A process of proving that the system is fit for purpose and achieves the operating performance originally specified. It will normally be a condition of contract that "The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Commissioning is often subdivided into sections (for example AHU, automatic controls, air-side balance, building fabric and fittings). Each section may be commissioned by its specialist installer, and they are often accepted in isolation. Validation differs from commissioning in that its purpose is to look at the complete installation from air intake to extract discharge and assess its fitness for purpose as a whole. This involves examining the fabric of the building being served by the system as well as inspecting the ventilation equipment fitted and measuring the actual ventilation performance.

It is unlikely that "in-house" staff will possess the knowledge or equipment necessary to validate critical ventilation systems such as those serving operating suites, pharmacy clean rooms and local exhaust ventilation systems. Validation of these systems should therefore be carried out by a suitably qualified Authorised Person appointed by the client.

It is anticipated that training and certification in the validation of specialised healthcare ventilation systems for Authorised Persons will become available during the life of this Health Technical Memorandum.

Commissioning

8.1 Commissioning is an essential process for ventilation systems. It is therefore important that adequate provision for the process be made at the design stage of the project. Procedures for commissioning air-handling systems are given in CIBSE Commissioning Codes and BSRIA Application Guide Set COMPAK 1.

8.2 The duct-sizing procedure should take into account the requirements of system balancing, and the position and number of regulating dampers included in the design should be sufficient for this purpose.

Location of dampers and test holes

8.3 Balancing/commissioning dampers should be installed in each branch of the distribution ductwork.

8.4 Test holes for the measurement of air-flow should be provided at carefully selected points in main and all branch ducts. The number and spacing of holes are given in the BSRIA Application Guide Set COMPAK 1. Their positions must be identified at the design stage.

8.5 The test positions need to be accessible for commissioning to take place. They may also be required for subsequent annual verification of the system performance, so they should be capped to prevent air leakage but not covered by permanent lagging.

8.6 The measurement point should be in a straight length of duct as far away as possible from any upstream bends, dampers or other elements that could cause disturbance to the air flow. The actual location should be:

a. at least 1.5 duct diameters upstream of sources of turbulence (such as dampers and bends);

b. if (a) is not possible, ten duct diameters downstream of dampers, bends or tees, and five

duct diameters downstream of eccentric reducers;

c. where there is enough space round the duct to insert the Pitot tube and to take readings;

d. where the duct has a constant cross-sectional area.

8.7 Test holes for measuring total air-flow from a fan should be located either four duct diameters upstream or ten duct diameters downstream of the fan. Provision should also be made for ascertaining the direction and measuring the speed of rotation.

Commissioning personnel

8.8 It is unlikely that one particular individual will have all of the required commissioning skills; a commissioning team is therefore usually needed. The objective of commissioning is to ensure that the necessary performance and safety requirements are met.

8.9 During the commissioning process, a great deal of information will be generated, which will form an invaluable future source of reference about the plant. It is essential to ensure that it is collected together in the form of a commissioning manual and handed over to the client on completion of the contract together with the as-fitted drawings. The information should be both in hard copy and electronic format.

8.10 In order to be successful, the commissioning process must start before practical completion, as many parts of the system will become progressively less accessible. The correct installation of those parts will need to be witnessed, and leak-rate tests carried out as construction proceeds. Failure to establish responsibility for commissioning early enough will delay the completion of the project or lead to unsatisfactory plant performance.

Commissioning brief

8.11 The commissioning team will require a detailed brief from the system designer. This should include:

- a user brief comprising a description of the installation and its intended mode of operation;
- the precise design requirements with regard to the scheme of air movement, room static pressures, supply and extract air-flow rates and acceptable tolerances;
- full details of the design conditions, both inside and out, for winter and summer together with the control strategy;
- the equipment manufacturer's type-test data, commissioning, operation and maintenance recommendations;
- drawings showing the layout of the system, positions of air-flow measurement test-points, dampers, regulating devices and filters within the duct runs, together with sizes of ducts and terminal fittings. It will save time if these drawings are annotated with the design volumes and static pressures required at each branch and outlet point (see Table 7 for information to be included on schematic drawings);
- wiring diagrams for all electrical equipment associated with the air-handling systems including motor control circuit details and any interlocking and safety devices such as emergency-stop buttons adjacent to the item of plant.

8.12 CIBSE's Commissioning Code A – 'Air distribution systems' provides full guidance on the information that will be required by the commissioning team.

8.13 The designer should include in the contract documents instructions on verifying the accuracy of test instruments, which should be supported by reference to relevant calibration certificates.

8.14 On completion, the system should be operated by the contractor as a whole and subject to performance tests in accordance with the contract requirements. For critical systems, these should include independent validation of the system performance on behalf of the client.

8.15 The commissioning process should be carried out in the order in which it appears in this guidance document; that is, the static checks and visual inspections should be followed by the dynamic and performance tests (as outlined in this chapter) and finally the handover procedures.

8.16 Prior to dynamic commissioning, it is essential that builders' work in the area served by the system is complete, all rubbish and dust is removed, Institute of Plumbing service (IPS) panels are in position and ceiling tiles are in place and clipped. Floors should be mopped, and visible dust removed from all other surfaces.

8.17 Once the system is shown to meet the design intent, the handover documentation should be

Table 7 Information to be provided on schematic drawings

Items in system	Information to be provided
Fans	Fan total pressure Volume flow rate at high and low speed Maximum motor current
Plant items	Type and identification numbers from equipment schedules Fluid and air-volume flow rates Fluid and air-side pressure losses Dry-bulb temperatures Wet-bulb temperatures Humidity
Dampers, including motorised and fire dampers	Identification numbers from equipment schedules Location Identification number Volume flow rate
Main and branch ducts	Dimensions Volume flow rates and velocities Identification numbers from equipment schedules
Terminal	Location Identification number Grille or diffuser factor Volume flow rate and neck velocity Operating static pressure
Test holes and access panels	Location Identification number
Controllers	Set-points

Notes: Fan total pressure is the difference between the total pressure (static pressure + velocity pressure) at the fan outlet and the total pressure at the fan inlet.
Where volume flow rates are variable, maximum and minimum values should be provided.

completed. In the event of performance not being acceptable, the matter should be dealt with in accordance with the contract arrangements.

Pre-commissioning checks

8.18 The pre-commissioning checks consist of visual inspection, manual operation of equipment, static measurements and functional tests of individual components. They should be carried out prior to setting the system to work and undertaking the dynamic commissioning process set out in paragraphs 8.29–8.42.

Standard of installation

8.19 During the installation of the system, the following must be witnessed by either the client or his representative:

- that the plant and installations have been provided and installed in accordance with the design specification and drawings;
- that only approved sealants have been used in the installation;
- that all components function correctly;
- that the satisfactory sealing of access doors and viewing ports have been carried out;
- that air-pressure tests and air-leakage tests on ventilation ducting have been carried out in accordance with the methods set out in the HVCA's (1998) 'DW/143 – A practical guide to ductwork leakage testing'. It is usual to carry out these tests a section at a time as the ductwork is installed and before its insulation is applied. The results must be recorded in the commissioning manual;
- that gaps around doors and hatches are as specified in the design;
- that the correct operation of pressure stabilisers, and control, isolating and non-return dampers have been checked and installed in the correct orientation for air flow;

- that test holes have been provided in their specified locations and are sealed with suitable grommets;
- that control dampers are secured and their quadrants fitted correctly;
- that any interlocks are operative and in accordance with specification;
- that the electric circuits are completed, tested and energised;
- that electric motors have been checked for correct direction of rotation at both full speed and set-back;
- that cooling and heating media are available at correct temperatures and pressures, and in specified quantities;
- that the air-conditioning plant's components and controls function correctly;
- that the air-conditioning plant's interlocks and safety controls function correctly;
- that the plant is physically complete, insulation is applied, and all ducts and pipework are identified as specified;
- that the building housing the ventilation plant is generally in a fit condition for commissioning and performance tests to commence – that is, windows, doors, partitions etc are completed, surfaces sealed and their final finish applied;
- that the areas containing the ventilation plant and those being served by it are clean;
- that access to all parts of the system is safe and satisfactory.

Cleanliness of installation

8.20 During installation it must be established that ductwork is being installed to the "advanced level" as defined in the HVCA's (2005) 'TR/19 – Guide to good practice: internal cleanliness of ventilation systems'. This specifically includes ensuring that ductwork sections arrive on site and are stored with their open ends sealed and that open ends remain sealed during installation to prevent the ingress of builders' dust.

8.21 Should any doubt exist as to whether the guidance has been observed, the ducts must be cleaned internally to restore them to this standard before being taken into use.

8.22 Builders' work ducts of brick or concrete must be surface-sealed to prevent the release of dust before being taken into use.

8.23 The area around the supply-air intake must be free of vegetation, waste, rubbish, builders' debris or any other possible source of contamination.

Certification of equipment

8.24 The following test certificates should be assembled by the commissioning team and be available for inspection at any time during the contract period. They will form part of the handover information and should be placed in the commissioning manual:

- type-test performance certificates for fans;
- pressure-test certificates for:
  - heater-batteries;
  - cooling coils;
  - humidifiers (if appropriate);
- type-test certificates for attenuators;
- type-test certificates for primary and secondary filters;
- individual test certificates for HEPA filters.

Equipment tests

8.25 Prior to setting the system to work, the checks in paragraphs 8.26–8.28 should be witnessed, and proving tests should be carried out as detailed.

Filters

8.26 The quality of filter housing and, in particular, seals is a critical factor in maintaining the efficacy of the filtration system by ensuring that air does not bypass the filter panels. Therefore, the following checks should be made:

- filter seals should be fitted and in good condition;
- filters should be installed correctly with respect to air flow;
- bag filters should be installed so that the bags are vertical and their pockets free;
- HEPA filters should be installed in a sealed housing and their seals tested to DIN 1946 if specified;

- all filters should be checked to ensure they are free of visible damage;
- the differential-pressure indicators should be checked for accuracy and to see that they are marked with the initial and final filter resistance.

Drainage arrangements

8.27 The drain should conform in all respects to the guidance given in this Health Technical Memorandum. In addition, the following must be proved:

- that the drain tray is easily removable;
- that a clear trap is fitted and is easily removable;
- that the drain has a clear air gap of at least 15 mm;
- that the pipework and trap are supported so that the air break cannot be reduced;
- that the drain system from each drain tray is independent up to the air break;
- that the operation of the drainage system is proved by introducing water into the duct at the drain tray and observing that it completely drains out. This check is to be repeated both at normal speed and set-back once the fans have been commissioned. At this time, the clear trap can be marked to indicate the normal water level with the fan running.

Fire dampers

8.28 The following must be witnessed, and proving tests should be carried out as detailed:

- the operation of all fire dampers;
- access provided to enable the dampers to be visually inspected and/or re-set should be sufficient for the purpose;
- indication should be provided of the dampers' position (open/tripped);
- indication of the fire dampers' location should be provided both on the ductwork and at a visible point on the building fabric if the ductwork is concealed.

Dynamic commissioning

Air-handling and distribution system

8.29 The fan drive, direction of rotation, speed and current drawn should be set in accordance with manufacturers' instructions.

8.30 After the installation has been checked to ensure that it is in a satisfactory and safe condition for start-up, it should be set to work and regulated to enable the plant to meet its design specification. The proportional balancing method described in CIBSE's Commissioning Code A should be followed. The air-flow rates must be set within the tolerances laid down in the design brief. This will normally be the design air-flow rate +10% –0%, that is, the measured value must at least achieve the design but must not exceed it by more than 10%.

8.31 When combined supply and extract systems are to be balanced and the area that they serve is to be at or above atmospheric pressure, the supply should be balanced first with the extract fan switched off, and then the extract balanced with the supply fan(s) on.

8.32 For combined systems where the area that they serve is to be below atmospheric pressure, the extract should be balanced first with the supply fan switched off and then the supply balanced with the extract fan on.

8.33 On completion of the balance, all volume air flows in supply and extract ducts and from grilles and diffusers must be measured and recorded. The true air-change rate can then be calculated from the data obtained.

8.34 The main supply and extract duct-volume control dampers should be locked and their position marked.

8.35 All grille and diffuser volume-control registers should be locked to prevent alteration and their final position marked.

Room-air distribution

8.36 Pressure-relief dampers and pressure stabilisers should be set to achieve the specified room's static pressures and should be locked. The grille's direction-control vanes and diffuser cones must be set to give the specified air-movement pattern. Visualisation techniques may need to be employed in order to prove that the required air-flow pattern is being achieved. This may be a particular

requirement when commissioning LEV systems or rooms that contain them.

Air-conditioning plant

8.37 The specified flow rate and/or pressure drops must be set for all heater-batteries, cooling coils and humidifiers. The methods described in CIBSE's Commissioning Codes W and R should be followed. On completion, their regulating devices must be locked to prevent alteration.

Control system

8.38 The control system should not be commissioned until both the air distribution system and air-conditioning equipment have been commissioned.

8.39 Because of the specialised nature of control systems and the fact that each manufacturer's system will contain its own specific components and settings, the commissioning should be completed by the supplier and contractor before being witnessed by a representative of the client.

8.40 The location of all control and monitoring sensors should be checked and their accuracy proved.

8.41 The control system's ability to carry out its specified functions must be proved. In this respect it is essential that control indication lights on the panel or mimic on the BMS actually relate to the running of a specific fan or movement of a damper.

8.42 If the plant is provided with a user's control panel in addition to the one located in the plantroom, the operation of both must be proved. This will typically apply to operating departments and laboratory systems.

Specific performance standards

Air movement

8.43 The performance of the system should be measured and compared with information provided by the designer.

Plant capacity and control

8.44 When setting to work and proving the design, both the contractor responsible for the air-handling plant and the control specialist should attend the site together and jointly commission the system.

8.45 If any doubt exists as to the capacity of the installed system, its ability to achieve the specified internal design conditions with the plant operating at external winter and summer design conditions must be proved. Artificial loads will be required in order to simulate the internal gains/losses and the external design conditions.

8.46 On completion of the plant's performance test, recording thermo-hygrographs should be placed in each room/area served by the plant and also the supply-air duct upstream of the fog/frost coil. The plant should be run for 24 hours with all doors closed. During this period, the inside conditions must stay within the tolerances specified. Alternatively the BMS may be used to obtain the information required.

Noise levels – general

8.47 The commissioning noise level is that measured with a sound-level meter in the unoccupied room, taking account of the external noise together with the noise generated by the ventilation system. Appendix 2 gives a summary for many applications. Full details and design information are contained in Health Technical Memorandum 08-01 – 'Acoustics'.

8.48 The noise levels apply at the maximum velocity for which the system is designed to operate. Acoustic commissioning tests should be carried out with all plant and machinery running normally and achieving the design conditions of air flow, temperature and humidity.

8.49 An industrial-grade Type 2 sound-level meter fitted with a muff will normally be sufficient to check the noise level. Its accuracy should be checked using a calibrated sound source before use.

8.50 The noise-level readings should be taken at typical normal listening positions 1.5 m above floor level and at least 1 m from any surface, and not on any line of symmetry. In critical care areas, the noise should be measured near to the centre of the room and near to the centre of each quarter. The mean of the five readings should then be calculated.

8.51 In the event of a contractual deficiency, a Type 1 precision-grade sound-level meter should be used, and the noise level determined by the procedure given in Health Technical Memorandum 08-01.

Filter challenge

General ventilation filters

8.52 In-situ performance tests will not normally be required for primary and secondary filters and

their housings. However, filters should be visually inspected for grade, tears, orientation and fit within their housings. Filters should be clean and a replacement set should be available. Bag filters should be installed so that their bags are vertical, and spaced so that air can move through them freely. Any filter found to be wet should be replaced and the cause investigated.

HEPA filters (for exhaust protective enclosures and laboratories)

8.53 Pathogenic material may be discharged through damaged or badly installed HEPA terminal filters. The complete installation must be tested using the method set out in BS EN: 14644 'Method of Testing for the Determination of Filter Installation Leaks'.

8.54 The challenge tests may be carried out using either of the following techniques:

- use DOP to provide the challenge and a photometer to detect leaks;
- use a discrete particle counter (DPC) to detect leaks. (In order to obtain a sufficient challenge, it may be necessary to temporarily remove the supply AHU's secondary filters.)

8.55 In both cases, the upstream challenge should be measured. A measurement of particle penetration through a representative section of the HEPA-filter media is then taken and used as the reference background level. These two readings enable the range of the detecting instrument to be set.

8.56 A challenge aerosol of inert particles of the type produced by a DOP generator should be introduced into the air, upstream of the HEPA filter. The downstream face of the filter, its mounting seal and housing would then be scanned for leakage using a photometer. A leak should be deemed to have occurred if a steady and repeatable reading on the photometer at any point exceeds 0.01% of the upstream reading.

8.57 Alternatively, a DPC may be used. For the DPC method, the filter face is sampled at several points to establish the smallest non-penetrating particle size. This will directly relate to the grade of filter under test. The filter face, its seal and housing are then scanned, and if a significant number of particles at or above this size are detected, there is deemed to be a leak at or near the test position.

8.58 Should the HEPA filter fail this test, it must be replaced. Should the filter mounting seal or housing fail this test, it may be repaired and the test repeated.

Bacteriological sampling

General ventilation systems

8.59 Bacteriological sampling will not normally be required for either general or local exhaust ventilation (LEV) systems unless otherwise specified.

Conventional operating rooms

8.60 Before commencing bacteriological testing, the room and its ventilation system should have achieved a steady state condition (see also paragraph 8.75).

8.61 The level of airborne bacteria introduced by the supply air should be checked by closing all doors and leaving the operating room empty with the ventilation system running for 15 minutes. An active air sampler set to take at least a 1 m^3 sample and mounted in the centre of the room approximately 1 m above floor level should then be activated remotely. Aerobic cultures on non-selective media should not exceed ten bacterial and/or fungal colony forming units per cubic metre (CFU/m^3).

8.62 The results should be examined to establish the broad category of organisms present. A high preponderance of fungal organisms may be an indication of inadequate filtration for the particular installation. Precise guidance is inappropriate and will depend on local circumstances.

8.63 A check of airborne bacteria should be carried out during a surgical operation. Unless there are unusually high numbers of personnel or extensive activity in the room, the number of airborne bacterial and/or fungal CFU averaged over any five-minute period would be unlikely to exceed 180 per m^3.

The Hospital Infection Society has issued guidance on the microbiological testing of operating theatres (www.his.org.uk/_db/_documents/OTIC-final.pdf).

Information on the additional validation testing of UCV operating suites is given in paragraphs 8.66–8.164.

Ventilation system commissioning/validation report

8.64 Following commissioning and/or validation, a full report detailing the findings should be produced. The system will only be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life.

8.65 The report should conclude with a clear statement as to whether the ventilation system achieved or did not achieve the required standard. A copy of the report should be lodged with the following groups:

- the user department;
- infection control (where required);
- estates and facilities.

Validation of UCV operating suites

General

8.66 Commissioning of a UCV terminal will normally be carried out by its supplier. Commissioning of the AHU, fire dampers, distribution ductwork and control systems may be undertaken by different teams. It is therefore important to recognise that the UCV terminal is only one element of the specialised ventilation system serving the operating suite, and it cannot be accepted in isolation.

8.67 In order to ensure that the complete system operates correctly, it will be necessary to validate the system as a whole from the air intake through to the extract discharge.

8.68 It is unlikely that in-house staff will possess the knowledge or equipment necessary to undertake this process. Therefore, a suitably qualified Authorised Person appointed by the client should carry out the validation of ultra-clean operating theatre ventilation systems.

Note

It is anticipated that training in the validation of specialised healthcare ventilation systems for Authorised Persons will become available during the life of this Health Technical Memorandum.

8.69 The following regime of inspection and testing should be applied to the validation of new installations designed to provide ultra-clean conditions in an operating suite. The test regime has been devised to ensure that the system, as installed, fully achieves the design requirement for these systems as set out in paragraphs 7.91–7.147.

Basic requirement

8.70 The operating suite to be validated should be physically complete with final finishes applied. All ventilation systems serving it should be operating correctly and delivering their design air-flow rates.

8.71 In order to avoid preloading the UCV terminal's recirculation ducts and HEPA filters, the operating suite should be free of any obvious dust and at least "builders clean" before the recirculation fans are set to work (see also paragraph 8.16).

8.72 The validation procedure for a conventional theatre suite should have been satisfactorily completed to the standard set out in this chapter prior to attempting to validate the UCV unit. In particular:

- the supply AHU will have achieved the minimum standard;
- the operation of all fire dampers will have been proved;
- the supply and extract air-flow rates as measured in ducts and at room terminals will achieve their design values +10% –0% (see paragraph 8.30);
- the room's differential pressures will be correct.

8.73 Evidence of the satisfactory achievement of the foregoing standards should be available for inspection and independently measured as necessary prior to validating the UCV unit.

UCV unit validation procedure

8.74 Tests to validate the suitability and performance of an ultra-clean operating suite should be undertaken in the order that they appear in Table 8. Should an item fail to meet the required standard, it should be rectified and successfully retested before passing on to the next test.

Table 8 Summary of test regime

1. Challenge tests to ensure that: • the UCV terminal unit is correctly assembled and sealed so that no air will bypass the filters; • the terminal filters are correctly sealed in their housings; • the terminal filters are of the same grade, of uniform quality and undamaged.
2. Air velocity measurements to ensure that: • a sufficient quantity of air is being delivered by the terminal; • the terminal quadrants are in balance; • the air flow has sufficient velocity to reach the working plane.
3. An entrainment test to ensure that contaminants arising outside of the UCV terminal footprint are not drawn into it.
4. Visualisation techniques to gain an understanding of the overall system performance.
5. Noise measurement to ensure that working conditions are satisfactory.
6. Control system checks to ensure that the system operates as specified.
7. Biological monitoring to determine how effective the system is in use.

Test and measuring conditions

8.75 While validating the UCV terminal, the conditions in the operating room should be stable and within the given ranges:

- temperature: 19–23°C dry bulb;
- humidity: 30–65% relative humidity.

Test and measuring equipment

8.76 Any test or measuring equipment used should have a certificate to prove that it has been validated within the previous 12 months at a calibration facility using traceable national standards.

8.77 In the case of a noise meter, its "matched sound source" should have a certificate to prove that it has been validated within the previous 12 months at a calibration facility using traceable national standards. The noise meter should be calibrated to the sound source on each occasion that it is used.

Test grid – vertical units

8.78 A test grid should be constructed on the floor within the ultra-clean terminal footprint as projected by the inside dimensions of the side walls or boundary air curtain. A suitably marked test sheet will provide a consistent standard of test grid.

8.79 The test grid should comprise test squares of 280 mm each side.

8.80 The test grid should be aligned along the centre lines of the terminal footprint with its centre under the centre point of the terminal.

8.81 Any test square with 80% or more of its area within the UCV footprint should be used as a test position.

8.82 An inner zone should be designated that is not less than 36% of the total footprint. It should be made up of a number of test squares distributed symmetrically about the terminal footprint's centre-line. Regardless of the shape of the terminal footprint, the inner zone should comprise a minimum grid of 6 × 6 test squares.

8.83 Unless specified otherwise, a test position should be in the geometric centre of a test square.

8.84 Test position 1 should be the leftmost test square in the row nearest to the operating room wall that houses the surgeon's panel.

8.85 Figure 8 shows a grid for a 2.8 m × 2.8 m terminal.

Test grid – horizontal units

8.86 A line of test positions should be marked on the floor 1 m in front of the face of the UCV terminal.

8.87 A test position should be marked in the centre of the line. Additional test positions should be marked at 280 mm intervals along the line either side of the centre position, up to the full face width of the unit.

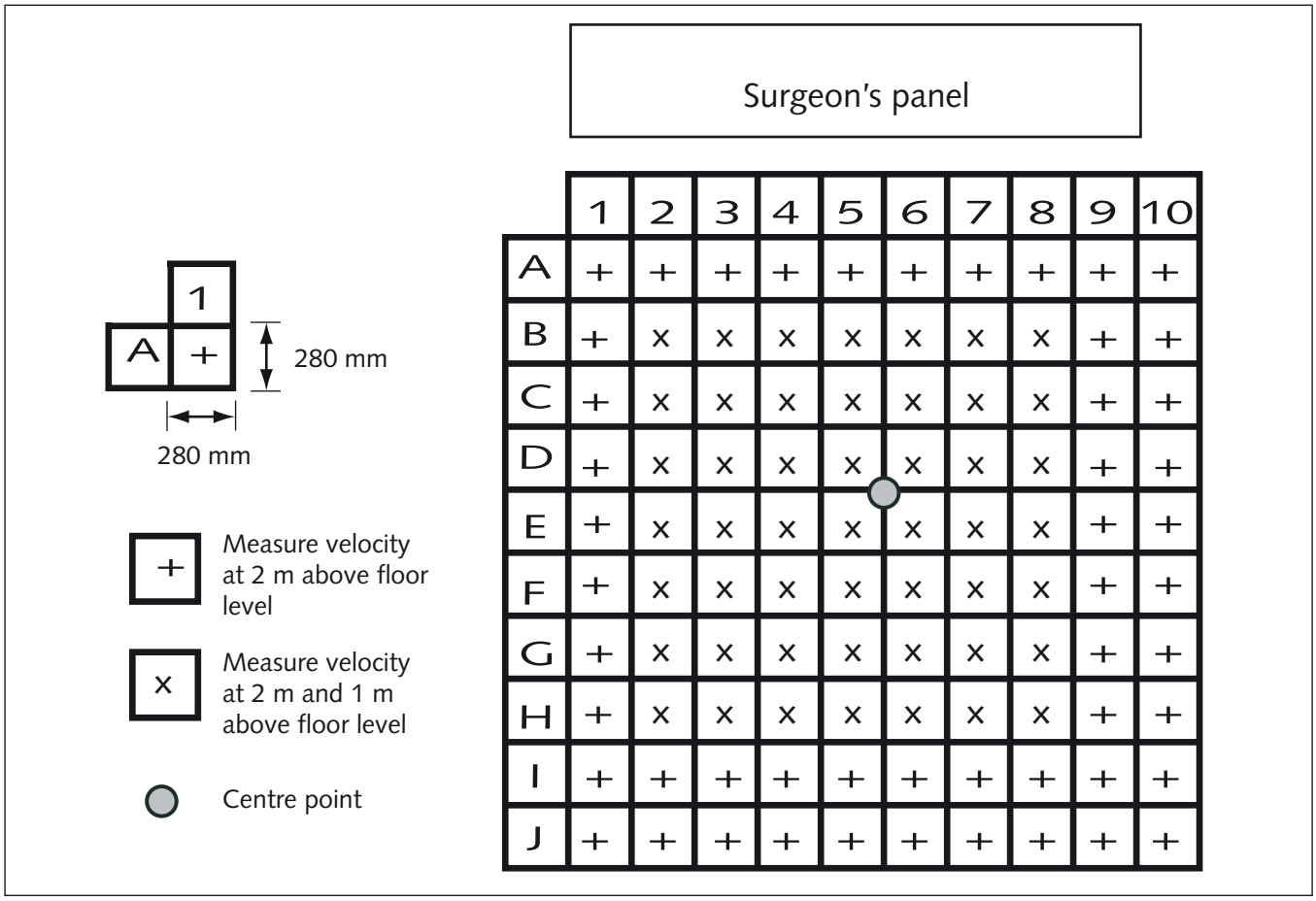
UCV terminal challenge tests (vertical and horizontal systems)

8.88 The diffuser screen fitted below the face of the terminal HEPA filters should be lowered or removed while the challenge tests are being carried out.

8.89 The installed HEPA filters should be checked to ensure that their grades accord with the design specification and that their performance has been certified by the manufacturer.

8.90 The challenge tests may be carried out using either of the following techniques:

Figure 8 Example of a test grid for a 2.8 m x 2.8 m UCV terminal



- use DOP to provide the challenge and a photometer to detect leaks;
- use a DPC to detect leaks. (In order to obtain a sufficient challenge, it may be necessary to temporarily remove the supply AHU's secondary filters.)

8.91 In both cases, the upstream challenge should be measured. A measurement of particle penetration through a representative section of the HEPA-filter media is then taken and used as the reference background level. These two readings enable the range of the detecting instrument to be set.

8.92 For the DOP test, this should be set as the reference level, and a leak will be declared significant if penetration greater than 0.01% of the range is detected (see paragraph 8.56 for details).

8.93 For the DPC method, the filter face is scanned to establish the smallest non-penetrating particle size. If significant particles at or above this size are detected when subsequent scans are made, there is deemed to be a leak at or near the test position (see paragraph 8.57 for details).

UCV terminal unit clean zone leak test

8.94 This test will confirm that there is no unfiltered air bypassing the HEPA filter.

8.95 The joints and service penetration points under the UCV terminal within its side walls or boundary air curtain should be scanned to prove that there are no leaks.

8.96 A leak is defined as a significant rise above the background level.

Terminal HEPA filter seal leak test

8.97 This test will confirm that there is no unfiltered air bypassing the HEPA filter's seal.

8.98 Each HEPA filter's seal should be scanned to prove that there are no leaks.

8.99 A leak is defined as a significant rise above the background level.

Terminal HEPA filter media leak test

8.100 This test will confirm that the HEPA filters have not sustained damaged while being installed.

8.101 The face of each HEPA filter should be scanned to prove that there are no leaks.

8.102 A leak is defined as a significant rise above the background level.

Vertical UCV terminal air velocity tests

Test set-up

a. The terminal face diffuser screen should be in place for these tests.

b. Take spot readings to establish that the room is within the specified temperature and humidity test conditions.

c. Set out the test grid as described in paragraphs 8.78–8.85.

d. Swing the operating lamp arms and any other stem arms so that they align to present the least resistance to air flow, are perpendicular to the front edge of the test sheet, and face the back edge. Any lamp and equipment heads should as far as practicable be outside of the UCV terminal footprint.

Test instrument

8.103 The measuring instrument should be a hot-wire anemometer with a digital read-out. The instrument resolution should be at least 0.01 m/s, have a tolerance of ±0.015 m/s or 3% of the reading, and be calibrated down to 0.15 m/s or lower. An alternative instrument may be used, providing it is of no lesser specification.

Test method

8.104 The instrument should be mounted on a test stand and set to record a mean reading over a ten-second sample interval.

8.105 It is recommended that a printer be linked to the test instrument so that readings are recorded automatically. Alternatively they could be downloaded to a computer or data logger at the end of the test.

8.106 The test stand should be positioned at each test point in turn and the reading taken when the instrument has stabilised.

8.107 When taking a reading, the test person should not stand within the same quadrant as the test instrument.

8.108 Readings are to be taken at the test positions – with the instrument probe facing the wall that houses the surgeon's panel – commencing at the first test position. Readings are taken either working along the row from left to right and back, or for all test positions in one quadrant at a time.

8.109 When all the test positions under one half of the terminal have been covered, readings of temperature and humidity are taken at the specified height in the centre of the terminal. The read-outs on the surgeon's panel should be recorded at the same time.

8.110 Having completed one half of the test grid, the operating lamp arms and any other stem arms should be swung round through 180 degrees and the test stand reversed so that the wall that houses the surgeon's panel is behind the test person. Readings are recommenced starting at the right of the test row and working from right to left or a quadrant at a time, as above.

UCV high level discharge velocity test

8.111 Measurements of air velocity are to be taken at every test position 2 m above floor level, and the results averaged.

8.112 The average of the total readings taken is to be not less than:

- 0.38 m/s for a partial-wall system;
- 0.30 m/s for a full-wall system.

8.113 The average air velocity for each quadrant should not exceed ±6% of the measured average velocity for the terminal.

UCV low level air velocity test

8.114 Measurements of air velocity are to be taken at each of the inner zone test positions 1 m above floor level.

8.115 The measured velocity at every test position in the inner (operating) zone should be not less than 0.2 m/s.

Horizontal UCV terminal air velocity test

Test set-up

a. Set out the line of test positions as described previously.

b. Swing the operating lamp arms and any other stem arms so that they align to present the least

resistance to air flow and are perpendicular to the line of test positions.

Test instrument

8.116 See paragraph 8.103.

Test method

8.117 The instrument should be mounted on a test stand and set to record a mean reading over a ten-second sample interval.

8.118 It is recommended that a printer be linked to the test instrument so that readings are recorded automatically. Alternatively, they could be downloaded to a computer or data logger at the end of the test.

8.119 The test stand should be positioned on each test point in turn and the reading taken when the instrument has stabilised.

8.120 When taking readings, the test person should stand well downstream of the instrument.

8.121 Readings are to be taken at the test positions – with the instrument probe facing the UCV terminal – commencing at the first test position on the left and working along the row from left to right at the specified height.

8.122 The instrument should be reset to the next specified height and the test repeated, and so on.

8.123 Readings of temperature and humidity should be taken at the specified height in the centre of the terminal. The read-outs on the surgeon's panel should be recorded at the same time.

UCV discharge velocity test

8.124 Measurements of air velocity are to be taken at all test positions at 1 m, 1.5 m and 2 m above floor level.

8.125 The average of the total readings taken should be no less than 0.4 m/s.

UCV entrainment test (vertical systems only)

Rationale for the entrainment test

8.126 The performance of UCV systems may be compromised by room air being drawn into the ultra-clean air flow, a phenomenon known as "entrainment". Significant levels of entrainment could lead to microbial contamination of items left exposed on instrument trolleys laid out beneath the canopy.

8.127 UCV systems having permanently fitted full side walls do not need to be tested, as the side walls physically prevent entrainment.

Principle of the test

8.128 A source of particles is produced outside of the UCV terminal and is used to challenge the system. A detector is placed within the ultra-clean air flow and used to determine the percentage penetration of the test particles at predefined locations under the UCV terminal footprint. The source and detector are moved in tandem around the UCV canopy and pairs of readings taken, from which the percentage penetration at specified locations is calculated. The degree of penetration should be below specified maximum limits if entrainment is to be declared not significant.

8.129 The entrainment test may be carried out using either of the following techniques:

- use DOPs to provide the challenge source at the specified release position and a photometer to measure the entrainment; or
- duct non-HEPA-filtered air to the specified release position and use a DPC to measure the entrainment.

Test set-up

a. The terminal face diffuser screen should be in place for these tests.

b. The test should be performed without any equipment in place beneath or closely adjacent to the UCV terminal.

c. Theatre lights should be moved to a central position beneath the terminal and raised to 2 m above floor level so as not to interfere with the peripheral air flows.

d. Take spot readings at the centre of the canopy, 1 m from floor level, to establish that the room is within the specified temperature and humidity test conditions.

e. Set out the test grid as described previously.

f. For either of the entrainment tests mentioned in paragraphs 8.131–8.132, a measurement of particle penetration through a representative section of the HEPA-filter media is to be taken and used as the reference background level.

Test equipment

a. Challenge source, measuring instrument and detector head

8.130 The challenge and detector equipment should be chosen so that:

- the tracer particles are mainly within the size range 0.3–5 µm and thus capable of remaining airborne for a substantial time;
- the particles used should not be able to penetrate the terminal filters in sufficient numbers to cause a background count that is more than 0.1% of the challenge count;
- the choice of particle and detector will enable a minimum of a three-logarithm (1000-fold) range of counts to be recorded between the highest (that is, source) and lowest (that is, background) readings expected. (A concentration of approximately 10^5 particles per cubic metre of source air has been shown to be adequate.)

b. Challenge source – DOP

8.131 The DOP generator should be able to produce a cloud of test particles in the form of a visible smoke. The test smoke should be delivered via an aperture so that it flows vertically downward from the lowermost edge of the partial wall, on the outside of the UCV canopy.

Note

To prevent undue contamination of the theatre and filters with deposits of oil, DOP should only be released for the minimum amount of time necessary to complete the test.

c. Challenge source – natural particles

8.132 The source unit should be a fan/blower or other method that takes non-HEPA-filtered air and expels it via a delivery head at the specified release position to provide the particle challenge. The challenge air should be delivered vertically downwards from the lowermost edge of the partial wall, on the outside of the UCV canopy, parallel to the air flow coming from the diffusers. The challenge air velocity should be the same as the measured average velocity at 2 m for the terminal under test.

Note

The use of DOP for testing is gradually being phased out and replaced by a natural challenge measured with a DPC. At the time of writing research is under way to more precisely define a challenge source unit for natural particles. It is anticipated that such a unit, together with a matching test methodology, will become available during the life of this Health Technical Memorandum.

The detector

8.133 This may be a photometer or a DPC. It is recommended that a printer be linked to the test instrument so that readings are recorded automatically. The instrument should be capable of sampling a minimum of 28.3 L of air (1 ft^3) per minute and, in the case of the DPC, provide readings for particle size ranges from 0.3 µm to 5 µm and greater. The instrument should be compliant with the requirements of BS EN ISO 14644-1. An alternative instrument may be used providing it is of no lesser specification.

Test positions and orientation of source and detector

8.134 The test positions should be at the centre of each test square, as defined for the velocity test.

8.135 For rectangular UCV terminals, measurements of penetration are to be taken at the four corner test squares of the test grid and at intermediate positions along the line of test squares between the corners. The number of intermediate test positions should be as equally spaced as possible around the periphery, with no fewer than three and no more than five complete test squares between test positions.

8.136 A further series of measurements are to be obtained around the periphery of the inner zone. Measurements of penetration are to be taken at the four corner test squares of the inner zone of the test grid and, if necessary, at intermediate positions along the line of test squares between the corners as equally spaced as possible, with no fewer than three and no more than five complete test squares between test positions.

8.137 A single measurement should be taken at the geometric centre of the UCV terminal footprint. The centre measurement should be taken with the

detector head mounted vertically upwards, 1 m above floor level.

8.138 The centre of the challenge particle source should be aligned with the centre of the designated test square, with its longer edge against the outer edge of the partial wall and delivering the challenge from the lower edge of the partial wall. The air containing challenge particles is directed vertically downwards from the lower edge of the partial wall, in a plane parallel to the partial wall. Where there is physical interference due to obstructions such as gas pendants, the source should be moved to the next available non-obstructed test-square location nearest to the stipulated sampling position. The detector should then also be moved to remain opposite the source.

8.139 In the case of non-rectangular terminals, an interpretation of the above strategy should be adopted that will yield a no less searching examination of the unit's ability to control entrainment.

Test method

8.140 The sampling head of the detector instrument is mounted on a test stand with its sampling orifice facing outwards horizontally from the centre of the UCV canopy, 1 m above floor level. The sampling head should be orientated at right-angles to the partial wall when sampling along the sides of the test grid, but should be set to bisect the angle when measuring at the corner test positions.

8.141 The test will commence at the first test position, this being designated the leftmost corner of the test grid when facing the wall housing the surgeon's panel. The penetration should also be measured at the corresponding test point on the inner zone commencing at the corner nearest to the first test position. When these tests have been completed, the source and detector equipment should be moved to the next test positions, working around the test grid in a clockwise direction.

8.142 The test stand should be positioned on each test point in turn and a pair of readings (challenge, then penetration) taken when the instrument has stabilised. The detector should be set to take a reading over a 15-second sample interval.

8.143 When taking a reading, the test person should stand within the UCV terminal footprint but not in the same quadrant as the detector head.

Analysis and interpretation

8.144 The following standard is to be achieved:

- at each test position in the outer zone, penetration is to be no greater than 10% of the challenge;
- at each test position in the inner zone, penetration is to be no greater than 1% of the challenge;
- at the centre test position, penetration is to be no greater than 0.1% of the challenge.

8.145 If a result is close to, or above, the given limits, a further reading must be obtained using a longer time base (one minute), and the penetration must not exceed the given limit.

Note

The entrainment test is based on the research of Whyte et al (1974) and Whyte et al (1983).

UCV visualisation

8.146 The use of smoke to gain an understanding of the overall performance of the system may prove useful at this stage in the validation process but cannot be relied on to produce a contractually definitive measure of performance.

UCV noise level

8.147 An industrial-grade Type 2 sound-level meter fitted with a muff should be used to check the noise level. The instrument should be calibrated using a matched sound source prior to each set of readings.

Vertical systems

8.148 The noise level readings should be taken at typical normal listening positions 1.5 m above floor level and at least 1 m from any surface and not on any line of symmetry. Measurements should be taken approximately under the centre of each quadrant of the UCV terminal and the four readings averaged.

Horizontal systems

8.149 The noise-level readings are to be taken at typical normal listening position 1.5 m above floor level on the test line. The width of the unit should be divided in two and a measurement taken in the

centre of each half but avoiding any line of symmetry. The two readings should be averaged.

8.150 Measurements should also be taken in each room of the suite.

8.151 In the event of a contractual deficiency, a Type 1 precision-grade sound-level meter should be used in accordance with Health Technical Memorandum 08-01.

8.152 For vertical or horizontal systems, the noise level should not exceed:

- 50 NR [55 dB(A)] – for UCV operating rooms and spaces without doors that open directly onto it (for example the scrub);
- 40 NR [45 dB(A)] – for all other peripheral rooms of the suite.

UCV control system checks

Temperature

8.153 The readings of temperature taken under or in front of the UCV unit should be within ±1 K of each other and the read-out on the surgeon's panel.

Humidity

8.154 The readings of humidity taken under or in front of the UCV unit should be within ±5% of each other and the read-out on the surgeon's panel.

Direct-reading differential-pressure gauges

8.155 The accuracy of the indicated reading of these gauges should be checked by measuring the actual differential pressure across the terminal filter(s).

Control functions

8.156 The operation of all control functions provided on the surgeon's panel should be proved for conformity with the design specification.

8.157 If an auxiliary panel has been fitted, its interlocking with the control functions of the main surgeon's panel must be proved to conform to the design specification.

Panel indicator lights

8.158 The panel indicator lights should illuminate as appropriate when the control functions are selected or warning levels are reached.

BMS interface

8.159 The operation, monitoring and alarm functions must be proved to conform to those set out in the design specification.

UCV theatre microbiological tests

8.160 There is little value in performing microbiological sampling in a new theatre supplied with ultra-clean ventilation. The foregoing filter challenge tests, air velocity measurements and entrainment test should have proved that the system operates satisfactorily and achieves the contracted level of performance. The HEPA filters will remove bacteria-sized particles from the air supplied through the UCV terminal. Therefore there will be an insignificant number of bacterial and/or fungal CFU present until the theatre is actually used.

8.161 Once the theatre has been taken into use, microbial sampling during a surgical procedure should help to confirm the satisfactory performance of the system and discipline of the users. Before commencing bacteriological testing, the room and its ventilation system should have achieved a steady state condition (see also paragraph 8.75).

8.162 The installation should be tested during surgical procedure at intervals between the time of first incision and final closure of the wound. On average, air sampled within 300 mm of the wound should not contain more than 10 CFU/m^3.

The Hospital Infection Society has issued guidance on the microbiological testing of UCV operating theatres (www.his.org.uk/_db/_documents/OTIC-final.pdf).

UCV validation report

8.163 Following validation, a full report detailing the findings should be produced. The report should conclude with a clear statement as to whether the UCV theatre suite achieved or did not achieve the standard set out above.

8.164 A copy of the report should be lodged with the following groups:

- operating department;
- infection control;
- estates and facilities.

Appendix 1 – Use and function of typical equipment used in ventilation systems

A1.1 Typical equipment used in ventilation systems is listed below together with a brief description of both function and use.

General

A1.2 The equipment built into the ventilation system and its ductwork should be of a type that will neither cause nor sustain combustion.

A1.3 No materials that could sustain biological activity should be used in the construction or assembly of the system.

Air intake

A1.4 An uncontaminated air supply to the system is essential. In order to achieve this, the air intake should be positioned so that air discharged from extract systems or other sources of dubious quality cannot be drawn in. Exhaust fumes from vehicles can present particular problems. The area surrounding the intake will need to be kept clean and free of vegetation and waste material in order to reduce the possibility of biohazards or fire. The intake itself should be protected by a louvre and mesh screen to prevent rainwater, vermin and leaves etc entering the system.

Damper

A1.5 Several types of damper may be fitted:

a. automatic dampers fitted immediately behind the air intake and extract louvres. They will automatically close when the system is shut down in order to prevent an uncontrolled circulation of air;

b. balance dampers are fitted into each branch of the air distribution ductwork system so that the design air-flow rate can be set during the commissioning process;

c. where ductwork passes through a fire compartment wall, ceiling or floor, a fire and/or smoke damper may be required;

d. plant-isolating dampers are fitted so that the main plant can be isolated from its air distribution duct system. They are manually operated, and enable cleaning and maintenance of the air-conditioning equipment to be carried out.

Ducting

A1.6 Ducting is the means by which air is conveyed from the intake to its point of use. It is usually constructed of galvanised steel and will normally be insulated to reduce noise and conserve energy. Ducts can also be formed in concrete, brickwork, stainless steel or plastic, and may be rigid or flexible.

Fan

A1.7 A fan is a series of rotating blades that move the air in the direction required. Fans are usually powered by electric motors either directly connected to them or driven through belts and pulleys. A fan may be arranged to either force air into or draw air from a ductwork system.

Attenuator/silencer

A1.8 An attenuator is a device that will contain and absorb the noise emitted by a fan. It may be required to reduce disturbance caused by noise breaking out through the air intake and also noise transmitted along the ductwork to the conditioned space.

Filter

A1.9 A filter consists of a labyrinth of fibrous material contained in a frame. It is designed to capture and hold particles being carried in the air stream. Because of the size range and number of particles that exist in air, no filter can remove them all. The purpose of filtration is to reduce their number and size range to an acceptable level. Filters of progressively higher grades are fitted through the ventilation system:

- primary filters (coarse) are designed to collect the larger particles and are intended to keep the air-handling plant clean;
- secondary filters (fine) remove the staining particles from air and keep the ventilated space visibly clean;
- high efficiency particulate air filters (HEPA/absolute) remove virtually all particles from air. These may be required in order to reduce contamination in the working area either biologically or in terms of particle count.

A1.10 Filters may be fitted to extract systems to protect energy-recovery devices. They are also fitted to remove biological, radiation or chemical hazards. They are often contained in a "safe change" facility in order to protect those carrying out maintenance.

A1.11 Activated carbon filters will reduce odours in extracted or recirculated air.

Heater coil/battery

A1.12 A heater coil/battery is a series of coils with or without fins through which steam or hot water is circulated. Heat is given up to the air passing over the battery, thus increasing its temperature. Heating is usually carried out in stages, the final battery being controlled by the end-user. Small batteries may be electric.

Humidifier

A1.13 A humidifier is a device for increasing the humidity of air by adding moisture. For ventilation in healthcare premises, this is normally achieved by releasing clean steam into an air-supply duct. The steam should be completely absorbed into the air, increasing its humidity. The level of humidity may be preset or controlled by the end-user.

Chiller battery/cooling coil

A1.14 A chiller battery/cooling coil is a series of finned coils mounted in the air-supply duct. Either chilled water or refrigerant is circulated through the coils, causing heat to be removed from the air. This will reduce its temperature and may also condense moisture out of the air. As free moisture in a duct can be a source of contamination, the coil will be fitted with an eliminator and drainage system.

Eliminator

A1.15 An eliminator is a device for catching and removing water droplets from an air stream. It may form part of a cooling coil or be a separate device.

Drainage system

A1.16 The drainage system is a means of removing water from ductwork and disposing of it safely. Typically it will consist of a tray mounted in the duct to catch moisture, a glass water-seal trap, continuously falling drainage pipework and an air break in the drain run to prevent waste water returning and contaminating the duct.

Access doors and observation ports

A1.17 Access doors and observation ports are doors and removable panels that provide access for routine maintenance and cleaning. The doors should be fitted with glazed ports, and suitable lighting should be provided so that the condition and correct operation of devices such as cooling coils, humidifiers and filters can be easily observed without needing to switch off the plant.

Energy recovery

A1.18 Modern plants are fitted with the means to recover energy from the extract air without causing contamination of the incoming supply air. These devices will be fitted with a drainage system and may incorporate an eliminator. Several types of energy-recovery system are available.

A1.19 Precise definitions of ventilation and air conditioning terms are given in CIBSE Guide B.

Typical plant

A1.20 The layout of a typical plant that conforms to the requirements for healthcare applications is shown in Figure 1 in Chapter 1 of this document. It contains most of the equipment described above.

Appendix 2 – Recommended air-change rates

Application	Ventilation	AC/hr	Pressure (Pascals)	Supply filter	Noise (NR)	Temp (°C)	Comments (for further information see Chapter 6)
General ward	S/N	6	–	G4	30	**18–28**	
Communal ward toilet	E	6	–ve	–	40	–	
Single room	S/E/N	6	0 or –ve	G4	30	**18–28**	
Single room WC	E	3	–ve	–	40	–	
Clean utility	S	6	+ve	G4	40	**18–28**	
Dirty utility	E	6	–ve	–	40	–	
Ward isolation room	–	–	–	–	–	–	See Health Building Note 04-01 (Supplement 1)
Infectious diseases isolation room	E	10	–5	G4	30	**18–28**	Extract filtration may be required
Neutropeanic patient ward	S	10	+10	H12	30	**18–28**	
Critical care areas	S	10	+10	F7	30	*18–25*	Isolation room may be –ve pressure
Birthing room	S & E	15	–ve	G4	40	*18–25*	Provide clean air-flow path
SCBU	S	6	+ve	F7	30	*18–25*	Isolation room may be –ve pressure
Preparation room (lay-up)	S	>25	35	F7	40	*18–25*	
Preparation room/bay (sterile pack store)	S	10	25	F7	40*	*18–25*	*50 NR if a bay in a UCV theatre
Operating theatre	S	25	25	F7	40	*18–25*	
UCV operating theatre	S	25*	25	H10 or greater	50	*18–25*	*Fresh-air rate; excludes recirculation
Anaesthetic room	S & E	15	>10	F7	40	*18–25*	Provide clean air-flow path
Theatre sluice/dirty utility	E	>20	–5	–	40	–	
Recovery room	S & E	15	0	F7	35	*18–25*	Provide clean air-flow path
Catheterisation room	S	15	+ve	F7	40	*18–22*	
Endoscopy room	S	15	+ve	F7	40	*18–25*	
Endoscopy cleaning	E	>10	–ve	–	40	–	
Day-case theatre	S	15	+ve	F7	40	*18–25*	
Treatment room	S	10	+ve	F7	35	*18–25*	
Pharmacy aseptic suite	S	20	#	H14	–	*18–22*	# See EGGMP (Orange guide) [a]
Category 3 or 4 containment room	#	>20	#	H14*	–	*18–22*	# See ACDP guide; *Filter in extract
Post-mortem room	S & E	S = 10 E = 12	–ve	G4	35	**18–22**	Provide clean air-flow path
Specimen store	E	–	–ve	–	–	–	Fan accessible from outside of store

Notes: **18–22**°C indicates the range over which the temperature may float.
18–22°C indicates the range over which the temperature should be capable of being controlled.
S = suppy
E = extract
N = natural ventilation
a – European guidelines on good manufacturing practice published by the Medicines and Healthcare products Regulatory Agency (MHRA)

Appendix 3 – Hierarchy of cleanliness

			Air-flow rate for bacterial contaminant dilution	
Class	**Room**	**Nominal pressure (Pa)[a]**	**Flow in or supply (m^3/s)**	**Flow out or extract (m^3/s)**
Sterile	Preparation room		See standard schemes in Appendix 7 for recommended design values	
	(a) lay-up	35		
	(b) sterile pack store	25		
	Operating room	25		
	Scrub bay[b]	25		
Clean	Sterile pack bulk store	+ve	6 AC/h	–
	Anaesthetic room[c]	14[c]	The greater of 15 AC/hr or 0.15	The greater of 15 AC/hr or 0.15
	Scrub room	14	–	0.10
Transitional	Recovery room	3	15 AC/hr[d]	15 AC/hr[d]
	Clean corridor	0	(See note e)	7 AC/hr
	General access corridor	0	(See note e)	7 AC/hr
	Changing rooms	3	7 AC/hr	7 AC/hr
	Plaster room	3	7 AC/hr	7 AC/hr
Dirty	Service corridor	0	–	(See note f)
	Disposal room	–5 or 0	–	0.41 or 0.10

Notes:

a. Nominal room pressures are given to facilitate setting up of pressure-relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not critical, provided the desired air-flow rates and movement are achieved.

b. An open or semi-open bay is considered to be part of the operating room; provided air movement is satisfactory, no specific extract is required. However, if the layout means that air movement is poor, a local extract may be required to control local condensation on the building surfaces, which can result in mould growth.

c. For design purposes, anaesthetic should be assumed to be at 14 Pa. When commissioning, 10 Pa is considered suitable.

d. 15 AC/hr is considered necessary for the control of anaesthetic gas pollution.

e. Supply air-flow rate necessary to make up 7 AC/hr after taking into account secondary air from cleaner areas.

f. No dilution requirement. Temperature control requirements only.

Appendix 4 – Leakage flows in m^3/s through closed door gaps

Type	Pressure difference (Pa)						
	5	10	15	20	25	30	40
Single door	0.03	0.05	0.06	0.06	0.07	0.07	0.08
Double door	0.04	0.08	0.10	0.11	0.12	0.13	0.14
High permanent length of 3 mm gap	0.004	0.008	0.010	0.011	0.012	0.012	0.013

Designers' notes:

The door gaps assumed are 4 mm along the bottom, 3 mm at the top and sides, and 2 mm between double leaves.

If doors are fitted with cold smoke seals, these will significantly reduce the door leakage rate when new and undamaged. It is therefore recommended that provision for the design leakage be factored into the size of the appropriate transfer grille or pressure stabiliser. Failure to do this will result in air-gap whistles and doors being held partially open by air pressure.

Factory-assembled door-sets with a steel frame and pre-hung leaves are becoming common. There is effectively no leakage across these doors when closed. Therefore, when this type of door assembly is fitted, the door leakage can be ignored and the design air flow into the room reduced accordingly. The design air flow would then become that required either (i) for open door protection (Appendix 5), or (ii) to achieve the specified air-change rate – whichever is the greater.

Appendix 5 – Recommended air-flow rates in m^3/s through a doorway between rooms of different cleanliness to control cross-contamination

Room class		Dirty	Transitional	Clean	Sterile
Sterile	Hatch	0.3	0.24	0.18	
	Single door	0.47	0.39	0.28	0 or 0.28[a]
	Double door	0.95	0.75	0.57	0 or 0.57[a]
Clean	Single door	0.39	0.28	0 or 0.28[a]	
	Double door	0.75	0.57	0 or 0.57[a]	
Transitional	Single door	0.28	0 or 0.28[a]		
	Double door	0.57	0 or 0.57[a]		
Dirty	Single door	0	Open single door = 0.80 m × 2.01 m high		
	Double door	0	Open double door = 1.80 m × 2.01 m high		

Designers' notes:

The degree of protection required at an open doorway between rooms is dependent on the degree of difference in cleanliness between them.

Flow rate required between rooms within the same class tends to zero as class reduces.

a. If two rooms are of equal cleanliness, no flow is required (in practice there will be an interchange in either direction) and the design of the air movement will assume zero air flow. In certain cases, however, interchange is not permitted, and a protection air flow of 0.28 is assumed in the design – for example in the case of a preparation room used as a "lay up"

Appendix 6 – Typical approximate pressures in an operating suite when a given door is open

		Typical approximate effect on other rooms	
Door open between	**Typical approximate resultant pressure in these rooms (Pa)**	**Room**	**Pressure (Pa)**
Operating room and corridor or Scrub bay and corridor	0	Anaesthetic Preparation – lay-up Disposal Preparation – sterile pack store	0 12 –6 5
Operating room and anaesthetic room (or other series room with double doors)	17	Preparation – lay-up Disposal Preparation – sterile pack store	26 –9 22
Operating room and disposal room or Operating room and preparation room	25	No change	
Anaesthetic room and corridor (or other series room with double doors)	0	Preparation – lay-up Disposal Operating room Preparation – sterile pack store	30 –6 20 25
Preparation room and corridor or Disposal room and corridor	0	No change	
Disposal room and outer corridor	0	No change	

Notes:

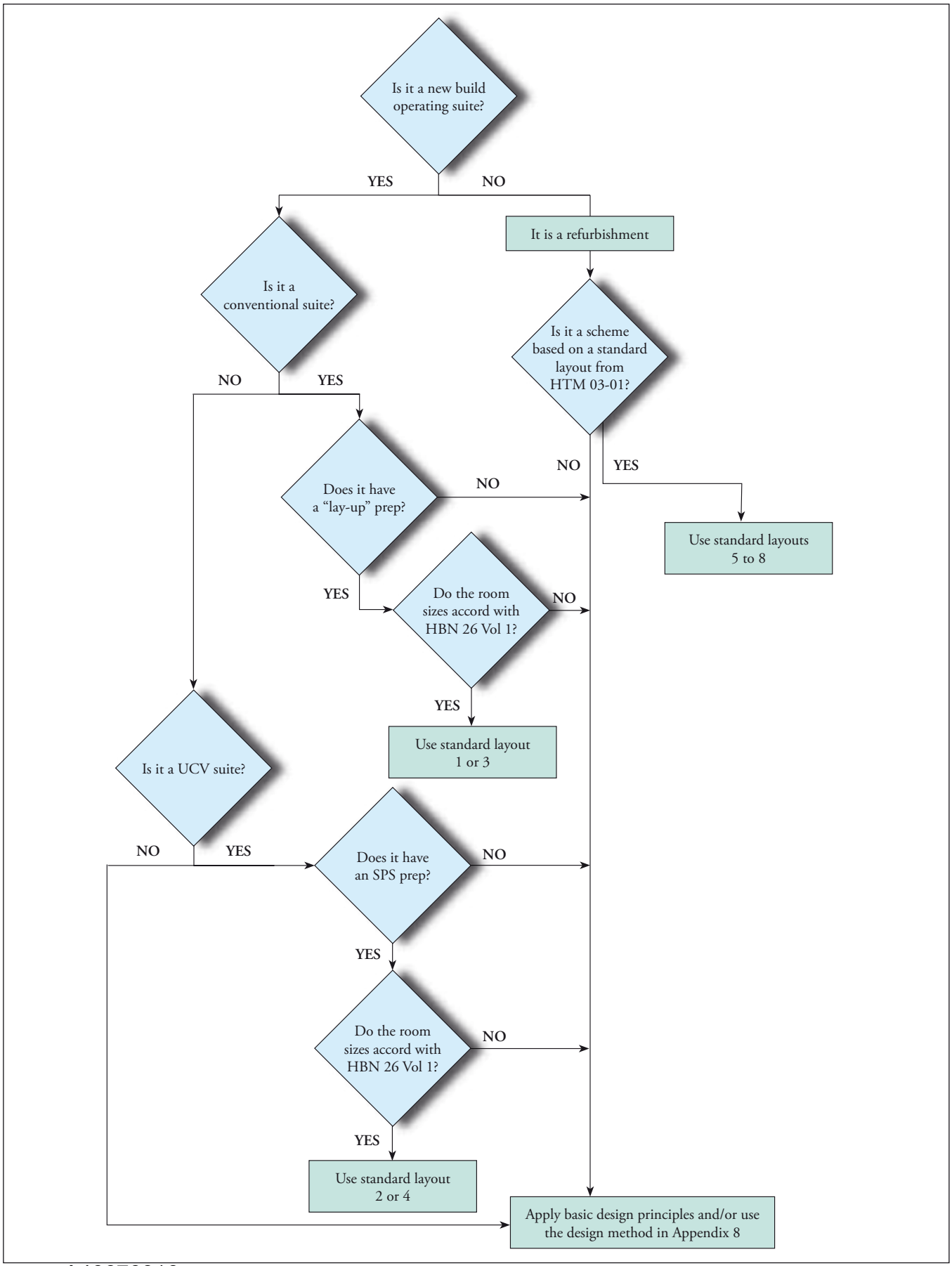
The room differential pressure protects against reverse flows when the door is closed.

The flow of air through a doorway protects against reverse air flow when the door is open.

Pressure stabilisers control flow and ensure a known air-flow path between rooms when doors are closed, and also reduce back-flow between rooms when doors to other rooms are open

Appendix 7 – Operating suite standard design solutions

Operating suite design logic



Standard layout 1 – Suitable for a typical conventional theatre suite

Room	Size (m^3)‡	Air-change rate (AC/hr)	Nominal pressure (Pa)	Flow rate (m^3/s)
Theatre	165	25	25	1.15
Anaesthetic	57	15	>10	0.24
Lay-up-prep	36	>25	35	0.28**
Scrub	*	–	25	–

Notes:

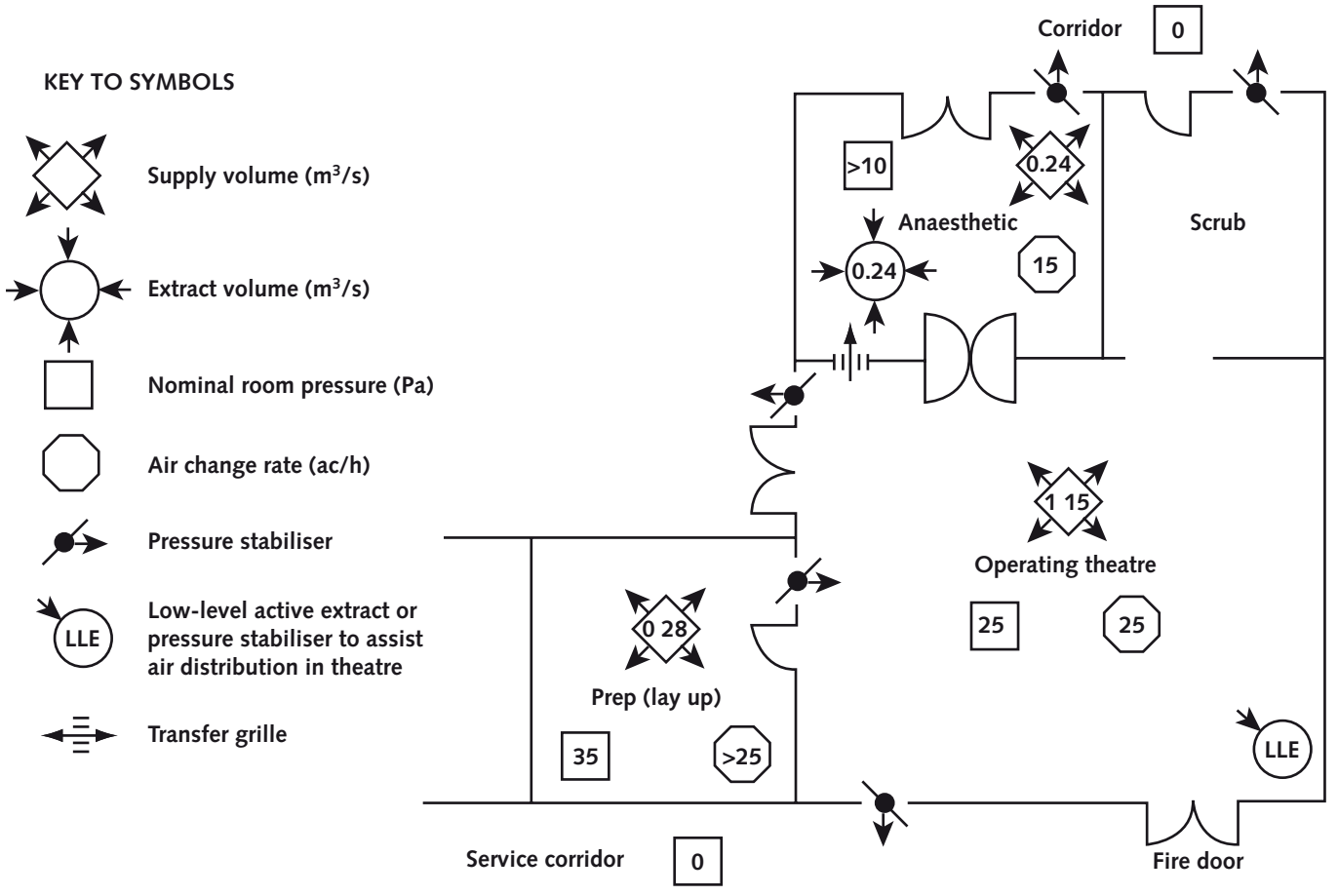
‡ Derived from Health Building Note 26.

* This is a separate scrub and is not considered as being part of the theatre volume.

** Interchange is not permitted between the theatre and lay-up prep; therefore, as in Appendix 5, an air-flow protection of 0.28 m^3/s is required as a minimum (but see also the "designers' notes" in Appendix 4).

The volume of air to be extracted from the theatre should be determined by subtracting the air flow required for door protection at the key door from the total air entering the space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre may be either passive and fitted with pressure stabilisers, or active and connected to the extract system. They should where possible be located at low level and positioned to promote the ventilation of all areas of the space



Standard layout 2 – suitable for a typical UCV theatre suite

Room	Size (m^3)‡	Air-change rate (AC/hr)	Nominal pressure (Pa)	Flow rate (m^3/s)
Theatre	165	25	25	1.15**
Anaesthetic	57	15	>10	0.24
Sterile pack store prep	36	10	25	0.10
Scrub	*	–	25	–

Notes:

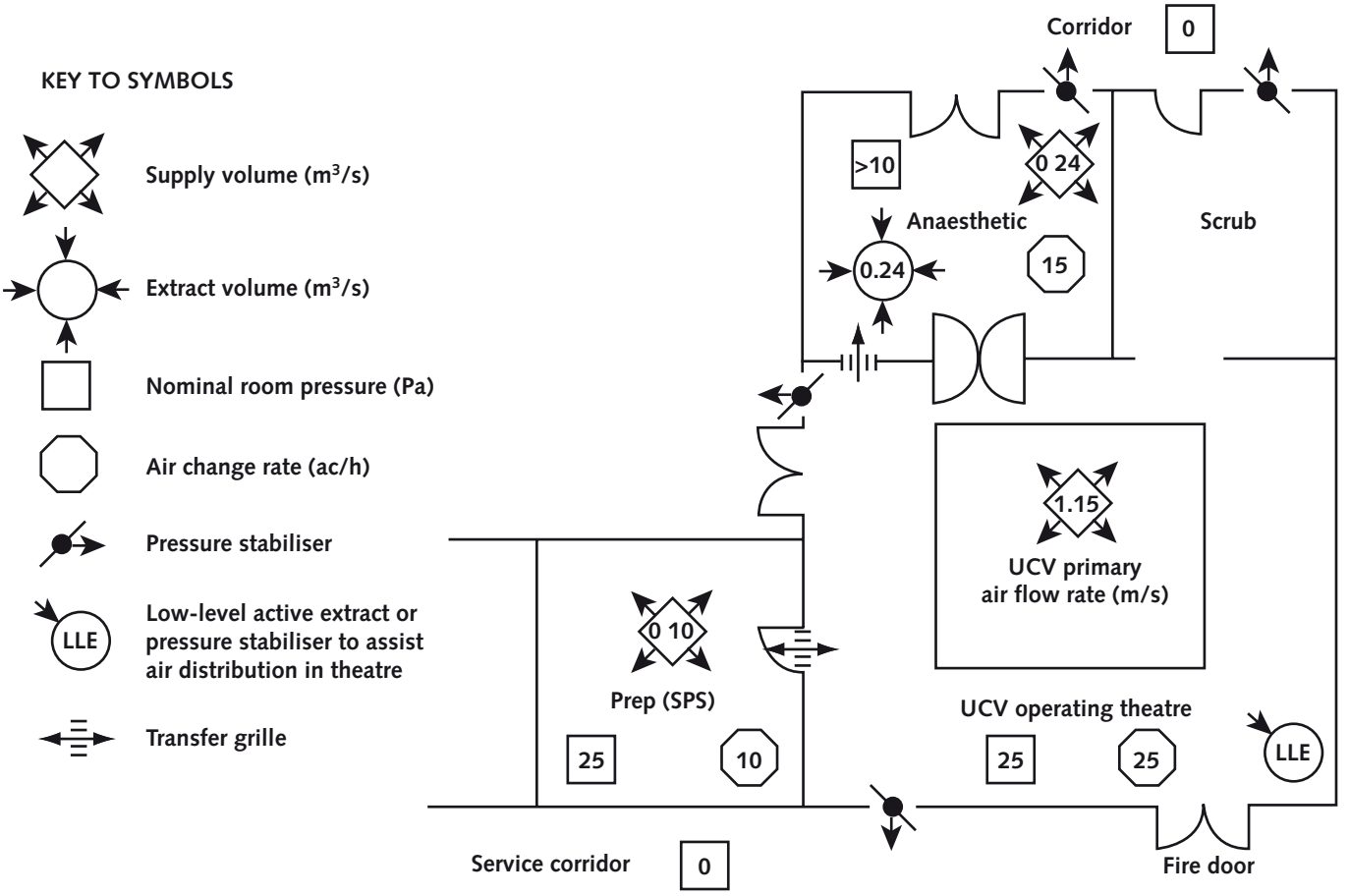
‡ Derived from Health Building Note 26

* This is a separate scrub and is not considered as being part of theatre volume.

** Primary fresh-air volume only.

The volume of air to be extracted from the theatre should be determined by subtracting the air flow required for door protection at the key door from the total air entering the space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre may be either passive and fitted with pressure stabilisers, or active and connected to the extract system. They should be located at low level and positioned to promote the ventilation of all areas of the space



Standard layout 3 – suitable for a typical conventional theatre suite

Room	Size (m^3)‡	Air-change rate (AC/hr)	Nominal pressure (Pa)	Flow rate (m^3/s)
Theatre	165	25	25	1.15
Anaesthetic	57	15	>10	0.24
Lay-up prep	36	>25	35	0.34**
Scrub	*	–	25	–
Dirty utility	36	–	–5	0.41

Notes:

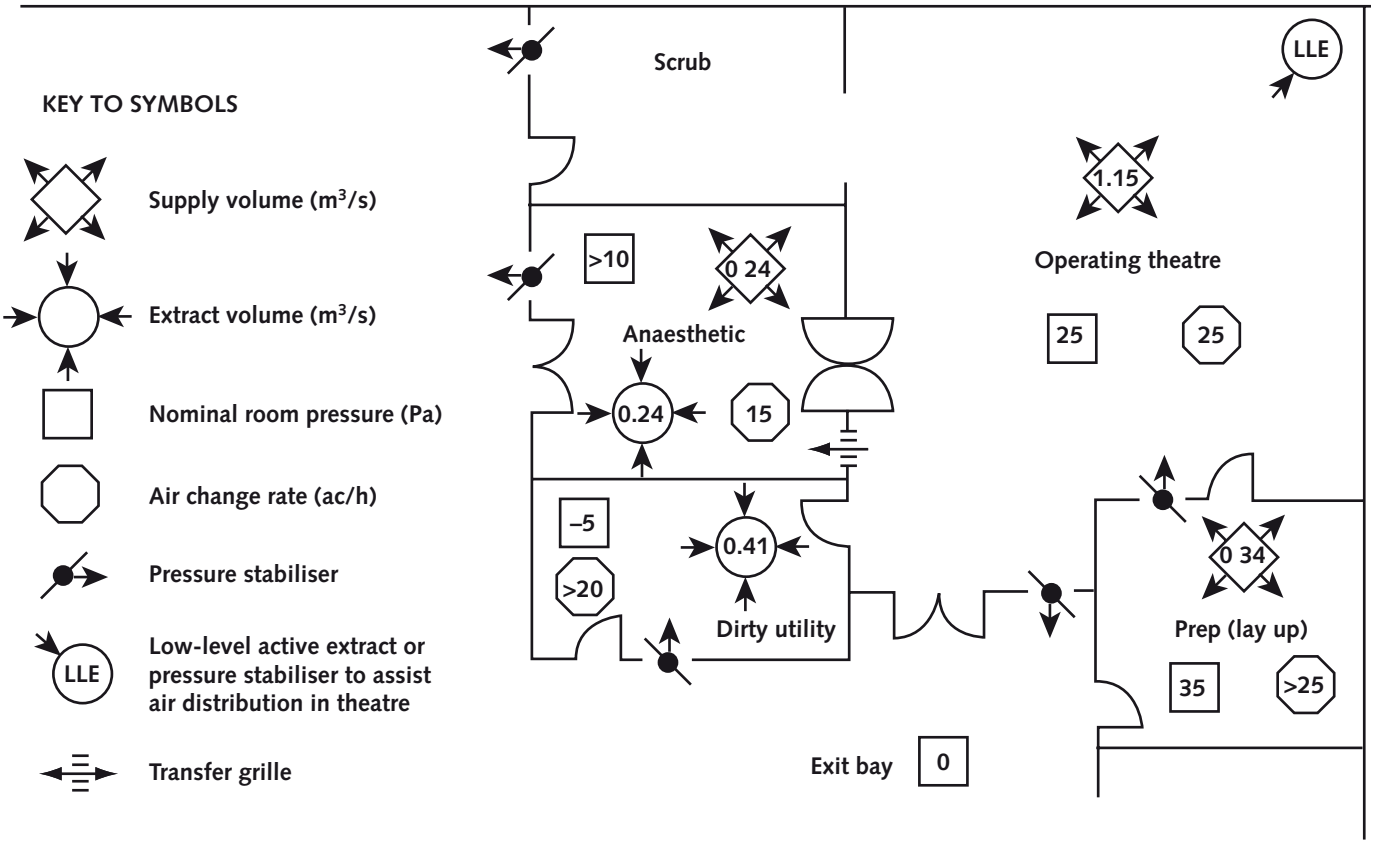
‡ Derived from Health Building Note 26

* This is a separate scrub and is not considered as being part of the theatre volume.

** Interchange is not permitted between the theatre and lay-up prep; therefore, as in Appendix 5, an air-flow protection of 0.28 + 0.06 closed-door air flow is required as a minimum (but see also the "designers' notes" in Appendix 4).

The volume of air to be extracted from the theatre should be determined by subtracting the air flow required for protection at the key door from the total air entering the space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre may be either passive and fitted with pressure stabilisers, or active and connected to the extract system. They should be located at low level and positioned to promote the ventilation of all areas of the space



Standard layout 4 – suitable for a typical UCV theatre suite

Room	Size (m^3)‡	Air-change rate (AC/hr)	Nominal pressure (Pa)	Flow rate (m^3/s)
Theatre	165	25	25	1.15**
Anaesthetic	57	15	>10	0.24
Sterile pack store prep	36	10	25	0.10
Scrub	*	–	25	–
Dirty utility	36	–	–5	0.41

Notes:

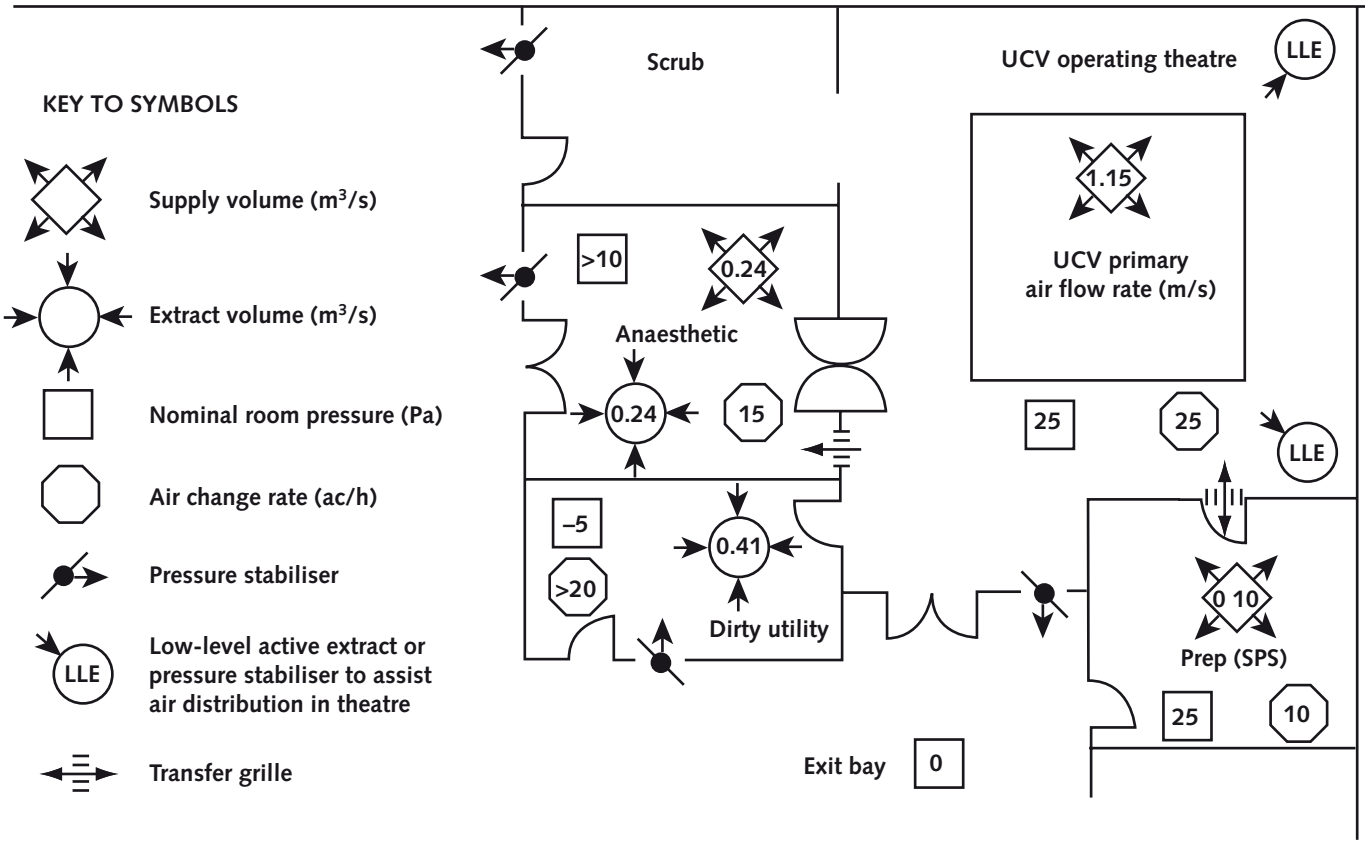
‡ Derived from Health Building Note 26

* This is a separate scrub and is not considered as being part of the theatre volume.

** Primary fresh-air volume only.

The volume of air to be extracted from the theatre should be determined by subtracting the air flow required for protection at the key door from the total air entering the theatre space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre may be either passive and fitted with pressure stabilisers, or active and connected to the extract system. They should be located at low level and positioned to promote the ventilation of all areas of the space



Standard layout 5 (Health Technical Memorandum 2025 existing standard plan "1b") – typical layout for a conventional theatre suite

Note

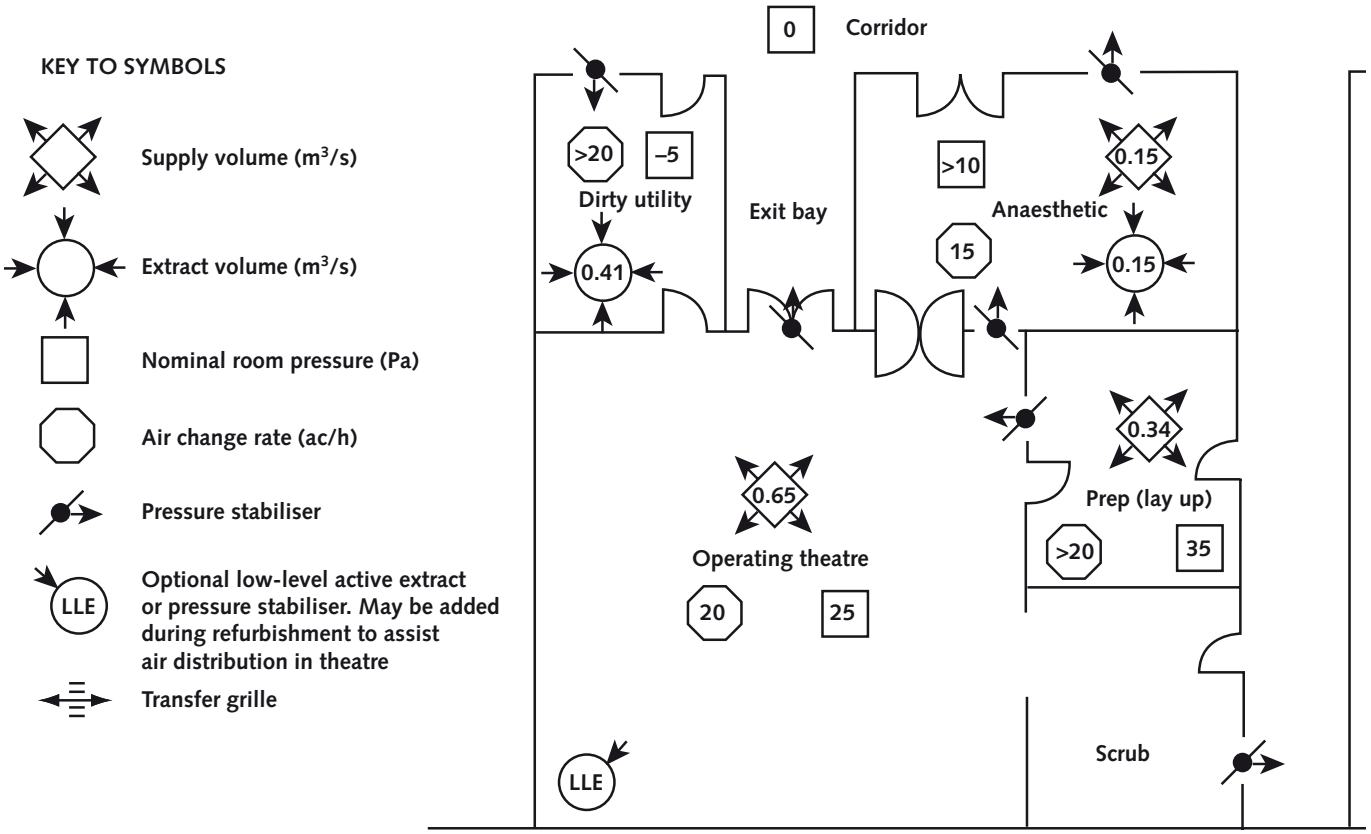
This layout and data is for historical purposes only. The information is to be used for the evaluation of existing systems, the fitting out of existing shell schemes or rebalancing following ventilation system cleaning.

Room	Size	Air-change rate (AC/hr)	Nominal pressure (Pa)	Flow rate (m^3/s)
Theatre	**Existing theatre suite to be measured on site**	20	25	0.65
Anaesthetic		15	>10	0.15
Lay-up prep		–	35	0.34*
Scrub		–	25	–
Disposal		–	–5	0.41

Notes:

* See the "designers' notes" in Appendices 4 and 5.

The disposal layout detailed will remain the same should a hatch be utilised instead of a door onto the outer corridor



Standard layout 6 (Health Technical Memorandum 2025 existing standard plan "1a") – typical layout for a UCV theatre suite

Note

This layout and data is for historical purposes only. The information is to be used for the evaluation of existing systems, the fitting out of existing shell schemes or rebalancing following ventilation system cleaning.

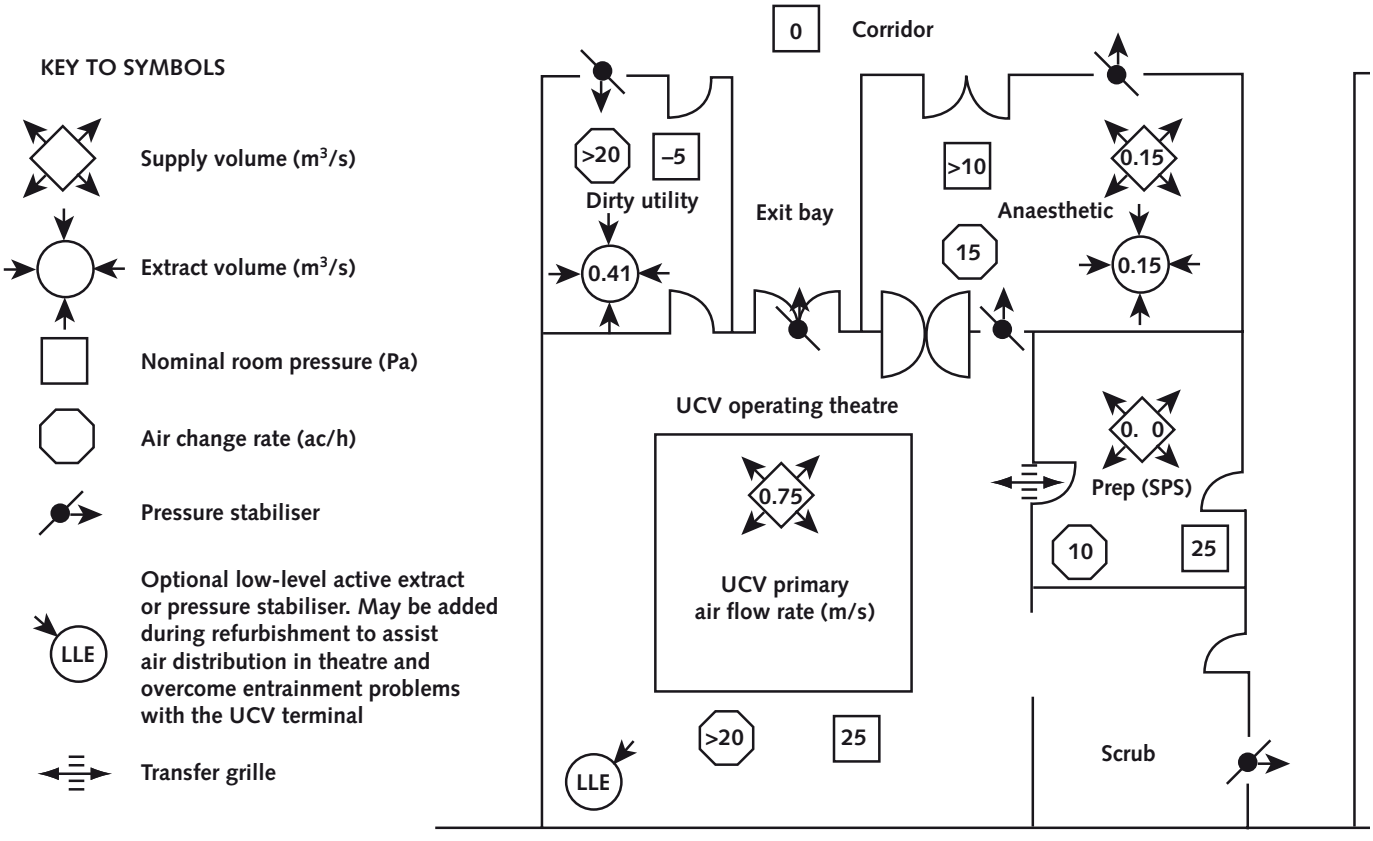
If difficulties are experienced with entrainment around the periphery of the UCV, adding a low-level active or passive extract in the location indicated will usually resolve the problem.

Room	Size	Air-change rate (AC/hr)	Nominal pressure (Pa)	Flow rate (m^3/s)
Theatre	**Existing theatre suite to be measured on site**	20	25	0.75*
Anaesthetic		15	>10	0.15
Sterile pack store prep		10	25	0.1
Scrub		–	25	–
Disposal		–	–5	0.41

Notes:

* Primary fresh-air-flow volume

The disposal layout detailed will remain the same should a hatch be utilised instead of a door onto the outer corridor



Standard layout 7 (Health Technical Memorandum 2025 existing standard plan "5b") – typical layout for a conventional theatre suite

Note

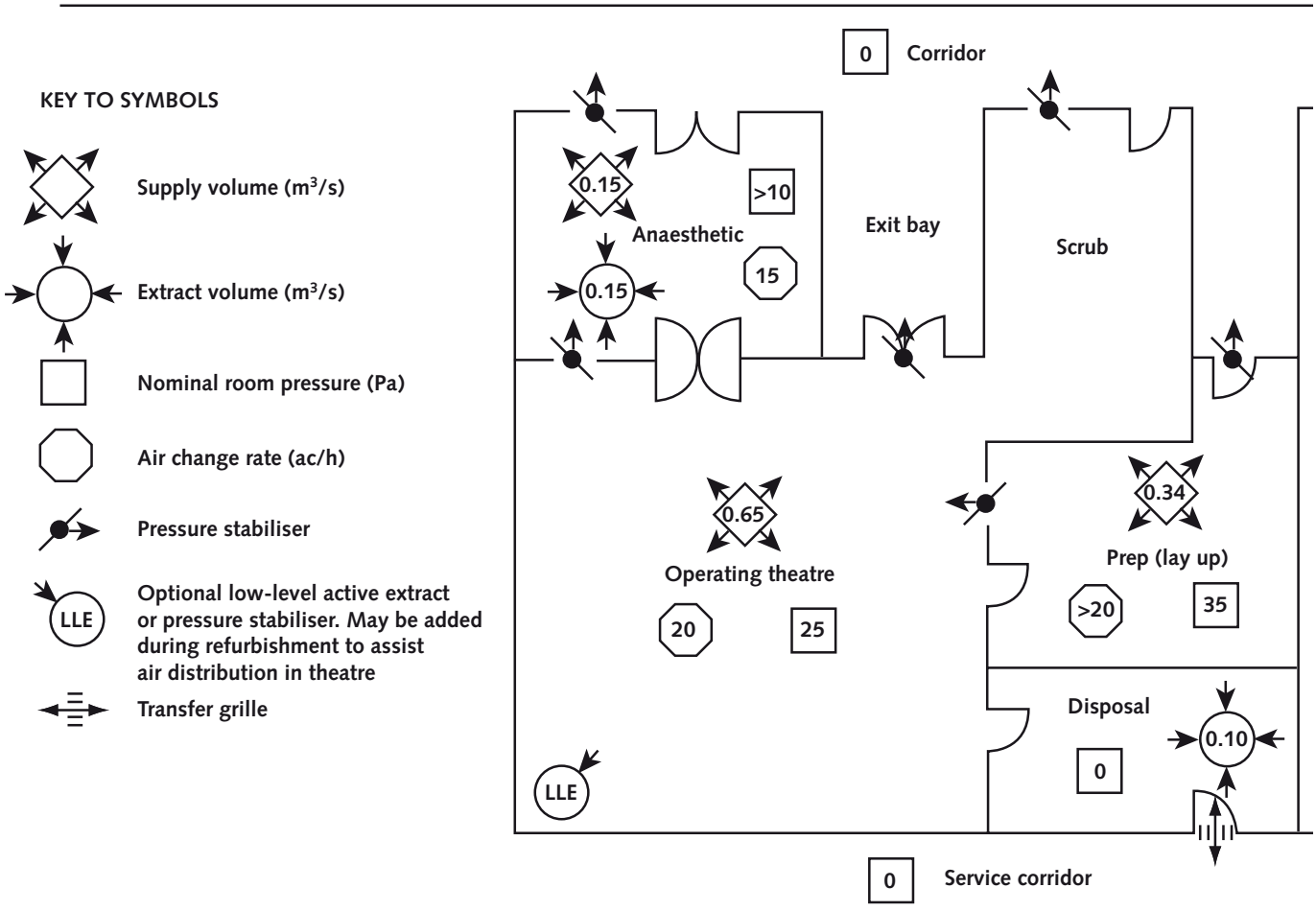
This layout and data is for historical purposes only. The information is to be used for the evaluation of existing systems, the fitting out of existing shell schemes or rebalancing following ventilation system cleaning.

Room	Size	Air-change rate (AC/hr)	Nominal pressure (Pa)	Flow rate (m^3/s)
Theatre	**Existing theatre suite to be measured on site**	20	25	0.65
Anaesthetic		15	>10	0.15
Lay-up prep		>20	35	0.34*
Scrub		–	25	–
Disposal		–	0	0.1

Notes:

* See the "designers' notes" in Appendices 4 and 5.

The disposal layout detailed will remain the same should a hatch be utilised instead of a door onto the outer corridor. Alternatively the disposal room could be omitted and replaced with a disposal hatch between the theatre and corridor



Standard layout 8 (Health Technical Memorandum 2025 existing standard plan "5a") – typical layout for a UCV theatre suite

Note

This layout and data is for historical purposes only. The information is to be used for the evaluation of existing systems, the fitting out of existing shell schemes or rebalancing following ventilation system cleaning.

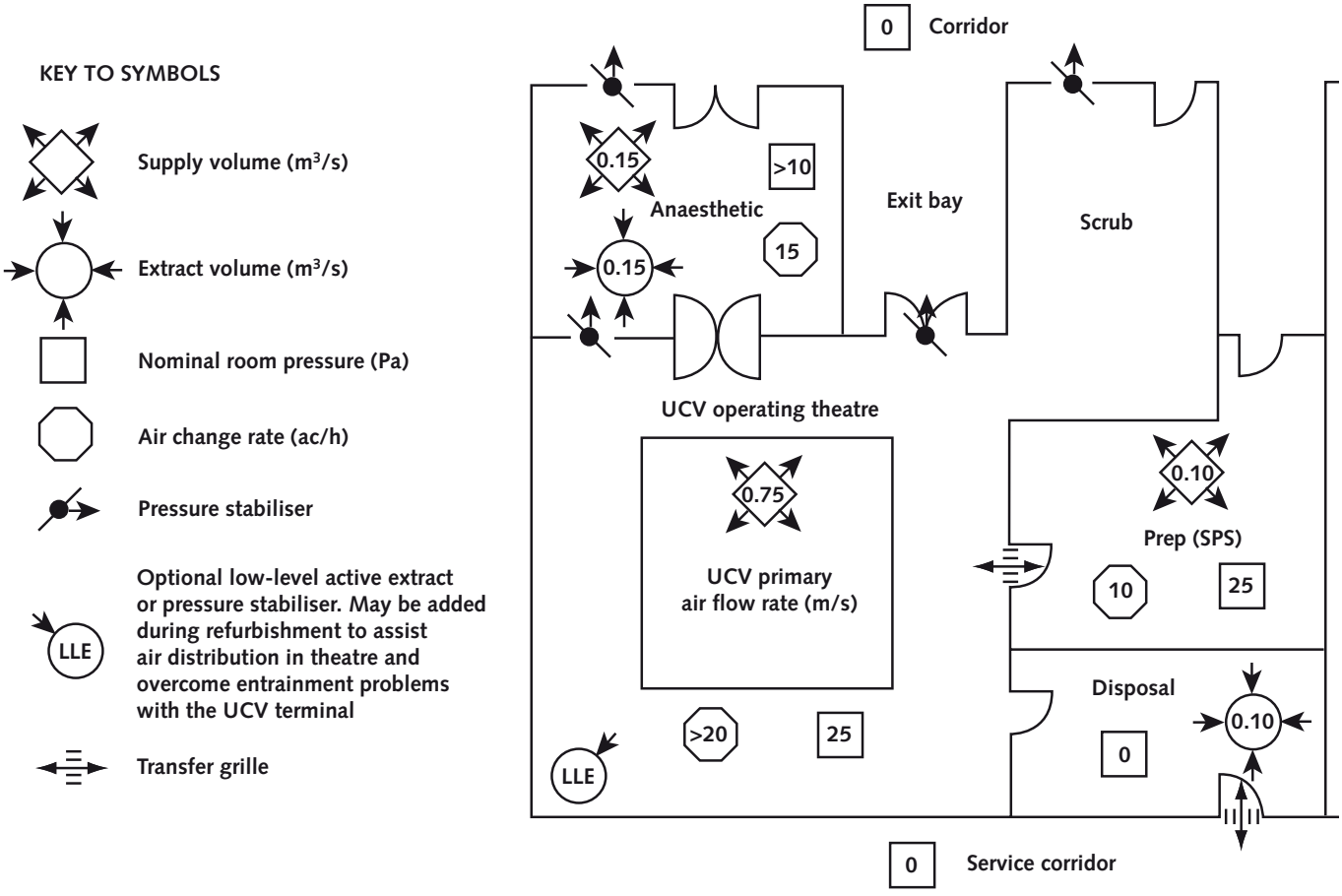
If difficulties are experienced with entrainment around the periphery of the UCV, adding a low-level active or passive extract in the location indicated will usually resolve the problem.

Room	Size	Air-change rate (AC/hr)	Nominal pressure (Pa)	Flow rate (m^3/s)
Theatre	**Existing theatre suite to be measured on site**	20	25	0.75*
Anaesthetic		15	>10	0.15
Sterile pack store prep		10	25	0.1
Scrub		–	25	–
Disposal		–	0	0.1

Notes:

* Primary fresh-air-flow volume only

The disposal layout detailed will remain the same should a hatch be utilised instead of a door onto the outer corridor. Alternatively the disposal room could be omitted and replaced with a disposal hatch between the theatre and corridor



Appendix 8 – Design of air-movement control schemes for operating theatres

General

A8.1 Standard operating suite design solutions are given in paragraphs 7.31–7.90 and Appendix 7. If these standard solutions cannot be used, the following procedure should be adopted, which will result in an acceptable design. Note that the method employed can equally be used to provide a design solution to a ventilated suite of rooms for any application.

A8.2 The method is concerned with the calculation of air-flow rates to ensure that correct air movement occurs between rooms when any one door is open. Under most circumstances, the air quantities required for air-movement control will approximate to those for either temperature control or bacterial contaminant dilution. This flow rate is sufficient to control the effects of any slight reverse flows occurring when a door is opened.

A8.3 The progression through the design procedure is shown in the air-flow design procedure chart (Figure A3) and is supported by worksheets WS1 to WS7 described in paragraph A8.4. It is recommended that a plan of the suite and an air-flow network be made (Figure A2) to collate all information. Flow rates, air-transfer devices etc should be entered as required. The remainder of this Appendix may be treated as reference data to assist in the various steps. The following symbols are used:

S_S – supply air-flow rate for summer temperature control;

S_W – supply air-flow rate for winter temperature control;

S_D – supply air-flow rate for dilution of bacterial contaminants;

S_L – supply air-flow rate for heat loss;

S_G – supply air-flow rate for heat gain;

E_D – extract air-flow rate for dilution of bacterial contaminants;

S_F – final supply air-flow rates

E_F – final extract flow rates;

S_{AMC} – air-supply flow rate for air-movement control;

E_{AMC} – air-extract flow for air-movement control;

L_{OUT} – leakage air-flow rate outward;

L_{IN} – leakage air-flow rate inward;

Σ_{OUT} – total air-flow rate outward;

Σ_{IN} – total air-flow rate inward.

A8.4 To simplify the procedure, standard worksheets (WS1 to WS7) have been devised. For each operating suite, a set is required comprising one each of WS1, WS3, WS5, WS6a, WS6b and WS7, one WS4 for each corridor and one WS2 to cover each peripheral room. WS2 has five versions:

- WS2a single flow,
- WS2b parallel/series multi-flow,
- WS2c parallel multi-flow or series multi-flow (unbalanced);
- WS2d series multi-flow (balanced); and
- WS2e bay (semi-open).

Peripheral room type

A8.5 The rooms in the operating suite other than the operating room and corridor are referred to as peripheral rooms. Peripheral rooms have been classified according to the flows in and out. These room classifications are defined in paragraphs A8.6–A8.11.

Single flow

A8.6 This is a room with only one door and a net surplus of supply or extract air.

Parallel multi-flow

A8.7 This is a room with two or more doors through each of which the air flows either outwards (high pressure) or inwards (low pressure) (for example the Prep (lay-up) in standard layout 5 in Appendix 7).

Parallel/series multi-flow

A8.8 This is a room having a net surplus of supply or extract and with two or more doors. One or more doors will be to an area of equal cleanliness and need not be protected; hence, the flow may vary between inwards and outwards, the remaining door being to an area of greater or lesser cleanliness (for example the Prep (SPS) in standard layout 6 in Appendix 7).

Series multi-flow (unbalanced)

A8.9 This is a room having a net surplus of supply or extract and with two or more doors. Air flows inwards through one or more doors and outwards through one or more doors.

Series multi-flow (balanced)

A8.10 This is a room as in paragraph A8.9 above, but having either no mechanical ventilation or no net surplus of supply or extract (for example an anaesthetic room).

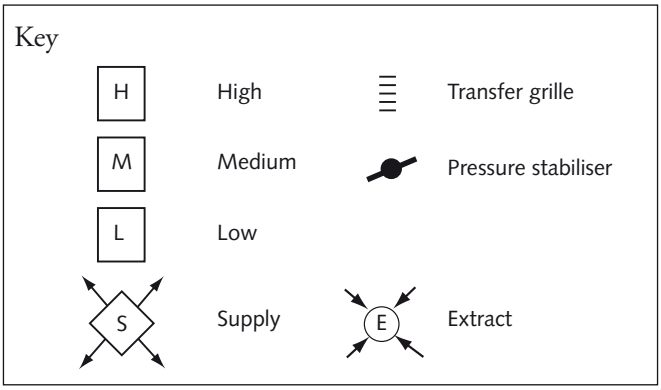
Bay

A8.11 A room which has a permanent opening to the operating room may be considered as a bay off the latter (for example a scrub). Two categories exist:

- open bay – the opening is larger than a normal single door opening. The bay may be considered as part of the main room;
- semi-open bay – the opening is no larger than a normal single door opening. In this case it is possible to protect the bay from the main room by provision of air supply or extract in the bay, or by passing air to or from another area.

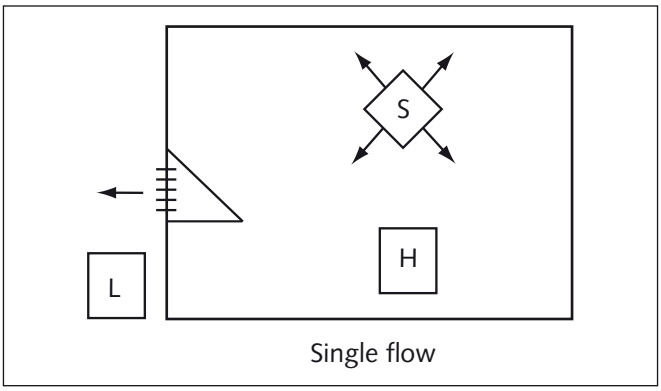
Air-movement control in peripheral rooms

A8.12 For the design of air-movement control, two types of air-transfer device are considered. These are transfer grilles and pressure stabilisers. Each has a particular field of application within the design, as described in paragraphs A8.34–A8.43. Air movement is controlled in each of the different room types described in paragraphs A8.13–A8.31.



Single flow rooms

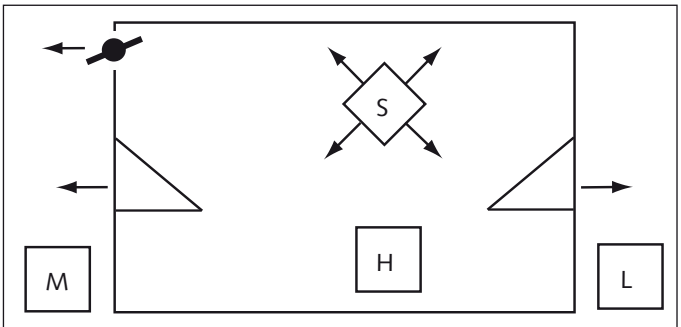
A8.13 An appropriately-sized transfer grille should be located in or adjacent to the door of each single flow room to relieve the pressure differences across the door when closed.



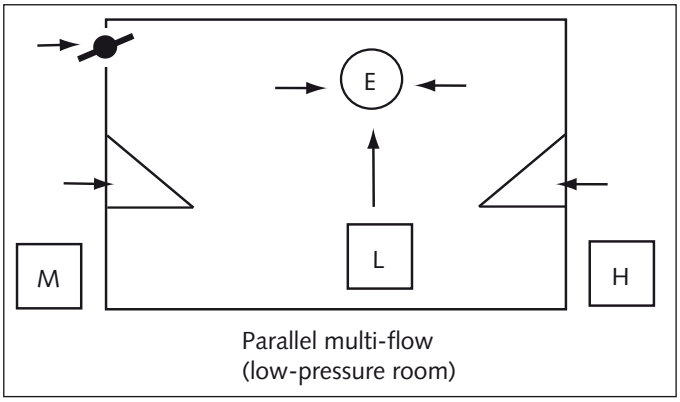
Single flow

Parallel multi-flow rooms

A8.14 The pressure difference across the closed doors must be relieved, but transfer grilles are not appropriate where two doors lead to areas of different pressures, because reverse flow could occur when the other door is open. For this reason, pressure stabilisers are used.



Parallel multi-flow
(high-pressure room)



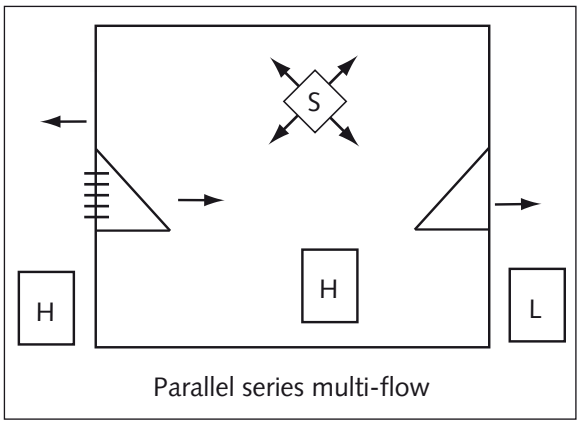
Parallel multi-flow
(low-pressure room)

A8.15 These rooms will be either high-pressure or low-pressure with respect to the adjacent areas (see preparation lay-up room and disposal room, respectively, in standard layout 5 of Appendix 7). The pressure-relief damper is always situated between the room and area, which results in the smaller differential pressure to ensure best use of air.

A8.16 Just as reverse flow can occur if transfer grilles are used, it can similarly occur via door gaps when the other door is opened. It is not possible to avoid this, except by using air locks, but due to the low flow rates and short durations involved, this is not considered to be of importance.

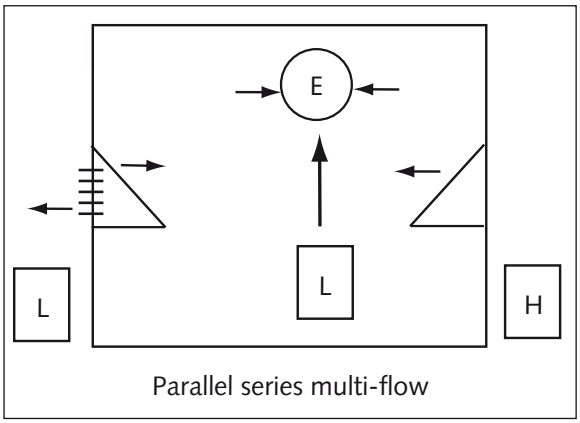
Parallel-series multi-flow rooms

A8.17 These rooms are similar to those in paragraph A8.14 above, but because the room is of equal cleanliness to one of the adjacent rooms, the nominal pressures will be equal and air may flow through the adjoining doorway in either direction (for example the Prep (SPS) in standard layout 6 of Appendix 7).



Parallel series multi-flow

A8.18 Where the nominal room pressure equals that of the higher-pressure adjacent room, the best use of air is by supplying air required for bacterial dilution only and allowing this to exhaust via a transfer grille to the area of equal cleanliness. The doorway to the lower pressure area is protected by the combination of the supply air and the air that will flow inwards through the transfer grille from the area of equal cleanliness.

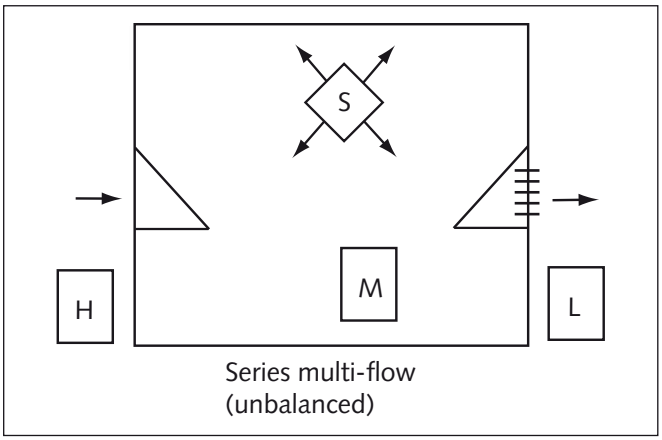


Parallel series multi-flow

A8.19 Conversely, where the nominal pressure equals that of the lower-pressure adjacent room, extract ventilation and a transfer grille to the lower pressure adjacent room should be provided (for example the disposal room in standard layout 8 of Appendix 7).

Series multi-flow (unbalanced)

A8.20 These rooms are somewhat similar to those in paragraph A8.15 above, but because the pressure lies between that of the rooms on either side, the back-flow problem does not exist.



Series multi-flow
(unbalanced)

A8.21 Where the room has a net surplus of mechanical supply air, a transfer grille should be located in or adjacent to the door through which air flows outwards, and the mechanical supply flow rate to the room should be chosen to give protection when this door is open.

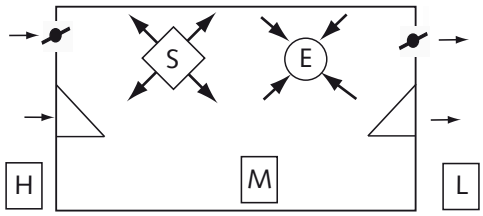
A8.22 Where the room has a net surplus of mechanical extract air, a transfer grille should be located adjacent to the door through which the air flows

inwards, and the mechanical extract flow rate to the room should be chosen to give protection when this door is open.

A8.23 The grille must be sized for the protection requirement of the opposing door when open. When the room on the high-pressure side depressurises, there is a possibility of back-flow through gaps around the door, but this problem may be ignored.

Series multi-flow (balanced)

A8.24 In these rooms, a transfer device adjacent to each doorway is required in order to provide a flow path for the air required to protect the opposing door when opened.



Series multi-flow (balanced)

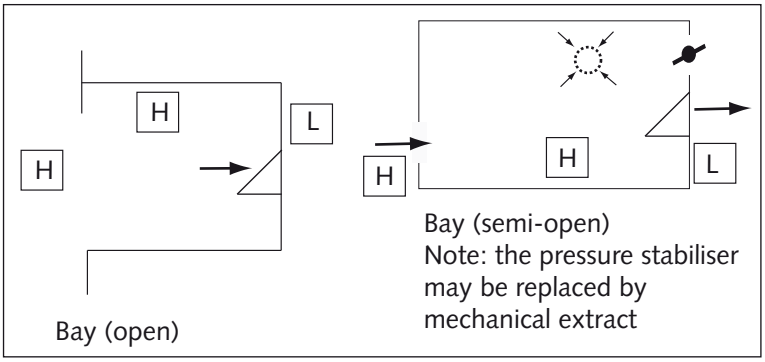
A8.25 These transfer devices will normally be pressure stabilisers, although transfer grilles may be used where a large amount of excess air is to be exhausted from the operating room when all doors are closed (for example anaesthetic rooms).

A8.26 The calculation procedure is to assume that pressure stabilisers are being used; then – if there is sufficient excess air – change to transfer grilles as described in paragraph A8.50.

Bay

Open bay

A8.27 A bay of the open type (for example scrub-up) is considered to be part of the operating room. Provided air movement is satisfactory, no specific extract is required.



Semi-open bay

A8.28 In a bay of the semi-open type, protection of one area from the other is possible (for example scrub-up).

A8.29 As stated previously, the need for protection between operating room and scrub-room is not very great. Better use of air can therefore be achieved in this case by installing a pressure stabiliser between the scrub-room and clean corridor. This will allow a flow of air through the scrub-room at all times, except when a door is opened elsewhere in the suite. The pressure stabiliser will then close and the air will be diverted to the other door. When it is considered necessary to protect the scrub-room at all times, either a transfer grille to the corridor or mechanical extract in the scrub-room should be provided.

Operating room

A8.30 Once the peripheral rooms have been considered, the operating room requirements may then be decided and the supply flow rate required for air-movement control calculated. This flow rate should be such that, with any one door open, the correct air movement directions are maintained. There will be one door in the suite that will require the largest supply flow rate to the operating room for protection when open. This is called the "key door" and is discussed separately in paragraph A8.33. Use of this concept avoids repetitive calculations for each door in turn. Having established the required supply flow rate, a relief route must be provided to the clean corridor for any excess air when the doors are closed. This would be via transfer grilles or pressure stabilisers through a series-flow room or via pressure stabilisers to the clean corridor directly.

Corridors

A8.31 All surplus air from the suite, except that lost through structure leakage and any passing to the outer corridor, will arrive in the patient/staff corridor. Should this air be insufficient to achieve the required air-change rate (see Appendix 3), some additional air supply should be provided. (The air balance should take account of structural leakage.)

Door opening

A8.32 Whereas the resulting pressures are dependent on ductwork layout, room relationships and characteristics of the fan, the generalisations shown in Appendix 6 can be used to estimate the change in room pressure when a door is opened.

A8.33 The "key door" will be the open double door which leaves the operating room at the highest pressure, and/or requires the largest air flow. This should be determined using the procedure in worksheet WS3.

Transfer grilles

A8.34 These may be used to limit the pressure differences across the closed door of a single-flow room or, in some instances, for protection of a series-flow or parallel-series-flow room. They allow air flow in both directions and may not be suitable for all applications.

A8.35 The free area of a grille is calculated from the following equation:

$$A = \frac{Q}{0.84\sqrt{\Delta P}}$$

where:

A is free area (m^2)

Q is flow rate (m^3/s)

P is pressure difference (Pa).

A8.36 The flow through a grille at a different pressure may be found from the following equation:

$$Q_2 = Q_1\sqrt{\frac{\Delta P_1}{\Delta P_2}}$$

where:

Q_1 and P_1 are original flow and differential pressure

Q_2 and P_2 are new flow and differential pressure.

A8.37 The transfer grille may be replaced by carefully proportioned door undercuts of the equivalent free area.

A8.38 The function of the transfer grille is to provide a means of air-flow control by which the volume and pressure loss can be established. If a grille is used, it should have an easily removable core to facilitate cleaning.

Pressure-relief dampers

A8.39 The functions of a pressure-relief damper are now carried out by pressure stabilisers. Accordingly, all mention of them has been removed from this document.

Pressure stabilisers

A8.40 Pressure stabilisers can be adjusted to hold the pressure constant over a wide range of flow rates. They are used where requirements exist for accurate room-pressure control or rapid shut-off on pressure fall.

A8.41 The installation of a grille or baffle in association with a stabiliser will alter the operating characteristics. It is recommended that a location be chosen to avoid the need for visual screening, for example, at high level. The location should be chosen to minimise the likelihood of damage.

A8.42 The stabilisers used should be virtually silent in operation, adjustable on site, maintenance-free and of a type which cannot be wrongly inserted. They should not be used in external walls or where the pressure difference is less than 5 Pa. The required size of a pressure stabiliser is dependent on the design pressure difference across it and flow rate through it. The manufacturer should provide data relating pressure difference to mean velocity (or flow rate per unit area). From this, the required area can be calculated and then rounded-up to the nearest size manufactured or nearest combination of smaller sizes.

A8.43 It is sometimes possible to arrange for a pressure stabiliser to perform two tasks. In an anaesthetic room, for example, the two pressure stabilisers may be made to pass the open door protection air, and also control the operating and anaesthetic room pressures with the door closed. To achieve this, the stabilisers are sized for the flow rate required with one of the doors open, but the pressure setting is

adjusted to be the value required with the doors closed. This is shown in Figure A1.

Door leakage flows

A8.44 For an air-movement control scheme to work satisfactorily, it is essential that the estimates of door-gap leakage made at the design stage are closely related to those which are achieved in practice. The calculation of gap-flows is complicated by the fact that such flows generally fall into the transition region between laminar and turbulent flow and hence do not follow the normal flow equations. The gaps assumed are 4 mm along the bottom, 3 mm at the top and sides, and 2 mm between double leaves. Doors should not have wider gaps than these. Tighter gaps would result in lower flow-rate requirements and hence lower fan power, but care should be taken to ensure that all doors in the suite have similar gap dimensions. It may be possible to ignore the door leakage and so reduce the air-flow requirement (see the "designers' notes" in Appendix 4).

Room temperature estimation

A8.45 The air-flow rate required to prevent back-flow through an open door is dependent on the temperature difference across the door. The design figures shown in Appendix 6 are based on the temperature differences that will normally occur in practice, assuming heat gains and losses in accordance with Appendix 4.

A8.46 At step 11 of the air-flow design process, the temperature differences across the doors of all rooms classed as "sterile" are calculated. Worksheet WS6 is recommended for the calculations, using the following criteria:

a. assume that the operating room is being controlled at 20°C and calculate the incoming air-supply temperature as shown on worksheet WS6;

b. the calculation should be repeated for both summer and winter conditions, with an operation in progress;

c. assume all doors are closed;

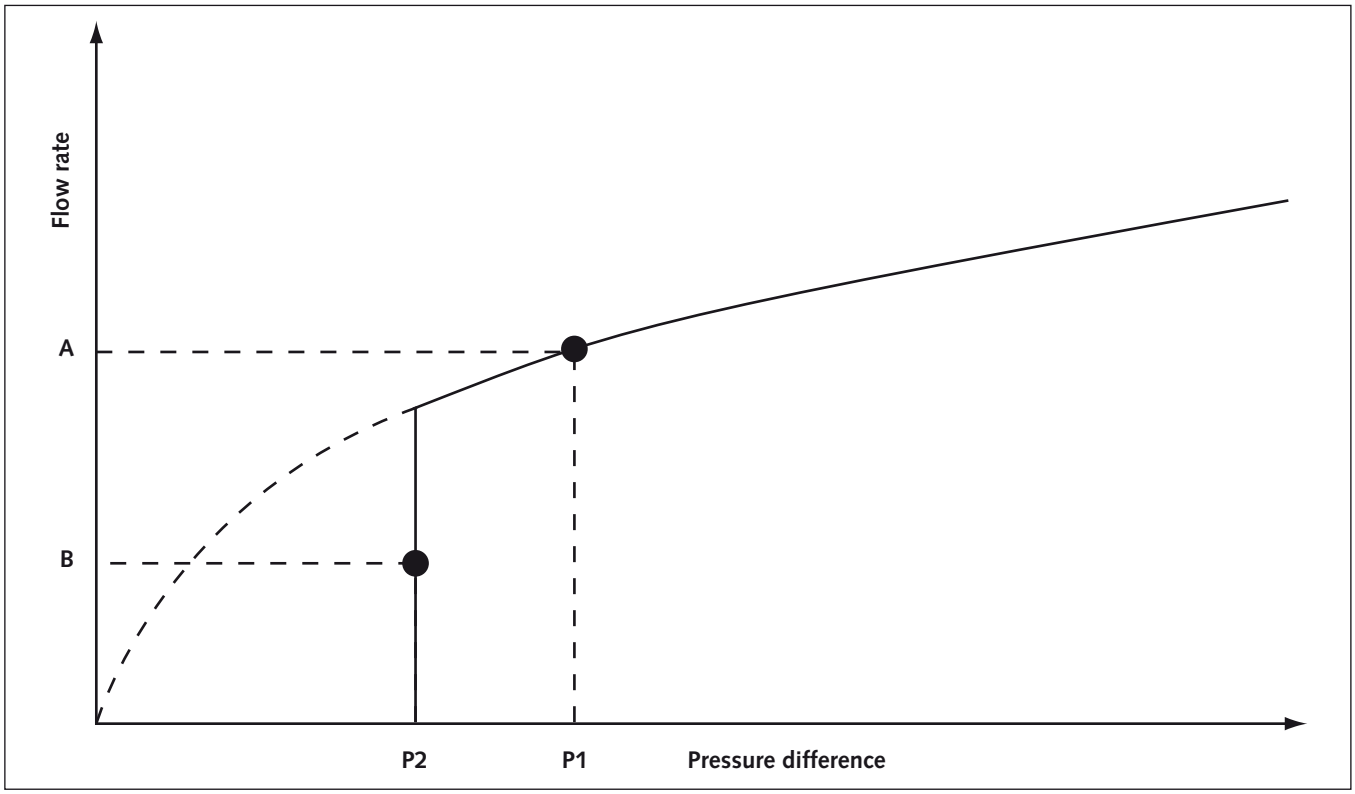
d. use the room supply flow rates from WS1;

e. use the inward air flows through air-transfer devices and closed door leakages from WS2a to WS2E;

f. the formula used in worksheet WS6 is as follows:

$$T = \frac{(t_1 Q_1 + t_2 Q_2 + \ldots + t_n Q_n) + 0.828H}{(Q_1 + Q_2 + \ldots Q_n)}$$

Figure A1 Pressure stabilisers performing two tasks



where:

Q = flow rate from source (m^3/s)

t = the temperature of source (°C)

H = the room heat gain (kW).

A8.47 If the evaluated temperature differences between rooms do not exceed 2°C, the solution is satisfactory; otherwise proceed as follows:

(i) check the assumption on which the heat gains are based;

(ii) take steps to reduce the heat gains;

(iii) if the door is to a corridor, the flow through the open door will be larger than the value given in Appendix 6. Calculate on WS3, assuming it is the "key door" with door-flow unknown, and the supply as known;

(iv) if the door leads to a room with mechanical supply, install a trimmer heater in the supply to the room controlled by either a differential thermostat or a thermostat slaved to the operating room thermostat to ensure that T is minimised;

(v) if the door leads to a room with no mechanical supply, increase the door protection flow as follows:

$$Q_{new} = Q_{old}\left[\frac{\Delta T + 1}{2}\right]$$

A8.48 These options should be considered in this order, and (i), (ii) and (iii) should be investigated thoroughly before proceeding to (iv) or (v). The mechanical supply may need to be increased in order to achieve the desired air-change rates.

Relief of excess air from operating room when all doors are closed

A8.49 As the mechanical supply to the operating room is sized to provide an appropriate flow outward through any door which is opened, it follows that when all doors are closed, there will be more air supplied to the operating room than can exit from it via leaks etc. This "excess" air can be relieved by either of the two methods described in paragraphs A8.50–8.54.

By transfer devices via the anaesthetic room

A8.50 For door protection, the transfer devices in the anaesthetic room are typically designed to pass 0.47 m^3/s at a differential pressure of 14 Pa. When the doors are closed, the differential pressure will change to 11 Pa between theatre and anaesthetic room, and 14 Pa between anaesthetic room and corridor; the volume of air passed by the transfer devices will be modified as shown in the following formula:

$$Q = Q_1\left(\frac{\Delta P_1}{\Delta P_2}\right)^{1/2}$$

$$= 0.47\left(\frac{11}{14}\right)^{1/2}$$

$$= 0.42\ m^3/s$$

where:

Q = "excess" air to be vented with doors closed

Q_1 = air flow required for door protection through transfer device

ΔP_1 = nominal differential pressure with door to operating room closed and door to corridor closed

ΔP_2 = nominal differential pressure between either the anaesthetic room and corridor when the operating room door is open, or the anaesthetic room and operating room when the corridor is open. This differential pressure is used when selecting size of both devices.

A8.51 If the "excess" air is less than 0.42 m^3/s, a pressure stabiliser is required to ensure that the correct protection air-flow is available to pass through the door.

A8.52 If the "excess" air is greater than 0.42 m^3/s, a transfer grille is acceptable because at all times the air-flow will exceed the flow required for door protection.

By pressure stabilisers to the corridor

A8.53 If it is undesirable to pass operating room air through the anaesthetic room, it may be passed directly to a corridor via a separate pressure stabiliser.

A8.54 If there is sufficient "excess" air, the transfer grille solution at paragraph A8.52 should be adopted, as it provides the simplest solution and, once set up, will require no further maintenance. With less excess air, it is recommended that the air be passed through the anaesthetic room via the pressure stabilisers as at paragraph A8.51, thus keeping the number of pressure stabilisers to a minimum. Both these solutions increase the air-change rate in the anaesthetic room, but care should be taken to avoid passing excessive amounts through that would cause discomfort to the occupants.

Figure A2 An example of an air-flow network

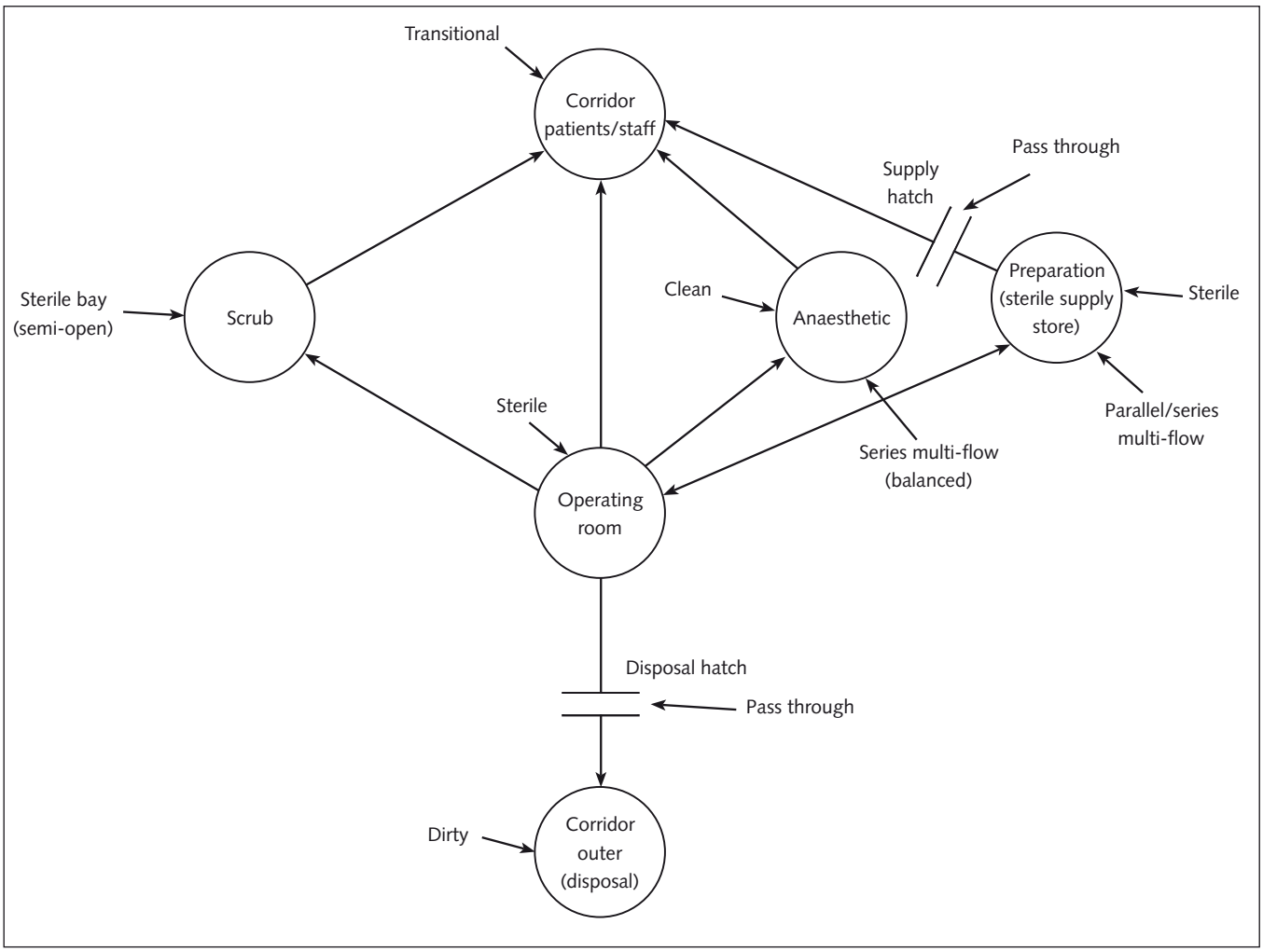


Figure A3 Air-flow design procedures

Step	Description	Worksheet
1	Show nominal room pressures and air flow directions on the plan of the theatre suite and WS1	WS1
2	Enter heat/loss/gain data and calculate supply air flow rates for temperature control only. Categorise room types, eg sterile, clean etc	WS1
3	Enter air flows required for bacterial contamination control or air change rate, whichever is the greater; add supply and extract volumes (S_D, E_D) on the plan	WS1
4	Define peripheral room types, see paragraphs A8.5–A8.11, and select appropriate worksheets	Select from WS2a to WS2e
5	Locate air transfer devices, enter details on worksheets and locate on the plan and Figure A2	Selected worksheets from WS2a to WS2e
6	For each peripheral room, determine air flows through doors when open and calculate mechanical supply or extract and transfer device flows	as above
7	Select "Key Door" and calculate air supply for operating room	WS3
	Does this door produce solution with greatest flow? — NO → (return to step 7)	
	YES ↓	
8	Transfer to WS1 and select final rate S_F and E_F	WS1, WS3
9	Make provision for relief of excess air with doors closed	Selected worksheets and WS3
10	Calculate supply and extract flow rates for corridor(s)	WS4, WS5
11	Calculate room temperatures (all doors closed) and ΔT's	WS6a and WS6b
	Do any ΔT's across doors to sterile rooms exceed 1.0°C? — YES → Rectify as in paragraph A8.47	
	NO ↓	
12	Make summary of flows	WS6a and WS6b
13	Size transfer devices, size ductwork, central plant etc	WS7
14	Design ductwork layout, control plant etc	–

Calculation sheet for flow rates			**Worksheet WS1** **Reference:**			
Room name						
1. Summer temperature control Heat gain	kW					
2. Acceptable Δt	°C					
3. Air flow rate (S_G) $= \frac{\text{Gain}}{\Delta t \times 1.2}$	m^3/s					
4. Winter temperature control Heat loss	kW					
5. Acceptable Δt	°C					
6. Air flow rate (S_L) $= \frac{\text{Loss}}{\Delta t \times 1.2}$	m^3/s					
7. Dilution of bacterial contaminants Air flow rate	m^3/s					
S_D or E_D						
8. Desired air change rate	AC/hr					
$\frac{\text{AC/hr} \times \text{room volume } (m^3)}{3600}$	m^3/s					
9. Maximum of S_G, S_L, S_D or E_D or air change rate from step 8	m^3/s					
10. Air movement control Air flow rate for air movement control S_{AMC} or E_{AMC} (from WS2, WS3 or WS4)	S m^3/s					
	E m^3/s					
11. Final supply flow rate (S_F)	m^3/s					
12. Final extract	m^3/s					
13. Total supply		m^3/s				
14. Total extract		m^3/s				

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Air movement control **Peripheral room ..... type, single flow**	**Worksheet WS2a** **Reference:**
	Nominal pressure: **Pa**

Consider door to ..... open

			Air flow, m^3/s		
	Pa	Δt	Out	In	Remarks
Flow required through doorway to give protection					
Total					

S_{AMC} $(\Sigma_{OUT} - \Sigma_{IN})$ ☐ m^3/s

or

E_{AMC} $(\Sigma_{IN} - \Sigma_{OUT})$ ☐ m^3/s

Transfer S_{AMC} or E_{AMC} to WS1

Consider door to ..... closed

	Pa	Δt	Out	In	Remarks
Closed door leakage					
Total					

Return S_F and E_F to WS1 ☐ ☐

Flow through transfer grille outward $(S_F - E_F - L_{OUT})$ ☐

or

Flow through transfer grille inward $(E_F - S_F - L_{IN})$ ☐

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Air movement control **Peripheral room ..... type, parallel/series multi-flow**	**Worksheet WS2b** **Reference:** **Nominal pressure:** **Pa**

Door from this room to ..... (room of equal cleanliness) is not to be protected.
A transfer grille is located in, or adjacent to, this door

Consider other door to ..... open.

Room pressure now becomes [ ] or [ ] or [ ] Pa (see Appendix 6)

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
At above pressures leaks through closed doors	Pa	ΔP			
Mechanical supply or extract (S_F/E_F)					
		Total			

X ($\Sigma_{OUT} - \Sigma_{IN}$) [ ] or Y ($\Sigma_{IN} - \Sigma_{OUT}$) [ ]

Transfer grille required
from high-pressure zone Flow = X
or [ ] at [ ] ΔPa
to low-pressure zone Flow = Y

Size of transfer grille (free area) A1 [ ]

Consider doors and hatch closed – room presssure becomes [ ] Pa (nominal)

Closed door leakage from Appendix 4 (assuming no transfer grille)	Pa	ΔP	Out	In	Remarks
Mechanical supply or extract					
		Total			

Air flow required through transfer grille = IN – OUT = Z' [ ]

or OUT – IN = Z'' [ ]

Transfer grille required flow Z' or Z'' [ ] @ [ ] ΔP

Size of transfer grille (free area) A2 = [ ]

Select larger of A1 or A2 [ ]

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Air movement control **Peripheral room ..... type, parallel multi-flow high/low or series multi-flow (unbalanced)**	**Worksheet WS2c** **Reference:** **Nominal pressure:** **Pa**

Consider door from this room to ..... open.

Room pressure now becomes [ ] or [ ] or [ ] Pa (see Appendix 6)

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through open doorway to give protection					
At above pressures leaks through closed doors are:	Pa	ΔP			
Total					

S_1 ($\Sigma_{OUT} - \Sigma_{IN}$) [ ] or E_1 ($\Sigma_{IN} - \Sigma_{OUT}$) [ ]

Consider door from this room to ..... open.

Room pressure now becomes [ ] or [ ] or [ ] Pa

			Out	In	Remarks
Flow required through open doorway to give protection					
At above pressures leaks through closed doors are:	Pa	ΔP			
Total					

S_2 ($\Sigma_{OUT} - \Sigma_{IN}$) [ ] or E_2 ($\Sigma_{IN} - \Sigma_{OUT}$) [ ]

Consider doors closed. Closed doors leakage from Appendix 4

Door to:	Pa	ΔP	Out	In	Remarks
Total					

Return S_F and E_F from WS1 [ ]

Flow through transfer device outward ($S_F - L_{OUT}$) [ ] to .....

or

Flow through transfer device inward ($E_F - L_{IN}$) [ ] from .....

Transfer grille [ ] Pressure relief damper [ ]

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Air movement control **Peripheral room ..... type, series multi-flow (balanced)**	**Worksheet WS2d** **Reference:** **Nominal pressure:** **Pa**

Note: In this type of room the supply and extract air flow rates are equal and take no part in the air movement control (AMC)

First, open door to higher pressure area.

Room pressure then becomes [ ] or [ ] or [ ] Pa (see Appendix 6)

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through open doorway to give protection. See Appendix 6					
At above pressures leaks through closed doors are:	Pa	ΔP			
Total					

Q_1 ($\Sigma_{IN} - \Sigma_{OUT}$) [ ] (+ve inwards)

Next, open door to lower pressure area.

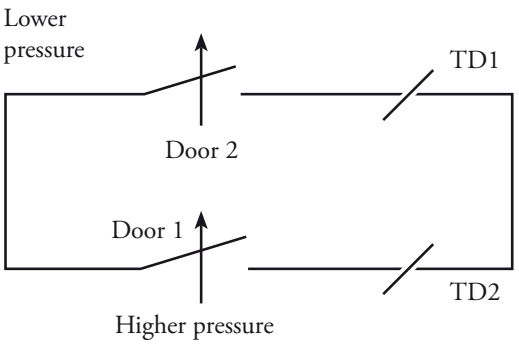
Room pressure then becomes [ ] or [ ] or [ ] Pa

			Out	In	Remarks
Flow required through open doorway to give protection					
At above pressures leaks through closed doors are:	Pa	ΔP			
Total					

Q_2 ($\Sigma_{OUT} - \Sigma_{IN}$) (+ve outwards)

Flow through transfer device (TD1) to protect door 1 = $Q1$ [ ] at resultant ΔP .....

Flow through transfer device (TD2) to protect door 2 = $Q2$ [ ] at resultant ΔP .....



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Air movement control **Peripheral room ..... type bay (semi-open)**			**Worksheet WS2e** **Reference:** **Nominal pressure:** **Pa**		
Note: If the room is of the open bay type (ie opening is larger than normal single doorway), the room should be considered part of the main room. No air movement control considerations need then be made, and this sheet can be discarded. Supply and/or extract flow will be based on air distribution considerations.					
Consider permanent opening					
			Air flow, m^3/s		
			Out	In	Remarks
Flow required through opening to give protection					
Leaks through closed doors to:	Pa	ΔP			
		Total			
E_{AMC} [ ] or flow outward through transfer device ($\Sigma_{IN} - \Sigma_{OUT}$) [ ]					
Transfer S_{AMC} or E_{AMC} to WS1					
Transfer device – transfer grille [ ] – pressure stabiliser [ ]					
Size select transfer device for flow rate [ ] @ ΔP [ ]					
Note: A door from the bay is considered with the peripheral room to which it leads or, if it leads to the corridor, it is considered with the main room					

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Air movement control **Operating room**	**Worksheet WS3** **Reference:** **Nominal pressure:** **Pa**

Note: To avoid considering each door open in turn, the "key door" concept is introduced. This is the door which requires the greatest mechanical flow when open. See paragraph A8.33

Select "key door" (see above).

Consider this door open – room pressure now becomes ____ Pa (see Appendix 6)

See Appendix 7 for room pressures

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
Air flow "out" or "in" via doors, transfer devices etc	Pa	ΔP			
Mechanical extract					
Total					

S_{AMC} ($\Sigma_{OUT} - \Sigma_{IN}$) ____ transfer S_{AMC} to WS1

Consider all doors closed.

Return S_F from WS1 ____ Room pressure now ____ Pa (nominal)

Air flow "out" or "in" via door leakage, transfer devices etc	Pa	ΔP	Out	In	Remarks
Mechanical extract and supply					
Total					

Flow ($\Sigma_{IN} - \Sigma_{OUT}$) through transfer device ____ @ ΔP ____ to .....

For final selection of transfer device see paragraphs A8.50–A8.54

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Air movement control **Corridor**			**Worksheet WS4** **Reference:**		
			Nominal pressure:		**Pa**
Consider all doors closed					
			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
Leaks through closed doors, transfer devices, permanent openings etc	Pa	ΔP			
Total flow inwards (S_1)					
Add mechanical input (S_2) if necessary to increase S_1 to give 7 AC/hr					
Total flow outwards and inwards					
$S_{AMC} = (\Sigma_{OUT} - \Sigma_{IN} + S_2)$ [ ] Transfer to WS5					
or $E_{AMC} = (\Sigma_{IN} - \Sigma_{OUT} + S_2)$ [ ] Transfer to WS5					

Note: this sheet to be used for each individual operating theatre suite (or pair of suites if they share a preparation room)

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Air movement control	**Worksheet WS5** **Reference:**	
Summary of air supply and extract for an operating suite		
Air flow to corridor	All doors closed	Anaesthetic (key door open)
	m^3/s	m^3/s
From preparation		
From operating room		
From scrub		
From anaesthetic		
Total (a)		
Air flow to corridor From disposal		
From other source		
Total (b)		
Other room supplies ..... Total (c)		
Total air supply (a) + (b) + (c)		
Consider corridor ventilation (see Appendix 3) and calculate air volume required, based on 7 AC/hr (see Note 1)		
		m^3/s
Air flow required to ventilate corridor		
Air flow required to ventilate service corridor (see Note 2)		
If the air flow from the operating suite (a) and (b) is greater than the calculated required volume, no further supply air is necessary		
		m^3/s
Additional air to ventilate corridor		
Additional air to ventilate service corridor (see Note 2)		
Air extract The size of the extract plant should be of the order of 10% below the supply to assist in maintaining the department under positive pressure relative to the outside departments		
		m^3/s
Extract plant = Supply less leakage		
Less 10% of supply		
Total extract (see Note 3)		

Notes: 1. In the case of a multi-theatre operating department, the air balance for the corridor should be considered as a separate exercise, taking into account the final dispersal of excess air.
2. Omit these if only one corridor in operating suite.
3. The extract volume includes 0.24 m^3/s from the anaesthetic room for a balanced condition

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Room temperature – summer	**Worksheet WS6a** **Reference:**

Find summer supply temperature $T_{SS} = 20 - \dfrac{0.828H(\text{O/R})}{Q(\text{O/R})}$ = T_{SS} ____ °C

Note: the temperature of a space may be calculated from

$$T = \frac{t_1Q_1 + t_2Q_2 + \ldots\ldots\ldots + t_nQ_n + (0.828H)}{Q_1 + Q_2 + \ldots Q_n}$$

Where t_1 is temperature of source 1 (°C)
Q_1 is flow from source 1 when all doors are closed (m^3/s)
H is heat gain in space (kW)

Room	Heat gain kWh	Supply		Flows inwards										Temperature °C T
		Q	T_{SS}	From		From		From		From		From		
				Q	t	Q	t	Q	t	Q	t	Q	t	

Check doors to sterile areas

Door between	Calculated room ΔT (°C)	Maximum ΔT permitted	Remarks

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Room temperature – winter	**Worksheet WS6b** **Reference:**

Find winter supply temperature $T_{SW} = 20 - \dfrac{0.828H(\text{O/R})}{Q(\text{O/R})}$ = T_{SW} ____ °C

Note: the temperature of a space may be calculated from

$$T = \frac{t_1Q_1 + t_2Q_2 + \ldots\ldots\ldots + t_nQ_n + (0.828H)}{Q_1 + Q_2 + \ldots Q_n}$$

Where t_1 is temperature of source 1 (°C)
Q_1 is flow from source 1 when all doors are closed (m^3/s)
H is heat gain in space (kW)

Room	Heat gain kWh	Supply		Flows inwards										Temperature °C T
		Q	T_{SW}	From		From		From		From		From		
				Q	t	Q	t	Q	t	Q	t	Q	t	

Check doors to sterile areas

Door between	Calculated room ΔT (°C)	Maximum ΔT permitted	Remarks

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Transfer grilles, pressure relief dampers and pressure stabilisers	**Worksheet WS7** **Reference:**

Transfer grilles – see paragraphs A8.34–A8.38

No	Location	Pressure difference Pa	Flow rate m^3/s	Free area m^2	Model	Resultant Δp Pa	Remarks

Pressure relief dampers – see paragraph A8.39

No	Location	Pressure difference Pa	Flow rate m^3/s	Free area m^2	Pressure setting Pa	Remarks

Pressure stabilisers – see paragraphs A8.40–A8.43

Note: where a stabiliser is acting both as series room door protection and operating pressure control, "pressure difference" and "flow rate" are from WS2d; "pressure setting" is from WS3

No	Location	Pressure difference Pa	Flow rate m^3/s	Free area m^2	Pressure setting Pa	Remarks

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BROOKFIELD MULTIPLEX CONSTRUCTION EUROPE LTD

- and -

TUV SUD LIMITED (trading as WALLACE WHITTLE)

APPOINTMENT OF MECHANICAL & ELECTRICAL ENGINEER

relating to the design and construction of
the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service
and the Department of Clinical Neurosciences in a single building adjoining
the Royal Infirmary of Edinburgh at Little France, Edinburgh

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BETWEEN:

(1) **BROOKFIELD MULTIPLEX CONSTRUCTION EUROPE LTD** (Company Registration No. 03808946 whose registered office is at 99 Bishopsgate, 2nd Floor, London EC2M 3XD (the "**Contractor**" which shall include its successors in title and permitted assigns under this Agreement); and

(2) **TUV SUD LIMITED (trading as WALLACE WHITTLE** (Company No. SC215164) whose registered office is at Napier Building, Scottish Enterprise Technology Park, East Kilbride, Glasgow G75 0QF (the "**Consultant**").

RECITALS:

(A) The Board has or will enter into the Project Agreement with Project Co whereby Project Co has agreed to design, build, finance and maintain the Project.

(B) Project Co has or will enter into the Construction Contract with the Contractor for the design and construction of the Works.

(C) The Contractor wishes to appoint the Consultant to provide services on the terms and conditions set out in this Agreement for the Project.

OPERATIVE PROVISIONS:

1. **DEFINITIONS**

In this Agreement the following words and expressions shall have the following meanings:

"Additional Services" means any additional services relating to the Project which the Contractor may instruct the Consultant to undertake provided always that any instruction relating to Additional Services must be given or confirmed in writing;

"Adequate Procedures" means procedures, as referred to in section 7(2) of the Bribery Act 2010 and described in guidance issued by the Secretary of State under section 9 of the Bribery Act 2010, both as amended, re-enacted or updated from time to time;

"BIM Execution Plan" means the plan prepared and agreed in accordance with Clause 10.3 to explain how the information modelling aspects of the Project will be carried out;

"BIM Outputs" means any and all information (whether graphical or non-graphical), calculations, designs, specifications and any other data, including without limitation, plans, sections, projections, elevations, tables, schedules, drawings, views and representations of the Works or any part thereof, produced or generated as an output

by the Project BIM or any other BIM output of any nature whatsoever, including but not limited to any information located in a "shared" folder;

"BIM Protocols" means the protocol for the use and development of the BIM Model attached at Schedule 10;

"Board" means Lothian Health board, a health board constituted in Scotland under the National Health Service (Constitution of Health Boards) (Scotland) Order 1974 (S.I. 1974/267) as amended by the National Health Service (Constitution of Health Boards) (Scotland) Amendment Order 2003 (S.S.I. 2003/217) pursuant to Section 2 of the National Health Service (Scotland) Act 1978 as amended by section 28 of the National Health Service and Community Care Act 1990 and having its principal address at Waverley Gate, 2-4 Waterloo Place, Edinburgh EH1 3EG;

"Board's Construction Requirements" means the requirements of the Board set out or identified in Section 3 (*Board's Construction Requirements*) of Schedule Part 6 (*Construction Matters*) of the Project Agreement as amended from time to time;

"BREEAM Report" means the BREEAM Prediction Report attached as Schedule 9;

"CDM Regulations" means the Construction (Design and Management) Regulations 2007 or any amendment or replacement thereof;

"Change in Control" means:

(a) any sale or other disposal of any legal, beneficial or equitable interest in any or all of the equity share capital of a corporation (including the control over the exercise of voting rights conferred on that equity share capital, control over the right to appoint or remove directors or members or the rights to dividends); and/or

(b) any other arrangements that have or may have or which result in the same effect as paragraph (a) above;

"Consents" means all permissions, consents, approvals, certificates, permits, licences, statutory agreements and authorisations required by Law, and all necessary consents and agreements from any third parties (including, without limitation, any planning permission), needed to carry out the Services in accordance with this Agreement;

"Contractor's Health and Safety Policy Statement" means the Contractor's health and safety policy statement as updated or amended from time to time;

"Construction Contract" means the contract between Project Co and the Contractor for the design and construction of the Works and any sub-contracts consequent thereupon in relation to the Project;

"Construction Quality Plan" means the document at Section 8 (*Quality Plans (Design and Construction)*) of Schedule Part 6 (*Construction Matters*) of the Project Agreement;

"Cost Plan" means the document attached as Schedule 8 identifying the estimated cost to the Contractor of executing and completing each element of the Project as the same may be revised by the Contractor from time to time such revisions to be notified to the Consultant;

"Deliverables" means any and all deliverables and the drawings, diagrams, CAD materials, technical data, inventions, computer software, pricing documents, details, plans, models, specifications, databases, schedules, reports, records, data, calculations and all other documents or recorded information of any nature whatsoever, and all revisions thereof and additions thereto, and the designs and work contained in them, prepared by or on behalf of the Consultant in respect of the Project (which shall include any BIM Outputs and the Design BIM if relevant to the Project);

"Deliverables Timetable" means the timetable of milestone dates for design documentation and deliverables set out in Schedule 6 as revised by the Contractor from time to time such revisions to be notified to the Consultant;

"Design BIM" means the building information models relating to the Services which shall be produced and maintained by the Consultant and submitted to the Project BIM Manager for incorporation within the Project BIM, as such model evolves and develops throughout the works, as more particularly described in the BIM Protocol;

"Design Consultant Responsibility Matrix" means the design consultant responsibility matrix agreed with the Contractor attached as Schedule 7 setting out the elements of the Works for which the Consultant is responsible together with those elements in respect of which the Consultant needs to co-ordinate its Services;

"Design Data" means all drawings, reports, documents, plans, software, formulae, calculations and other data relating to the design, construction, testing and/or operation of the Project whatsoever;

"Design Quality Plan" means the document at Section 8 (*Quality Plans (Design and Construction)*) of Schedule Part 6 (*Construction Matters*) of the Project Agreement;

"Direct Losses" means all damage, losses, liabilities, claims, actions, costs, expenses (including the cost of legal or professional services, legal costs being on an agent/client, client paying basis), proceedings, demands and charges whether arising under statute, contract or at common law but, to avoid doubt, excluding Indirect Losses;

"Disclosed Data" means any Design Data and any other written information, data and documents made available or issued to the Consultant in connection with the

Project by or on behalf of the Contractor, the Board or Project Co. whether on, before or after the execution of this Agreement;

"Documentation" shall have the same meaning as Deliverables;

"Environmental and Waste Minimization Policy Statement" means the Contractor's environmental strategy for sustainability and the minimization of waste as may be updated or amended from time to time;

"Fee" means the fee to be paid by the Contractor to the Consultant for the due and proper performance of the Services as detailed in Schedule 1;

"Fee Payment Schedule" means the schedule setting out the timetable for fee payments forming part of Schedule 1;

"Financial Close" means the execution of the Project Agreement and the appointment of the Contractor pursuant to the Construction Contract;

"Financial Close Payment" means the payment to be made to the Consultant in accordance with clause 5.3 of this Agreement and as set out in Schedule 1;

"Good Industry Practice" means using standards, practices, methods and procedures conforming to the Law and exercising that degree of skill and care, diligence, prudence and foresight which would reasonably and ordinarily be expected from a skilled and experienced person engaged in a similar type of undertaking under the same or similar circumstances;

"Independent Tester" means the party appointed or to be appointed by the Board and Project Co and who is identified as carrying out this role in Schedule 1 or such substitute independent tester as may be subsequently appointed pursuant to the Project Agreement.

"Indirect Losses" means loss of profits, loss of use, loss of production, loss of business or loss of business opportunity or is a claim for consequential loss or for indirect loss of any nature;

"Intellectual Property" means all registered or unregistered trademarks, service marks, patents, registered designs, utility models, applications for any of the foregoing, copyrights, unregistered designs, the sui generis rights of extraction relating to databases, trade secrets and other confidential information or know-how;

"Intellectual Property Rights" means the Intellectual Property which (or the subject matter of which) is created, brought into existence, acquired, used or intended to be used by the Consultant or by other third parties (for the use by or on behalf of or for the benefit of the Contractor or Project Co) for the purposes of the design or construction of the Project or the conduct of any other Project Operation or otherwise for the purposes of this Agreement;

"Law" means:

(a) any applicable statute or proclamation or any delegated or subordinate legislation;

(b) any enforceable community right within the meaning of section 2(1) of the European Communities Act 1972;

(c) any applicable guidance, direction or determination with which the Contractor, the Board and/or Project Co is bound to comply to the extent that the same are published and publicly available or the existence or contents of them have been notified to the Consultant by the Contractor; and

(d) any applicable judgement of a relevant court of law which is a binding precedent in Scotland,

in each case in force in Scotland;

"Insolvency Event" means the occurrence of any of the following events:

(a) any arrangement or composition with or for the benefit of creditors (including any voluntary arrangement as defined in the Insolvency Act 1986) being entered into by or in relation to either Party;

(b) a receiver, administrator, administrative receiver or other encumbrancer taking possession of or being appointed over, or any distress, execution or other process being levied or enforced (and not being discharged within ten (10) Business Days) upon, the whole or any material part of the assets of either Party;

(c) either Party ceasing to carry on business;

(d) a petition being presented (and not being discharged within twenty (20) Business Days), or a resolution being passed or an order being made for the administration or the winding up, bankruptcy or dissolution of either Party; or

(e) if either Party shall suffer any event analogous to the events set out in this definition in any jurisdiction in which it is incorporated or resident;

"NHS Requirements" means Health Building Notes and Health Technical Memoranda and such other requirements as are designated as NHS Requirements in the Board's Construction Requirements, all Executive Letters, Health Service Guidelines, Health Circulars of the NHS and any similar official requests, requirements and guidance having similar status for the time being in force, but only to the extent the same are published and publicly available or the existence and contents of them have been notified to the Consultant;

"Other Consultants" means any consultants which may be appointed by the Contractor from time to time in connection with the Project and notified to the Consultant;

"Practical Completion" means practical completion of the Works under the Construction Contract;

"Programme" means the overall construction programme for the Project identifying the time for executing and completing each element of the Works as may be revised by the Contractor from time to time such revisions to be notified to the Consultant;

"Project" means the project described in Schedule 1;

"Project Agreement" means the agreement entered into or to be entered into between the Board and Project Co. in respect of the design, build, finance and maintenance of the Project;

"Project BIM" means the federated building information model for the Works which shall be maintained by the Project BIM Manager as such model evolves and develops throughout the works, as more particularly described in the BIM Protocol;

"Project BIM Manager" means the Contractor unless any other party is identified as carrying out this role in Schedule 1, or such other party as notified to the Consultant by the Contractor from time to time;

"Project Co" means the party referred to as such in Schedule 1;

"Project Co's Proposals" means Project Co's Proposals as set out at Schedule Part 6, Section 4 of the Project Agreement;

"Project Manager" means the party referred to as such in Schedule 1;

"Project Operations" means the carrying out of the Works and all other obligations of the Project Co under the Project Agreement from time to time;

"Quality Plans" means the Design Quality Plan and Construction Quality Plan, prepared in accordance with Section 8 (*Quality Plans (Design and Construction)*) of Schedule Part 6 (*Construction Matters*) of the Project Agreement, as required to be

implemented by Project Co in accordance with Clause 20 (*Quality Assurance*) of the Project Agreement;

"Services" means the services as set out in Schedule 2 together with any Additional Services;

"Site" means the location described in Schedule 1 on which the Works are to be constructed;

"Third Party Agreements" means the agreements listed in Schedule 4 together with any other agreements entered into by or on behalf of Project Co or the Contractor, the relevant parts of which have or will be disclosed to the Consultant;

"Works" means the works described in and to be executed under the Construction Contract whether by the Contractor or his sub-contractors.

2. **CONSULTANT'S OBLIGATIONS**

2.1 The Contractor appoints the Consultant with effect from the date on which it first commenced performance of its obligations under this Agreement to undertake the obligations set out in this Agreement and to provide the Services listed in Schedule 2 (and in accordance with the Design Consultant Responsibility Matrix listed in Schedule 7), and the terms of this Agreement shall retrospectively govern any work or services carried out by the Consultant prior to the date of this Agreement.

2.2 The Consultant confirms that the drawings and specifications that it has provided to the Contractor together with any supporting information produced by the Consultant or its sub-consultants comply with the Project Co's Proposals (insofar as they relate to the Services) in their current form as at the date of this Agreement, are adequate and are sufficiently advanced so as to enable the Contractor to accurately price and programme the Project and the Consultant acknowledges that the Contractor has and will rely on the drawings and specification and supporting information for that purpose. Nothing in this clause extends the Consultant's obligation to exercise the standard of reasonable skill, care and diligence owed pursuant to clause 2.3.1.

2.3 The Consultant warrants that:

2.3.1 it has used, and will continue to use, the degree of skill, care and diligence in the performance of the Services that would reasonably be expected of a competent professional designer experienced in carrying out design activities and services of a similar nature, scope and complexity as the Project, and that it has and will continue to proceed with the Services in a regular and diligent manner and so as not to prejudice or interfere with the progress of the Project;

2.3.2 its officers, employees, agents and consultants are competent and appropriately qualified and experienced and hold all necessary licences to

perform the Services, and that the Consultant will promptly take steps to replace any such people that reveal themselves during the course of the Project not to have the necessary competence, qualifications or experience with people that are approved by the Contractor (such approval not to be unreasonably withheld);

2.3.3 it has the necessary power and authority to enter into this Agreement and that it is under no obligations or restriction that would in any way interfere or be inconsistent with, or create a conflict of interest concerning, its performance of the Services; and

2.3.4 it shall not permit or effect a Change in Control in respect of its business without the prior written consent of the Contractor.

2.4 The Consultant shall comply at all times with the Contractor's reasonable requests in relation to the Project. The Consultant shall co-operate, as directed by the Contractor, with the Board, Project Co., the Independent Tester and any funders of the Project.

2.5 The Consultant shall provide the Contractor with all reasonable assistance in relation to any disputes or claims that arise in connection with the Project insofar as the Services are relevant to such disputes and the Consultant shall not be entitled to additional payment for such assistance.

2.6 In carrying out the Services the Consultant shall at all times comply with the Deliverables Timetable so as to enable the Contractor to meet the Programme.

2.7 If the Consultant is delayed or likely to be delayed in the performance of the Services, the Consultant shall:

2.7.1 as soon as possible, notify the Contractor in writing of such delay and the Consultant shall use all reasonable endeavours to mitigate such delay. Such notice shall not in any event be given later than seven calendar (7) days after the Consultant becoming aware of the commencement of the delaying event.

2.7.2 The Consultant shall within seven (7) calendar days of service on the Contractor of a notice pursuant to clause 2.7.1 provide to the Contractor in writing full and detailed particulars of the delaying event and the actual or anticipated extent of the delay with details of the measures the Consultant has adopted or proposes to adopt to avoid or mitigate the effects of such delay.

2.7.3 To the extent that the Consultant is responsible for any delay to the Services the Consultant shall use all reasonable endeavours to recover the delay, including but not limited to the provision of additional resource and/or the implementation of such hours of working as are required to recover the lost time. To the extent that the Contractor is responsible for

any delay to the Services the Contractor shall adjust the Deliverables Timetable as is fair and reasonable in all the circumstances.

2.8 If the Consultant in breach of this Agreement fails to provide the Services in accordance with the Deliverables Timetable, the Contractor may serve a written notice on the Consultant requiring him to perform in accordance with the Deliverables Timetable and to take whatever steps are necessary to do so. If in the reasonable opinion of the Contractor the Consultant is not complying with such notice, the Contractor shall at its discretion be entitled to take such further action as it considers necessary, including but not limited to:

2.8.1 requiring the Consultant to supplement its resources with additional experienced personnel and/or replacement personnel at no cost to the Contractor; or

2.8.2 terminating the Consultant's engagement under this Agreement and the Consultant's entitlement to further payment shall be calculated in accordance with the provisions of Clause 12;

2.8.3 withholding or exercising rights of set-off against monies that may be due or become due to the Consultant in relation to the delayed Services.

The Consultant must comply forthwith with any direction issued by the Contractor pursuant to this clause 2.8.

2.9 The Programme and/or the Deliverables Timetable may be amended from time to time in accordance with the Contractor's instructions if in the Contractor's opinion it is reasonable to do so, provided that:

2.9.1 the Contractor shall consult with the Consultant over the proposed amendments to the Deliverables Timetable and shall give due consideration to the Consultant's suggestions prior to issuing any instruction amending the same; and

2.9.2 if an instruction given by the Contractor pursuant to clause 2.9 amounts to an instruction by the Contractor to provide Additional Services any adjustment to the Fee shall be determined in accordance with clause 2.11.

2.10 Without prejudice to the Services listed in Schedule 2 the Consultant warrants and undertakes that it will (exercising the level of skill and care set out in Clause 2.3):

2.10.1 whenever and wherever an inspection is reasonably necessary or expedient for the proper performance of their duties or where specifically requested by the Contractor, inspect the work and materials of the Contractor or any sub-contractor or supplier;

2.10.2 liaise as reasonably requested by the Contractor with the Independent Tester and Project Co's advisers and, if appointed, any funding institution's representative or adviser and give due consideration to any representations or suggestions made by them;

2.10.3 not specify for use or permit materials to be used in connection with that part of the Project to which the Services relate which are:

(a) contrary to the recommendations in the version of "Good Practice in the Selection of Construction Materials" published by Ove Arup & Partners current at the time of specification; or

(b) materials or substances whether on their own or in combination with other materials or substances, processes or methods of working generally known in the Consultant's profession to be deleterious to health and safety or to the durability of the Project in the particular circumstances in which they are used or which are not in accordance with British Standards and Codes of Practice (where applicable standards exist) or which are publicised in the Building Research Establishment Digest as being deleterious; or

(c) prohibited under the Construction Contract or any of the Third Party Agreements.

If such materials as referred to in Clause 2.10.3 are discovered in the Works or it becomes known to the Consultant that such materials have been used in connection with the Works the Consultant will as soon as practicable notify the Contractor.

2.10.4 not make or approve any material alteration, addition to or omission from any agreed design or part of the design of the Project nor except in an emergency for reasons of constructability shall it issue any instructions or give any approval or do any other thing which might materially increase the cost of the Services or the Project or affect the date of Practical Completion without referring the matter to the Contractor with its comments and obtaining the Contractor's prior written approval thereto. The Consultant shall use all reasonable endeavours in the performance of the Services so as to ensure that the Works are able to be undertaken in accordance with the Cost Plan. Where such Cost Plan is exceeded which is not as a result of the Consultant failing to carry out its obligations under this Appointment and causes the Consultant to carry out Additional Services, then such Additional Services shall be paid for in accordance with clause 5.

2.10.5 promptly comply with any instructions by the Contractor to correct any Deliverables provided by it that are, in the Contractor's reasonable opinion,

non-compliant or inadequate or inaccurate and shall do so without delay and without adjustment to the Fee.

2.11 The Contractor may instruct the Consultant in writing to provide any of the Additional Services or an omission from the Services. In the event that the Consultant receives such an instruction from the Contractor to provide any of the Additional Services or an omission from the Services, then the following provisions will apply:

2.11.1 The Consultant shall notify the Contractor within ten working days following receipt of any instruction given under clause 2.11 of any addition or deduction to be made to the Fee which the Consultant considers is fair and reasonable as a consequence of such instruction, and shall provide the Contractor with such information as the Contractor reasonably requests to enable it to determine, in its reasonable opinion, the fair and reasonable addition or deduction to be made to the Fee as a consequence of such instruction together with confirmation that the said adjustment represents the entire adjustment that the Consultant seeks in relation to the instruction.

2.11.2 Within a reasonable time following the receipt of the information referred to in clause 2.11.1 the Contractor shall notify the Consultant of its determination of the fair and reasonable addition or deduction to be made to the Fee as a consequence of an instruction given under clause 2.11. For the avoidance of doubt, no addition to the Fee shall be made in respect of any instruction or order issued by the Contractor to repeat, modify or revise the Services where the repetition, modification or revision required by the Contractor arose through any negligent act, omission, default or breach by the Consultant in carrying out the Services.

2.11.3 If the Contractor issues any instruction pursuant to clause 2.11, the Consultant shall immediately implement the necessary variation to the Services notwithstanding any disagreement between the Consultant and the Contractor as to any sum determined by the Contractor pursuant to clause 2.11.2 and, except as expressly excluded, the provisions of this Agreement shall apply to all Services which are the subject of the instruction.

2.12 In performing its obligations under this Agreement the Consultant:

2.12.1 shall comply with all Law and Consents (including without limitation the giving of notices and the obtaining of any such Consents which are the responsibility of the Consultant as set out in the Services) and so as not to prejudice the renewal of any such Consents;

2.12.2 shall act in a manner that is not likely to be injurious to health or to cause damage to property;

2.12.3 shall act in a manner consistent with the Quality Plans;

2.12.4 except to the extent expressly stated to the contrary in the Board's Construction Requirements, shall comply with all applicable NHS Requirements;

2.12.5 shall act in a manner consistent with the Board, Project Co and/or Contractor discharging their respective statutory duties and other functions undertaken by it as the same may be notified to the Consultant from time to time;

2.12.6 in so far as not in conflict with an express obligation of the Contractor under the Construction Contract, or where in relation to a matter there is no express obligation or standard imposed on the Contractor under the Construction Contract, shall act in accordance with Good Industry Practice;

2.12.7 shall carry out the Services in accordance with the Board's Construction Requirements;

2.12.8 shall comply with the CDM Regulations and in particular the obligations allocated to a "designer" as defined and set out in the CDM Regulations, and in particular Regulation 11, and will furnish to Project Co information showing how the Consultant has sought to eliminate hazards to health and safety and to assist it and its Other Consultants to do the same;

2.12.9 warrants it is competent to act as a designer as defined in the CDM Regulations, and will provide Project Co with reasonable evidence of the same in accordance with Regulation 4 and Appendix 4 of the Regulations, and has allocated and will continue to allocate adequate resources to enable it to undertake the Services and comply with the CDM Regulations;

2.12.10 will liaise and co-operate with the 'CDM Co-ordinator', as defined in Schedule 1, and provide all information and assistance reasonably required to see that the Project is undertaken at all times in accordance with the CDM Regulations;

2.12.11 shall notify the Contractor of any changes or potential changes to applicable statutory requirements, professional standards, codes of practice and regulations. The Consultant shall comply with any instruction issued by the Contractor to review and advise upon such foreseeable changes and there shall be no addition to the Fee in respect of such instructions, including, but not limited to, if such instructions require re-documentation save to the extent that the said changes were not reasonably foreseeable then any instruction issued by the Contractor pursuant to this clause shall be deemed to be a variation and valued in accordance with the principles set out in clause 2.11;

2.12.12 acknowledges that the Project and/or the Services may be subject to various performance ratings assessments during the design stages (including without limitation environmental assessments, sustainability and energy efficiency assessments). In performing the Services, the Consultant shall observe and implement the standards and recommendations described in the relevant assessments and any report of the assessors, provided these standards and recommendations are consistent with Project Co's Proposals for the Project;

2.12.13 shall comply with the requirements of all health and safety legislation, regulations, approved codes of practice and guidance documents;

2.12.14 shall establish and implement an effective safety management system complying with or certified to the requirements of OHSAS 18001. The Consultant recognises and shall undertake to operate within the requirements of the Contractor's Health and Safety Policy Statement;

2.12.15 shall submit to the Contractor a Quality Management Plan for comment and approval, which shall specify how the design is to be developed in accordance with British Standard EN ISO 9001 or 9002 (as the case may be) and which will make specific reference to the Consultant's internal quality management procedures including those in relation to:

(a) the design and development stages;

(b) the review, verification and validation that are appropriate to each design and development stage;

(c) the responsibilities and authority for design development.

2.12.16 shall, insofar as they relate to the performance of the Services, (and exercising the level of skill and care set out in clause 2.3.1) diligently and regularly review the various documents which are relevant to the performance of the Services obtained by or provided to it in connection with the Project in particular to ascertain whether any ambiguities, discrepancies, inconsistencies, divergences, design or construction impracticalities or omissions exist from, within or between any such documents so as to identify conflicts in the design. The Consultant shall forthwith notify the Contractor of any issue arising from such review and provide the Consultant's recommendations in respect thereof;

2.12.17 shall provide the Contractor with all reasonable assistance including arranging for the Contractor, its servants, agents and any Other Consultant employed by it to have access to personnel, and relevant design and project related information from time to time, whether stored in human readable or machine readable form, to enable the Contractor to carry out a

full and systematic review of any part of the Services, provided always that such assistance does not disrupt the performance of the Services by the Consultant. The Consultant shall ensure that in any agreement with any sub-consultant that such sub-consultant will be obliged to afford like assistance to the Contractor as aforesaid. For the avoidance of doubt, all assistance provided by the Consultant in accordance with this clause, save for the delivery of such information to the Contractor's office outside of the UK as required, shall not be a variation to the Appointment or the Services, and the Consultant shall not be entitled to any additional payment for providing such assistance;

2.12.18 shall include in each of its monthly reports written confirmation that:

(a) it has performed the Services to date in full compliance with this Agreement (or to the extent the Services have not been so performed, it shall identify areas of material non-compliance); and

(b) it is not aware of any reason that may cause or result in either an increase in the cost of the Project and/or a delay to the Project.

2.12.19 shall aim to minimise any adverse impacts that construction has on the environment. This shall be through the design process, materials selection, construction techniques, and operational methods;

2.12.20 shall undertake the Services having due regard to the Contractor's Environmental and Waste Minimization Policy Statement;

2.12.21 shall identify throughout the performance of the Services methods to reduce waste and waste to landfill, and increase reused and recycled content, which shall be reported to the Contractor at the end of each design and construction phase together with the financial and practical implications of implementing the recommended actions;

2.12.22 shall work with the project team to ensure that design actions to reduce construction waste and increase reused / recycled content are implemented;

2.12.23 shall agree with the Contractor which level of waste reduction and reuse to pursue;

2.12.24 shall work with the project team to develop a site waste management plan for the Project as soon as possible following commencement of the Services, including waste forecasts and data on reduction targets and actions;

2.12.25 shall use site waste management software nominated by the Contractor;

2.12.26 shall produce its design in accordance with and so as to meet the lifecycle replacement requirements and the energy performance targets as set out in clause 23 of the Project Agreement; and

2.12.27 shall comply with and produce its design in accordance with and so as to meet the Board's requirements in relation to achieving a minimum performance for BREEAM credit ENE 01 and a minimum Energy Performance Certificate rating, as set out in the Board's Construction Requirements.

3. **OTHER CONSULTANTS**

3.1 The Consultant shall where appropriate co-ordinate and integrate the performance of the Services with the services performed by the Contractor and/or the Other Consultants and/or with all relevant authorities and others involved on the Project and shall exercise the level of skill care and diligence referred to in Clause 2.3.1 to ensure it performs the Services in such manner so as not to interfere with any of the services provided by the Other Consultants.

3.2 The Consultant will prepare and supply to the Contractor and the Other Consultants such information and drawings (based on information available to the Consultant or reasonably obtainable by the Consultant) at such times as may be reasonably necessary and shall comply with the Deliverables Timetable and have due regard to the Programme.

4. **CONTRACTOR'S OBLIGATIONS**

4.1 The Contractor upon the request of the Consultant shall supply in such time as may be reasonable having regard to the timing and nature of any such request any reasonably necessary and relevant data and information in the possession of the Contractor and the Contractor shall give or shall request that the Other Consultants or Project Co give such assistance as shall be reasonably required by the Consultant in the performance of the Services provided that this obligation shall not affect the Consultant's obligation to liaise directly with the Other Consultants and with the Contractor in order to procure the production of any information to be supplied by such persons.

4.2 The Consultant acknowledges that the Contractor gives no warranty or undertaking of any nature in respect of the Disclosed Data and, specifically (but without limitation), the Contractor does not warrant that the Disclosed Data represents all of the information in its possession or power (either during the conduct of the tender process for the Project or at the time of execution of this Agreement) relevant or material to or in connection with the Project or the obligations of the Contractor under this Agreement or under any of the Project Documents. In addition, neither the Board, Project Co or the Contractor shall be liable to the Consultant in respect of any failure to disclose or make available to the Consultant (whether before, on or after the

execution of this Agreement) any information, documents or data, nor any failure to review or to update the Disclosed Data, nor any failure to inform the Consultant (whether before, on or after execution of this Agreement) of any inaccuracy, error, omission, defects or inadequacy in the Disclosed Data.

4.3 The Consultant acknowledges and confirms that:

4.3.1 it has conducted its own analysis and review of the Disclosed Data and has, before the execution of this Agreement, satisfied itself as to the accuracy, completeness and fitness for purpose of any such Disclosed Data upon which it places reliance; and

4.3.2 it shall not be entitled to and shall not make any claim against the Board, Project Co or the Contractor whether in contract, delict or otherwise including, without limitation, any claim in damages, for extensions of time or for additional payments under this Agreement on the grounds:

(a) of any misunderstanding or misapprehension in respect of the Disclosed Data; or

(b) that incorrect or insufficient information relating to the Disclosed Data was given to it by any person,

nor shall the Consultant be relieved from any obligation imposed on, or undertaken by it, under this Agreement on any such ground.

5. **FEE**

5.1 The Contractor shall pay the Consultant the Fee for performance of the Services in accordance with this Clause 5 and Schedule 1.

5.2 The Consultant acknowledges and agrees that:

5.2.1 it has no entitlement to payment whatsoever in respect of stages of the design (as detailed in the Fee Payment Schedule) that it has not been expressly instructed in writing by the Contractor to undertake;

5.2.2 until such time as the Contractor notifies the Consultant in writing that Financial Close has occurred, the Consultant shall only be entitled to be paid the Preferred Bidder Fee as set out in Schedule 1.

5.3 The Employer shall make the Financial Close Payment to the Consultant within 21 days of the occurrence of Financial Close. For the avoidance of doubt the Consultant acknowledges and agrees that it has no entitlement whatsoever to the Financial Close Payment (or loss of profit or otherwise) if Financial Close does not occur.

5.4 Not later than five (5) days before the end of each calendar month the Consultant shall submit to the Contractor:

5.4.1 a valid tax invoice showing the instalment of the Fee and any other sums which the Consultant considers is due under this appointment, together with value added tax. Invoices shall comply with Regulations 13 and 14 of the Value Added Tax Regulations 1995 (SI 2518) and shall be supported by documents necessary for verifying the same; and

5.4.2 a payment notice to the Contractor specifying the sum that the Consultant considers to be due or to have been due at the payment due date and the basis on which that sum is calculated with reference to the Fee Payment Schedule and progress of the Services ("Payment Notice").

5.5 The payment due date shall be the date of receipt by the Contractor of the documents required under clause 5.4 ("the Due Date"). The final date for payment shall be 30 days from the Due Date ("the Final Date for Payment").

5.6 The Contractor may give to the Consultant, not less than five (5) days before the Final Date for Payment, a notice of the payer's intention to pay less than the notified sum ("Payless Notice"). The Payless Notice shall specify the sum that the Contractor considers to be due on the date such notice is served and the basis on which that sum is calculated.

5.7 Without prejudice to any other rights or remedies at common law, the Contractor shall at all times before the completion of the Services be entitled to set off against or withhold against any monies due to the Consultant under this Appointment which the Contractor considers are due and payable by the Consultant under this Appointment provided that any such set off or abatement will be effected in accordance with this clause.

5.8 No later than three (3) days before the Final Date for Payment the Consultant shall submit a formal invoice for the amount stated in the Payment Notice issued pursuant to Clause 5.4 or as adjusted by the Payless Notice issued pursuant to Clause 5.6 as the case may be and (subject to receiving such invoices) the Contractor shall pay the Consultant all sums properly due under this Agreement on or before the Final Date for Payment.

5.9 Where any amount due is not paid by the relevant Final Date for Payment and the Consultant has issued the invoice required pursuant to clause 5.8 (taking account of any Payless Notice issued under Clause 5.6) and where such failure to pay has continued for thirty (30) days after the Consultant has given to the Contractor written notice of the amounts owed and of its intention to suspend the performance of any or all of its obligations under this Agreement, the Consultant shall be entitled to charge interest on any outstanding amounts at 3% above the Bank of England Base Rate,

such interest to be calculated on a daily basis from the Final Date for Payment, and to suspend performance (without prejudice to any other right or remedy) of any or all of its obligations under this Agreement. The right to suspend shall cease when the Contractor makes payment of the outstanding amounts and any period during which performance is validly suspended under this clause 5.9 shall be disregarded in computing the time taken by the Consultant to complete any of the Services affected by the suspension.

5.10 All payments made by the Contractor pursuant to this Agreement shall be on account save for the final payment upon completion of the Services.

6. PROFESSIONAL INDEMNITY INSURANCE

6.1 The Consultant shall maintain professional indemnity insurance with a reputable insurance company and which does not include any unusual exclusions or conditions covering its liability under this Agreement to cover claims arising out of any one claim or series of claims arising out of any one originating source or cause, for not less than the amount stated in Schedule 1 for a period ending twelve years after Practical Completion provided such insurance is available in the open market at commercially reasonable rates. The Consultant must ensure that such insurance shall cover the performance of any aspect of the Services by a sub-consultant engaged by the Consultant or alternatively that the relevant sub-consultant has taken out and maintained equivalent insurance with the effect that entirety of the Services are adequately insured up to the level of cover set out in Schedule 1.

6.2 If professional indemnity insurance ceases to be available in accordance with Clause 6.1 then the Consultant shall notify the Contractor before the expiry of its then current policy and the parties shall determine the best insurance cover available which the Consultant shall thereafter maintain at its cost.

6.3 The Consultant shall comply with all conditions and obligations of any insurance policy, and as and when reasonably requested to do so by the Contractor, the Consultant shall provide documentary evidence to the satisfaction of the Contractor that his professional indemnity insurance is being maintained, which shall include a letter from the Consultant's insurance provider confirming the same.

6.4 The above obligations in respect of professional indemnity insurance shall continue notwithstanding termination of this Agreement for any reason whatsoever, including (without limitation) breach by the Contractor.

6.5 Should the Consultant be in breach of any of the provisions of Clause 6, the Contractor may insure against any risk with respect to which the breach shall have occurred and may deduct the sum or sums equivalent to the amount paid or payable in respect of premiums from any monies due or to become due to the Consultant under this Agreement or may otherwise recover such sum or sums as a debt due to the Contractor by the Consultant.

7. **COLLATERAL WARRANTIES**

7.1 The Consultant shall, within 10 working days of a request by the Contractor to do so, enter into a collateral warranty in favour of Project Co, the Board, or a Funder in the form set out in Schedule 3 or in such other form as may reasonably be agreed between the parties.

7.2 The provision of any collateral warranties requested by the Contractor pursuant to clause 7.1 shall be a condition precedent to payment pursuant to this Agreement and the failure of the Consultant to provide any such requested collateral warranties will constitute valid grounds for the Contractor to issue a pay less notice pursuant to clause 5.3 of this Agreement.

7.3 The Consultant's obligation to provide the collateral warranties in favour of third parties shall continue notwithstanding termination of this Agreement for any reason whatsoever, including (without limitation) breach by the Contractor. However, any collateral warranty given after such termination shall be amended so as to refer to the fact and date of such termination, to omit any obligation to continue to exercise skill, care and diligence and any provision enabling a third party to assume the position of the Contractor.

8. **STAFF**

8.1 The Consultant's key personnel with responsibility for the Services are set out in Schedule 1 and the persons listed will remain involved in the performance of the Services (unless otherwise agreed with the Contractor) until completion of the Services. The Consultant shall not remove the said key personnel or any replacements of any of them without the prior written consent of the Contractor which consent shall not be required in case of permanent incapacity, death, sickness or where such person voluntarily leaves the employment of the Consultant. The Contractor shall be entitled to require the removal from the performance of the Services of any persons employed by the Consultant whose performance or conduct is, in the reasonable opinion of the Contractor, unsatisfactory and/or who do not evidence the necessary level of experience, qualification or competence to properly carry out the Services. The Consultant shall replace such removed person with a person of appropriate experience and expertise.

8.2 The Consultant shall at all times have adequate resources devoted to the Project so that the Services can be performed in accordance with any timetables agreed with the Contractor, and in accordance with the Deliverables Timetable and having due regard to the Programme.

9. **COPYRIGHT**

9.1 Copyright and all other intellectual property rights relating to or in the Deliverables and the Intellectual Property Rights shall remain vested in the Consultant, but the

Consultant hereby grants to the Contractor a free of charge, perpetual, irrevocable, royalty-free, non-exclusive and transferable licence to copy and use the Deliverables and the Intellectual Property Rights and to reproduce the designs contained in them for any purpose whatsoever relating to the Project including, but without limitation, the construction, completion, reconstruction, reinstatement, modification, extension, maintenance, operation, repair, letting, sale, advertisement or use of the Project and the Consultant shall ensure that the Contractor is provided with hard and electronic copies of such Deliverables as are necessary or desirable to enable the Contractor to carry out and complete the Project and to comply with its obligations under the Construction Contract and any of the Third Party Agreements.

9.2 To the extent that the Consultant is the owner of any copyright, design right, database right or other intellectual property right in the Design BIM and/or the BIM Outputs, the Consultant assigns to the Contractor with full title guarantee (by way of present assignation of future rights) (and insofar as such assignation is ineffective shall forthwith upon the Contractor's request assign) all of the rights, title and interest in all of the BIM Outputs and the Design BIM to the Contractor. The Contractor hereby grants to the Consultant a licence to use the BIM Outputs and the Design Model for the purposes of carrying out the Services. For the avoidance of doubt, the Consultant waives any intellectual property rights it may otherwise have in the Project BIM whatsoever.

9.3 The Consultant shall not without the Contractor's prior written approval use the Deliverables:

9.3.1 to design any building or structure obviously similar in overall design, appearance or features to the Project; and/or

9.3.2 for any purpose connected with the Project other than for the purposes of this Agreement and the completion of the Project.

9.4 The Consultant will work with the Contractor exclusively in connection with the Project and any future manifestations of the Project, and it will not provide services, advice, information or assistance to any other party in connection with the Project without the Contractor's prior written approval.

9.5 The licence granted pursuant to clause 9.1 above shall carry with it the right to grant sub-licenses and shall be transferable to third parties. The Consultant shall not be liable to the Contractor or any sub-licensee for any use of the Deliverables or the Intellectual Property Rights for any purpose other than that for which the same was prepared or provided by the Consultant.

9.6 The Consultant shall at any time (including after any termination or suspension of this Agreement) on request immediately provide the Contractor with further copies of any of the Deliverables referred to in clauses 9.1 subject to the Contractor undertaking to pay the Consultant's reasonable copying charges.

9.7 The Consultant hereby waives any rights it may have by virtue of Chapter IV (Moral Rights) of Part 1 of the Copyright, Designs and Patents Act 1988 and any revisions, re-enactments or similar ("the 1988 Act") in respect of both the Deliverables and the Project and agrees and undertakes that the Consultant will not assert against the Contractor or any other person, who with the Contractor's permission publishes commercially, exhibits in public, films, broadcasts, includes in a cable programme service, photographs or otherwise copies or deals with any image of the Project or any document, drawing or model prepared by the Consultant in connection with the Project any right which the Consultant may have to be identified as author of the Project (or any part thereof) or such document, drawing or model pursuant to Section 77 of the 1988 Act or any other legislation which may supplement the 1988 Act.

9.8 The Consultant undertakes to the Contractor that it shall observe all restrictions on copyright and other intellectual property rights as set out in the Construction Contract and any of the Third Party Agreements.

9.9 The Consultant warrants and undertakes to the Contractor that the design, construction, alteration, modification, extension, maintenance, repair and use of the Works or any part thereof in accordance with the Deliverables, the Intellectual Property Rights, the BIM Model and/or the BIM Outputs, and/or the use of the Deliverables, the BIM Model and/or the BIM Outputs, for any purpose described in clause 9.1 will not infringe any copyright, moral right, related right, patent, design right, trademark, service mark, trade name or other intellectual property right such as know-how, trade secrets or inventions (whether patentable or not) of any third party, and the Consultant shall indemnify the Contractor from and against any and all losses, expenses, liabilities, claims, costs or proceedings whatsoever arising by reason of this warranty being or becoming incorrect.

9.10 All documents made available by the Contractor to the Consultant in connection with the Project or otherwise must be returned to the Contractor on the earlier of completion of the Services or termination of the Consultant's appointment under this Agreement.

9.11 The Consultant hereby indemnifies the Contractor against all actions, suits, claims, demands, losses, charges, damages, costs and expenses and other liabilities which the Contractor may suffer or incur as a result of or in connection with any infringement or alleged infringement of any intellectual property rights of any person arising from the carrying out of the Works and any use of the Deliverables, except to the extent that such claim relates to the use of material supplied by the Contractor or the use of the Deliverables which is the subject of the licence set out in clause 9.1 for purposes not permitted under the terms of licence.

9.12 The provisions of this clause 9 shall continue to apply notwithstanding the completion of the Services or the termination of the Consultant's appointment under this Agreement.

10. **BIM**

10.1 The Consultant shall, in performing the Services, comply with and adhere to the BIM Protocols and the BIM Execution Plan. Without limiting its other obligations under this Agreement, the Consultant shall as part of the Services and as often as necessary update the Design BIM in accordance with the BIM Protocols and the BIM Execution Plan and see that updates to the Design BIM have been carried out correctly and that the Consultant's designs are accurately depicted on or incorporated into the information set out in the Design BIM. In doing so, the Consultant must ensure that information is updated to the Design BIM and provided to the Project BIM Manager promptly to ensure the Project BIM is kept continuously up to date.

10.2 Exercising the standard of reasonable skill, care and diligence required pursuant to clause 2.3.1 of this Agreement, the Consultant warrants the accuracy of each Design BIM and the BIM Outputs and confirms it remains responsible for the Design BIM and the BIM Outputs notwithstanding its incorporation into the Project BIM.

10.3 As soon as it is practicable, but in no event later than thirty (30) days after the latter of the execution of the Construction Contract or the date of this Agreement, the Contractor and the Consultant shall meet with the Other Consultants and Project Co and confer and use their best efforts to agree upon the terms of or modifications to a BIM Execution Plan. The Project BIM Manager shall be responsible for compiling the final BIM Execution Plan. The parties shall work in accordance and comply with the BIM Execution Plan.

10.4 Unless otherwise agreed, the Project BIM Manager shall schedule and chair all such meetings.

10.5 The BIM Execution Plan shall address the following elements, but may include additional elements:

10.5.1 Contact information for each party contributing to the BIM Model ("a Project Participant");

10.5.2 Identification of what Design BIM are to be created, the purpose(s) each Design BIM Model is intended to serve, and which Project Participant(s) is(are) responsible for creating each Design BIM;

10.5.3 Procedures and protocols for 3D co-ordination and clash detection;

10.5.4 Procedures and protocols for quality control of the Design BIM;

10.5.5 Procedures and protocols for BIM quality audits;

10.5.6 The spatial portions or areas of the Project to be modelled in each Design BIM;

10.5.7 The expected content of each Design BIM and the required level of detail at various Project milestones, which content includes

(a) geometric and spatial data;

(b) object property data;

(c) object constitution data;

(d) provision for object parameters as place holders for cost and schedule data; or

(e) authoritative source information;

10.5.8 A schedule of Design BIM exchange and delivery of both the Design BIM and BIM Outputs to the Project BIM Manager;

10.5.9 A schedule for updating of each Design Model and preservation of versions of each Project BIM and its constituent Design BIM models;

10.5.10 A definition of what Design BIM or Project BIM Models shall constitute part of the record documents for the Project;

10.5.11 Procedures and protocols for submission of a Design BIM, including electronic stamping, and for designating a Design BIM as a design model;

10.5.12 Procedures and protocols for designating two-dimensional projections derived from a Design BIM as being contractually binding;

10.5.13 Establishment of a common coordinate system;

10.5.14 Establishment of conventions as to units;

10.5.15 Conventions for defining critical dimensions and critical BIM Model content;

10.5.16 File format to be used;

10.5.17 Software to be utilized;

10.5.18 Measures needed to achieve interoperability of applications;

10.5.19 Utilization of a Design BIM for RFI process;

10.5.20 Utilization of a Design BIM for the change order process;

10.5.21 A schedule for BIM development, coordination and clash detection meetings among the Project Participants;

10.5.22 Utilisation of Aconex or such other data sharing system notified by the Contractor;

10.5.23 Procedures and protocols for confirmation of field changed through an as-built Project model;

10.5.24 Specification of Project close-out and final deliverables; and

10.5.25 The extent, if any, to which Project participants or specified staff for each will be co-located.

11. APPROVALS

The obligations of the Consultant under this Agreement shall not be lessened or affected by:

11.1 any power or duty of Project Co, the Independent Tester, the Contractor, the Project Manager or any of the Other Consultants to grant or withhold approval of, or object to, any matter in connection with the Project, or to inspect the Project; or

11.2 the granting, or failure to grant, such approval, or the making, or failing to make, such objection;

11.3 any inspection of, or failure to inspect, the Project; or

11.4 the incorporation, approval, integration and co-ordination of the Consultant's Deliverables, the Design BIM and the BIM Outputs into the Project BIM alongside the design deliverables produced by the Other Consultants.

12. TERMINATION AND SUSPENSION

12.1 The Contractor may suspend the whole or any part of the Services at any time upon 10 working days written notice. Subject to Clause 12.7 the Contractor shall pay the Consultant all sums properly due to the Consultant in accordance with this Agreement up to the date of suspension.

12.2 In the event of a suspension of the Services the Contractor may at any time within a period of 12 months of the suspension require the Consultant to resume performance of the Services upon 10 working days written notice. In the event that the Contractor has not instructed the Consultant to resume performance of the Services within 12 months of the date of suspension, the Consultant shall be entitled to give the Contractor 10 working days written notice of his intention to terminate his appointment in respect of the Services that have been suspended pursuant to clause 12.1. If the Contractor does not serve a counter notice upon the Consultant within the said 10 working days requiring him to resume performance of such Services, the Consultant shall be entitled to terminate the appointment only in respect of the Services that have been suspended pursuant to clause 12.1.

12.3 The Contractor reserves the right to terminate the Consultant's appointment at any time on 20 working days written notice, in which case, subject to the Consultant complying with the requirements of clause 12.7 and any other rights and remedies which the Contractor might have, the Contractor will be liable to pay the Consultant such proportion of the Fee as is reasonable in all the circumstances in relation to the Services carried out prior to the termination.

12.4 The Contractor may terminate the Agreement immediately and without notice to the Consultant in the event that the Consultant has a winding up order made against it, has a provisional liquidator appointed to it, passes a resolution for winding up, has an administration order made against it, has a receiver, receiver and manager or administrative receiver appointed over the whole or a substantial part of its undertaking or assets, or has made an arrangement with creditors.

12.5 This Agreement shall automatically terminate if the Contractor's employment is terminated under the Construction Contract.

12.6 The Consultant may terminate its appointment upon 20 working days written notice, in the event that an Insolvency Event occurs in respect of the Contractor or the Contractor has not paid the Consultant any sums properly due under this Agreement and has failed to remedy such breach within 20 working days of receipt of a written notice from the Consultant requiring it to do so.

12.7 Upon any termination or suspension of the Consultant's appointment, the Consultant shall forthwith deliver to the Contractor all Deliverables in its possession relating to the Project and shall take immediate steps to bring to an end the Services in an orderly manner, but with all reasonable speed and economy. The delivery of all Deliverables to the Contractor is a condition precedent to the Consultant's entitlement to be paid any further monies pursuant to this Agreement following a suspension and/or termination.

12.8 Upon any termination or suspension of the Consultant's appointment and whether or not such termination or suspension shall have arisen as a result of any fault, negligence or breach of contract by the Contractor, the Contractor shall not be liable to the Consultant for any Indirect Losses, including loss of profit, loss of contracts or other losses and/or expenses arising out of or in connection with such termination or suspension. Termination or suspension of the Consultant's appointment shall be without prejudice to the parties' respective rights and liabilities under this Agreement.

12.9 In the event that the Consultant's appointment is terminated by reason of its default of its obligation, or pursuant to Clause 12.4, 12.5 or 21.2, then the Consultant shall not be entitled to any further payment until after completion of the Services by a replacement consultant. The Contractor shall have the right to set off against the aforesaid payment any losses that it sustains by reason of the Consultant's failure to complete the Services.

13. **ASSIGNATION**

The Contractor shall be entitled to assign its entire benefit under this Agreement at any time for the sole purpose of completing the Services. The Consultant shall not assign charge or transfer any right or obligation under this Agreement.

14. **CONFIDENTIALITY**

14.1 Save as may be necessary for the proper performance of the Services, the Consultant may not disclose to any third party or make use of any information of any kind whatsoever relating to the Project (including but not limited to any or all Deliverables) without the Contractor's prior written consent.

14.2 Unless otherwise required by any Law or any regulatory or governmental authority (but only to that extent), the Consultant shall not make or permit or procure to be made any public announcement or disclosure (whether for publication in the press, the radio, television screen or any other medium) of any Confidential Information or the Consultant's interest in the Project or, in any such case, any matters relating thereto, without the prior written consent of the Contractor (which shall not be unreasonably withheld or delayed).

15. **SUB-CONTRACTING**

The Consultant shall not sub-contract to or allow any other person to perform any of the Services without the Contractor's prior written consent. The Consultant shall remain responsible for the performance of any of the Services so sub-contracted as if no sub-contracting had occurred.

16. **OTHER AGREEMENTS**

The Consultant confirms it has received copies and reviewed the Construction Contract and the Third Party Agreements. The Consultant shall as far as is consistent with the terms of this Agreement take into account the provisions of the Construction Contract and Third Party Agreements as they may relate to the Project and where appropriate actively assist the Contractor in complying with its obligations under the Construction Contract and such Third Party Agreements and subject to clause 2.3 perform the Services so that no act, omission or default on its part shall constitute, cause or contribute to any breach by the Contractor of the Construction Contract or such Third Party Agreements.

17. **INDEMNITIES**

17.1 The Consultant shall indemnify and keep the Contractor indemnified at all times from and against all Direct Losses sustained by the Contractor or for which the Contractor becomes liable by reason of any act or omission of the Consultant for which the Consultant acknowledges may include any Direct Losses sustained by the Contractor in consequence of:

17.1.1 any claim for, or in respect of, the death and/or personal injury of any employee of, or person engaged either directly or indirectly by the Consultant notwithstanding any act or omission of the Contractor;

17.1.2 any claim for, or in respect of, the death and/or personal injury of any third party (other than a person referred to in clause 17.1.1) arising due to the breach of this Agreement by the Consultant;

17.1.3 any physical loss of or damage to property or assets of Project Co, the Board, the Contractor or any other third party arising by reason of any act or omission of the Consultant arising due to the breach of this Agreement by the Consultant;

17.1.4 any breach of and/or any negligent act in complying with the terms of the Board's Construction Requirements save to the extent such breach arises due to the breach of any express provision of this Agreement by Contractor or any deliberate or negligent act or omission of the Contractor.

18. **ENTIRE AGREEMENT**

This Agreement supersedes any previous agreement or arrangements between the parties or the Consultant and any other party previously interested in the Project in respect of the Services (whether written or oral) and represents the entire understanding between the parties in relation thereto. All additions, amendments and variations to this Agreement shall be binding only if in writing.

19. **NOTICES**

Any notice provided for in accordance with this Agreement shall be deemed to be duly given if it is delivered by hand at, or sent by registered post or electronic transmission to the party named therein at, the address of such party shown in this Agreement or such other address as such party may by notice in writing nominate for the purpose of service (such notice to be acknowledged in writing by the recipient), and if sent by registered post shall be deemed to have been received not later than forty eight hours after the same shall have been posted.

20. **GOVERNING LAW AND JURISDICTION**

20.1 This Agreement shall be governed by and construed in accordance with Scottish Law.

20.2 Subject to Clause 20.3, the parties submit to the jurisdiction of the Scottish Courts.

20.3 If any dispute shall arise under this Agreement, the Dispute Resolution Procedure set out at Schedule Part 20 of the Project Agreement shall apply.

20.4 Notwithstanding any other provision of this Agreement, where an adjudicator or other relevant court has made a decision in relation to a dispute under the Project

Agreement or the Construction Contract then that decision shall be binding on the Parties insofar as that decision relates to any issue under this Agreement.

20.5 If any provision of this Agreement is determined to be invalid or unenforceable as against any party the remainder of this Agreement shall not be affected thereby. Each provision of the Agreement shall, except as otherwise provided herein, be valid and enforced to the fullest extent permitted by law.

21. **BRIBERY ACT**

21.1 The Consultant undertakes to the Contractor that:

21.1.1 it has not given or agreed to give and shall not during the term of this Agreement give or agree to give to any person any bribe on behalf of the Contractor or otherwise with the object of obtaining a business advantage for the Contractor;

21.1.2 it has not offered or given or agreed to give or accepted or agreed to accept to or from any person any gift or consideration or commission of any kind as an inducement or reward for doing or forbearing to do or for having done or forborne to do any action in relation to obtaining or execution of this or any other agreement relating to the Project or for showing or forbearing to show any favour or disfavour to any person in relation to this or any other agreement relating to the Project;

21.1.3 during the term of this Agreement it will not engage in any activity or practice which would constitute an offence under any applicable anti-corruption laws;

21.1.4 it has and during the term of this Agreement will maintain in place its own policies and procedures including Adequate Procedures to ensure compliance with any applicable anti-corruption laws and will impose similar obligations on its own sub-consultants and supply chain; and

21.1.5 from time to time during the term of this Agreement, at the reasonable request of the Contractor, it will confirm in writing that it has complied with its undertakings under clause 21.1 and will provide any information reasonably requested by the Contractor in support of such compliance.

21.2 In the event that the Contractor has at any time during the term of this Agreement reasonable cause to believe that the Consultant or his agents, contractors, sub-contractors, and/ or sub-consultants or any person employed by him or them or acting on his or their behalf (whether with or without the knowledge of the Consultant) or his agents, contractors, sub-contractors and/or sub-consultants is in breach of any of the provisions of clause 21.1 the Contractor may suspend performance of or terminate this Agreement with immediate effect by the service of written notice on the Consultant.

22. **THIRD PARTY RIGHTS**

Save to the extent expressly provided in this Agreement and, to avoid doubt, without prejudice to the rights of any permitted assignee, it is expressly declared that no rights shall be conferred under and arising out of this Agreement upon any person other than the Contractor and without prejudice to the generality of the foregoing, there shall not be created by this Agreement a *jus quaesitum tertio* in favour of any person whatsoever.

23. **LIMITATION**

No action or proceedings for any breach of this Agreement shall be commenced after 12 years from Practical Completion.

IN WITNESS WHEREOF these presents typewritten on this and the preceding 28 pages together with the 10 annexed Schedules are executed by the parties hereto as follows:

SUBSCRIBED for and on behalf of **BROOKFIELD MULTIPLEX CONSTRUCTION EUROPE LIMITED**

at Lo[redacted]

on the 13[redacted] 5 as follows: -

.....[redacted] ~~Authorised Signatory~~)

BEND[redacted]

Before this[redacted]

Witness Signature: .....

Full name THOMAS MARKE

Address 99 Bishopsgate,

London EC2M 3XD

.....

SUBSCRIBED for and on behalf of **TUV SUD LIMITED (trading as WALLACE WHITTLE**

at GLASGOW

on the 2ND day of FEBRUARY 2015 as follows: -

[redacted] (~~Director~~/Authorised Signatory)

ALAN McGILL

Before this witness: - [redacted]

Full name DONNA MILLER

Address 369 BATH STREET

GLASGOW G2 4AA

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SCHEDULE 1

PROJECT PARTICULARS

The Site:	The area of land adjoining the Royal Infirmary of Edinburgh at Little France made available to the Consultant for the Project
The Project:	Design and construction of the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France
Project Co:	IHS Lothian Limited
The Project Manager:	Such party appointed by Project Co and notified to the Consultant.
Independent Tester:	Such party appointed by Project Co and notified to the Consultant.

Consultant Team:	Lead Designer	HLMAD Ltd
	Architect	HLMAD Ltd
	Structural Engineer	Robert Bird and Partners Ltd
	Building Services Engineer	TUV SUD Ltd
	CDM Co-ordinator	The Contractor (sub-consulted to Brookfield Multiplex CDM Services Europe Ltd)
	Landscape Architect	HLMAD Ltd
	Acoustics Consultant	Acoustic Logic Consultancy (UK) Ltd
	Project BIM Manager	HLMAD Ltd
	Traffic Consultant	Ove Arup & Partners Ltd
	Planning Consultant	Ironside Farrar Ltd
	Fire Engineer	WSP Ltd
Consultant's Key Personnel:	Stewart McKechnie	
The required minimum indemnity limit under the professional indemnity to be maintained by the Consultant:	£15,000,000 (Fifteen Million pounds) for each and every claim.	
Specialist Consultants	None	
The following sub-consultants are the Specialist Consultants and all costs and co-ordination are deemed inclusive within the Fee and the terms of this Agreement.		

The Fee

The total Fee for the Project is [£2,160,000.00] (as broken down below) and is payable in accordance with Clause 5 and the Fee Payment Schedule set out below.

- The Fee payable for Services performed up to Financial Close is [£200,800.00] ("the Preferred Bidder Fee")
- The Financial Close Payment is [£135,200.00]
- The Fee payable for Services after Financial Close is [£1,824,000.00]

Fee Payment Schedule

The following is the Fee Payment Schedule referred to in clause 5 of the Appointment. Payment will be subject to a review of deliverables and as such the Consultant should ensure that an application is submitted for review by the due date as shown.

Design Stage	Fee
Design to end Feb '15	£106,666.67
Design to end March '15	£106,666.67
Design to end April '15	£106,666.67
Design to end May '15	£106,666.67
Design to end June '15	£106,666.67
Design to end July '15	£106,666.67
Design to end August '15	£106,666.67
Design to end Sept '15	£106,666.67
Design to end Oct '15	£106,666.67
Design to end Nov '15	£54,000.00
Design to end Dec '15	£54,000.00
Design to end Jan '16	£54,000.00
Design to end Feb '16	£54,000.00
Design to end March '16	£54,000.00
Design to end April '16	£54,000.00
Design to end May '16	£54,000.00
Design to end June '16	£54,000.00
Design to end July '16	£54,000.00
Design to end August '16	£54,000.00
Design to end Sept '16	£54,000.00
Design to end Oct '16	£54,000.00

Design to end Nov '16	£54,000.00
Design to end Dec '16	£54,000.00
Design to end Jan '17	£54,000.00
Design to end Feb '17	£54,000.00

SCHEDULE 2

SERVICES

The following schedule and contents listed was issued to the Consultant via Aconex Transmission BMCE-TRANSMIT-001242 dated 2 February 2015 from Liane Edwards-Scott timed at 13:20 GMT.

- Scope of Services Appendix A MEP Design Demarcation Matrix 300115

SCOPE OF SERVICES

relating to

the Re-provision of the Royal Hospital for Sick Children,

Child and Adolescent Mental Health Service

and the Department of Clinical Neurosciences in a single building adjoining

the Royal Infirmary of Edinburgh at Little France, Edinburgh

(MEP) Services Engineer

Tuv Sud t/a Wallace Whittle

18 December 2014

Table of Contents

1. OUTLINE

Introduction

1.1 The Royal Hospital for Sick Children and Department of Clinical Neurology Project consists of new acute children's hospital and re-provision of Department of Clinical Neurology, Energy Centre, and associated support facilities and infrastructure for NHS Lothian (the Board).

The Project is located on the existing hospital site at the Royal Infirmary of Edinburgh (RIE) at Little France Edinburgh which is required to remain operational during the execution of the Works. The Project is to provide in the order of 51000m2 of internal area comprising approximately 400 beds in addition to the development of the external spaces.

1.2 The Services shall be the provision of professional labour, supplies, systems and other resources as necessary to design, specify, document, inspect, report and certify the building services elements of the Works for the Project. The Services outlined herein are the basic scope of works specifically applicable for this Project and are completely allowed for in the initial total fee.

1.3 Key Performance Indicators (KPIs) – The quantitive KPIs are defined in the Contract Datain addition to the Design Programme and the Cost Plan referenced in the Building Contract. This Scope of Services represents the qualitative KPIs to be achieved by the Consultant.

1.4 The Consultant shall adequately and timely coordination, cooperation and liaison with other consultants, subcontractors, suppliers, Authorities and other relevant parties/stakeholders to clearly define the relevant Project works, which minimises the Project costs, time and risk.

1.5 The Consultant's coordinated design and documentation shall be fully integrated with all relevant designs and advice from other consultants, the subcontractors (where arranged by the Employer) and Statutory Authorities.

1.6 The Services are to be provided in the following Work Stages:

- Concept Design and Design Development
- Construction Documentation and Construction Phase
- Commissioning, Completion and Post Completion

Note: Notwithstanding the entry point to an individual scheme or design task, the Consultant is required to review all the previous information for the scheme made available by the Employer in addition to those sourced by the Consultant and undertake the Services irrespective of where the Services is listed in order to enable the Employer to complete the Works.

Performance Standards

1.7 The Consultant shall submit its Quality Plan for review by the Employer. The Consultant shall amend its Quality Plan as reasonably required by the Employer. The Quality Plan shall explain how the design and documentation work are to be planned to the standard specified in ISO 9001:2008 particularly the Section 7.3 and shall include:

- The design and documentation stages
- The review, verification and validation that are appropriate to each design and documentation stages

- The responsibilities and authority for design and documentation

The Consultant shall review and comment on the Quality Plans (especially the Quality Inspection and Test Plans) from the subcontractors and suppliers as reasonably required by the Employer.

1.8 The Documentation (or Documents) to be provided by the Consultant shall be all that is required in order that the Project can be completed in the most time and cost efficient manner and shall include but not be limited to:

- Drawings (including 3D as required)
- Schedules
- Specifications
- Working models, illustrations and other presentation materials
- Calculations and sketches
- Reports (including Progress Status)
- Certifications (including Compliance)
- Meeting minutes, file notes etc.

1.9 Conform with the Project specific documentation protocols as updated from time to time by the Employer (or its designate) including the CAD& BIM parameters and electronic documentation transfer facilities such as the FTP websites or as requested by the Employer. Further information is contained within Section 6.0 for BIM requirements & compliance. Reference should also be made to the separate BIM responsibilities matrix documentation.

1.10 In respect of all Work Stages, the Consultant shall:

a) Perform the Services in a diligent manner with the standard of skill and care and undertake any work falling within the level of Services to be reasonably expected of a Consultant appointed for a Project of a similar size, scope and complexity.

b) Ensure that it has the necessary skill and resources to provide the Services and acknowledges that in reliance on this obligation, the Employer has agreed to engage the Consultant to perform the Services.

c) Take all necessary steps on an ongoing basis so that all persons engaged for the Services are properly qualified, competent and experienced for the size, scope and complexity of the Project.

d) Inform itself of the Project requirements by regularly consulting with other relevant parties and the Employer. Review all relevant documents and immediately inform the Employer of any apparent errors or ambiguities contained in such documents and make recommendations for the correction of such ambiguities.

e) Keep secure the Employer materials and documents and return them at the end of this Appointment.

f) Strictly remain within the scope of the authority granted by the Employer and not act beyond its authority or hold out that it has authority beyond this Appointment.

g) Seek the Employer's prior consent to any proposed sub-letting or employing outside agency and/or self employed staff.

h) Comply with all policies relating to the use of the Employer office premises and facilities when using them.

i) Permit the Employer to carry out agreed and scheduled visits to the Consultant's business premises in connection with the Services.

j) Keep proper commercial records and accounts for any claims it makes on the Employerincluding if applicable, for reimbursement of expenses and remuneration of fees based on time charged billing and permit the Employer auditors to inspect such records and accounts.

k) Nominate a person or persons who have authority to receive notices and take instruction under this Appointment and not change such nominees without the consent of the Employer.

l) Liaise and cooperate with the other consultants employed (and likely to be employed) by the Employer for the purpose fulfilling its obligation that the Project shall be designed in compliance with the Project requirements.

m) Coordinate and manage the sequence of design and documentation production.

n) Provide Technical Advisory role to the Employer for design works provided by others associated with the Project.

Performance Obligations

1.11 The Consultant shall:

a) Carry out the Services using proven best up-to-date practice and to appropriate standards (having regard to the nature of the Project) and consistent with the intended use of the Project.

b) Comply with the requirements of planning consent for the Project and with all Statutory Authorities requirements and regulations and with all other legislation applicable to the Services and/or to the Works.

c) Comply with all specific standards contained in this Appointment. If no such standards are stated in this Appointment and if they cannot be reasonably inferred from the Project Documents, the standards shall be those required by relevant British Standards and/or UK Building Regulations and/or any relevant applicable legislation and/or relevant local Statutory Authority requirements.

d) Comply with the Employer's Requirements and the Contractor's Proposals.

e) In the event of any discrepancies, ambiguities and inconsistencies within and/or between the Project documents, such discrepancies shall be decided on by the Employer and the Consultant shall at no cost to the Employer and that the Services and any Documentation prepared by the Consultant in relation thereto shall comply with and meet the requirements as decided by the Employer.

f) Progressively submit the Consultant's Documentation and any other documentation included within the ambit of the Services to the Employer by the dates specified in the Programme or if no dates are specified, in accordance with the progress of the Works and the Employer's reasonable requirements.

g) In respect to all drawings produced as part of the Documentation are computer generated and capable of being transferred into 'tiff', 'pdf, and 'dwg' formats or other format approved by the Employer. The Consultant shall send and receive written correspondence, drawings, schedules and specifications and any other relevant documentation by a controlled web based document management system (Aconex) in

accordance with the rules and procedures (updated from time to time) as provided by the Employer.

h) In reference to the specifications as referred to in the definition of Documentation are in A4, double sided and comprising of two bound copies and one copy on a portable memory storage device. The Consultant shall also upload one copy onto a web based document control system (Aconex). The specifications shall be in full compliance with the Project requirements and shall be complete and coordinated with all other consultants in a format agreed by the Employer. The specifications shall be in trade sections and capable and suitable for the Employer to invite tenders for the various packages of work and for the subsequent construction and completion of the Project. The specifications shall also incorporate, but not be limited to, materials, finishes workmanship and quality standards and other items as may be reasonably required by the Employer.

i) Include all those duties that are set out in this Schedule together with those duties that can be reasonably expected from the Consultant, preparing design and documentation for works of a similar size, scope, nature, value and complexity of the Project.

j) Specify the materials and its method of use, fixing or working that do not infringe any patent, registered design, copyright or other protection rights.

k) Review and comment on all relevant temporary works as reasonably requested by the Employer in completing the Project.

l) Send, receive, review and comment all information in relation to O&M manuals which may be by a controlled web based management system.

m) Provide advice and documents as required to assist the Employer in the maintenance of the building to ensure whole-life costs are minimised.

n) Provide information as requested by the Building Owner, Funders, Facilities Manager, Operators and the like.

o) Coordinate, incorporate and document where relevant to the building services, all fire protection and acoustic treatment measures in consultation with the Fire Engineer and Acoustic Engineer respectively.

p) Proactively endeavours to maximise the BREEAM rating of the Project and develop energy efficient strategies.

q) Evaluate, design, specify and document Secure by Design, acoustical and fire protection measures related to their Services and where applicable to satisfy building insurance requirements. Should there be exceptional insurance requirements, such information to be made available to the Consultant in a timely manner during the design period.

r) In reference to CDM 2007 Regulations and in particular Regulation 11 that requires the Designers to eliminate hazards which may give rise to risks to those undertaking construction work or subsequently using the building, and to reduce any hazards which cannot be eliminated. The Consultant shall produce information to the Employer, other Designers and Contractors in this regard and where possible this information shall be included in all Documentation especially the drawings issued by the Consultant.

s) Submit evidence of competence to comply with the CDM 2007 Regulations as per Regulation 4 and as set out in Appendix 4 of the Regulations.

t) In providing the Services, the Consultant shall aim to minimise any adverse impacts that construction has on the environment. This shall be through the design process, materials selection, construction techniques and operational methods. Specific information on the Employer's policy which the Consultant is required to comply is set out in the Environmental Policy Statement (refer Schedule 5 of the Consultants Appointment).

The Consultant shall work towards to reduce waste and use materials efficiently and proactively assist in reaching the Employer's objective as outlined in the Waste Policy Statement (as set out below).The Consultant shall support this Policy by:

- Assist in developing the Site Waste Management Plan from an early design stage, including waste forecasts and data on reduction targets and actions.
- Assist in implementing the Site Waste Management Plans throughout the design and construction period that comply with the applicable Regulatory requirements and include in such Plans project-specific targets for waste recovery and reused and recycled content and for waste reduction;
- Identifying methods to reduce waste and waste to landfill and increase reused and recycled content, throughout the duration of providing the Services and report to the Employer. In this regard, the Consultant shall use site waste management software nominated by the Employer which shall be WRAP's Designing out Waste Tools or Net Waste Tool (accessible at www.wrap.org.uk/nwtool) unless notified otherwise;
- Work with the Project team to ensure that design actions to reduce construction waste and increase reused / recycled content are implemented;
- Agree with the Employer which level of waste reduction and reuse to pursue.

Note: The Consultant should refer to the WRAP Designing out Waste guidance to identify, prioritise and implement ways of meeting Project targets for waste.

Meetings

1.12 The Consultant shall:

a) Attend and issue records of the meetings and workshops for those in relation to the design, construction, value engineering, risk management and co-ordination of the building services as required by the Employer.

b) Attendance may be required for factory visits and design and or construction meetings at off site locations.

c) Attend and issue records of the design meetings with other consultants as necessary to integrate, coordinate and clarify the Works during the Project as reasonably required by the Employer.

d) Attend and issue records of the meetings with Statutory Authorities as reasonably required by the Employer.

e) Attend and issue records of the meetings with the Employer as reasonably required on all relevant Project issues.

f) Provide draft minutes for all of the above meetings, workshops and the like as required for review by the Employer or distribute as requested by the Employer.

Reports

1.13 The Consultant shall:

a) Provide periodic status reports (fortnightly and/or monthly to be agreed with the Employer) in a form reasonably required by the Employer which shall include as a minimum, a summary documenting the progress of the Services against the Design Programme and Documentation Schedules. Highlight areas of difficulty being experienced with progress of the Services, design co-ordination issues, Statutory Authority approvals status and the like including the proposed mitigating measures.

b) Undertake site inspection as reasonably required or as requested by the Employer and provide inspection reports including tracker schedules to monitor close-out of issues identified which will require revisiting the site.

c) Prepare report or documentation required (on a reasonable and realistic basis) for the assessment of design alternatives and in contemplation of envisaged change to the Project requirements.

d) Not used.

e) Progressively compile and provide design risk registers.

f) Provide compliance reports confirming compliance with the Project documents such as the Employer's Requirements and other compliance reports as requested by the Employer.

g) Provide non compliance reports in relation to the construction works when requested by the Employer in a workable electronic format including photographs.

h) Provide draft reports for all of the above for review by the Employer prior to the formal issue.

i) Not used.

j) Provide reports on energy performance during the 12 months Defect Liability Period based on the information provided by the Employer.

Certification

1.14 On a periodic basis (once a month as a minimum) or when requested by the Employer, provide a progress certification that the design and documentation work done to that period is in accordance with and complies with the Project requirements such as the Employer's Requirements, the Cost Plan, the Programme, Contractor's Proposals and with all relevant Statutory Authority requirements.

Authorities

1.15 The Consultant shall:

a) Liaise with the Employer, other consultants and all relevant Statutory Authorities for the purpose of confirming that the design complies with all Planning consent conditions.

b) Liaise with the Employer, other consultants, and others involved in the Works, including without limitation the CDM Coordinator, subcontractors and all relevant Statutory Authorities for the purpose of confirming that the design complies with all relevant Statutory Authority requirements and for obtaining all necessary permits and approvals. Incorporate all relevant Statutory Authority requirements into the design and documentation.

c) Advise on the need to obtain further Planning permissions, Building Regulation approvals and any other Statutory approvals and prepare all necessary associated applications for consideration by the Employer.

d) Liaise closely with all relevant utility companies, service providers and others involved in the identification, relocation and modification of utility services affected by the Project.

e) Prepare coordinated Documentation in conjunction with other consultants for submission to the relevant Authorities. All such Documentation is to be discussed with the Employer prior to submission to the Statutory Authority.

f) Revise and re-submit submissions to the Planning Authority as required where the development of the design has varied from the original Planning consented scheme. Amend Documentation in conjunction with other consultants for resubmission to other relevant Statutory Authorities arising from any directives, requirements or comments from the Employer or Statutory Authorities including those on the previous submissions.

g) Review all relevant Statutory Authority approvals and conditions. Contribute toa schedule/checklist for review by the Employer to monitor timely discharge of all conditions and actions to be carried out by the Consultant in conjunction with other consultants and to be incorporated into the Project.

h) Liaise with all relevant Authorities for expeditious approval and attend all meetings as required by the Employer. Update and amend documentation in conjunction with others as required, to obtain all regulation modifications, approvals and permits.

i) Highlight opportunities to the Employer in respect to alternative means of achieving the Statutory compliance for the benefit of the Project including waivers, relaxations and dispensations. Where requested by the Employer, negotiate the same with the Authorities.

j) Revise documentation as necessary to reflect the outcome of the negotiations with the Statutory Authorities.

k) Assist the Employer with any relevant tests and inspections required by the Statutory Authorities and in obtaining all permits, approvals and certificates required for the lawful use of the Project.

l) Complete all relevant certificates associated with the Services as and when required by the Employer and liaise with Statutory Authorities for the purpose of assisting in obtaining staged building permits and other approvals.

m) Prepare design certification necessary for the completion of the Project and/or the granting of relevant Statutory Authority for Completion, occupancy and title.

n) Provide coordinated sections & plans relating to Service strip requirements, including existing services.

Specific Designs

1.16 The Services to be provided by the Consultant shall include the design and documentation for the following elements of the Worksbut not necessarily be limited to:

Mechanical and Public Health Systems

The Consultant's design shall cover all works associated with the mechanical and public health systems to comply with the fire strategy, acoustic requirements and all systems necessary as set out below for a fully operational building.

- Chilled water system including high efficient chillers, pumps, heat exchangers etc.
- MTHW & LTHW systems including plant and equipment, valves and pipe systems and interfaces with the RIE Link Corridor.
- CHP system with all plant and equipment.
- Condensate drainage systems including all condensate pumps, pipework and traps.
- Air conditioning systems including all air handling units, chilled beams, fan coil units, distributed ducted system, diffusers, return air plenums, fresh air intake and exhaust etc.
- Under floor heating systems including all pipework and valves.
- Thermal insulation applied to the engineering services systems.
- Heat recovery systems.
- Consideration of borehole water, ground source energy.
- Renewable energy systems integrated with electrical systems including wind turbines, photovoltaic systems and the like.
- Generator cooling.
- Lift pressure relief and pressurisation systems as required.
- Staircase pressurisation systems as required.
- Lift motor room cooling systems.
- Electrical and UPS ventilation and cooling systems.
- Packaged split air conditioning systems including all pipework, electrical systems between fan coil and condenser units.
- Communications rooms and ICT Node rooms cooling systems and ventilation.
- The main communications and secondary communication rooms containing network core switches and main servers to be provided with positive pressurised filtered fresh air systems.
- High specification air conditioning systems.
- Smoke extract system including all fire rated ductwork, smoke dampers, and smoke damper control and power interface with the fire alarm system.
- Misc ventilation systems such as toilets, storage areas, plant rooms, generator ventilation, and gas meter room etc.
- Local exhaust ventilation systems.
- Basement mechanical ventilation systems including all plant, equipment, ductwork, dampers.
- Natural ventilation systems where practical.
- Water filtration systems.

- Hot water calorifiers, pumps, valves, piped distribution systems and dead leg (legionnaires) protection.
- Cold water storage tanks, pumps, valves and piped distribution systems including dead leg (legionnaires) protection.
- Mechanical water systems, including all pipework and valves.
- Softened water treatment systems where required.
- Rainwater and roof drainage systems including all pipework, roof outlets.
- Power, water and drainage to Green roof water feed and any fertiliser systems as required by the Green roof specialist.
- Landscape water supply and drain systems (if necessary) including automatic irrigation system.
- Internal soil vent, waste drainage systems including acid resistant systems connected to below ground drainage connections points provided.
- Basement level drainage systems including all sump pumps, pipework and control system, incorporating all above slab drainage with the civil and structural consultant detailing below slab drainage and any sump pumps for which the services consultant would get location and duties etc. of any power supplies and if required discharge pipework.
- Assist in designing the integrated plumbing solutions systems, if any.
- Above ground specialist drainage systems.
- Floor wastes in suspended floors for all wet areas, design coordinated with plant locations etc.
- Automatic flushing systems, pipework, valves and sensors.
- Gas suppression system serving communication and ICT nodal rooms as required.
- Helipad intrinsically safe electrical and fire protection systems.
- Any special medical fixtures and fittings (eg. Pendants).
- Bulk fuel oil storage system including all pipework, valves, filling points and control system.
- Gas distribution systems.
- Compressed air systems.
- Distributed medical gas systems.
- Steam and condensate systems as required.
- Cleaning, flushing and treatment systems.
- Acoustic and vibration treatments and systems.
- Utilities gas, water including interface with existing service strip.

Electrical Systems

The Consultant's design shall cover all works associated with the electricity supply and reticulation including incoming supply, all ducting and supply from the Supply Authority's network. The incoming supplies from the Supply Authority's network are to be reviewed for the substation requirements and mains, power factor correction and power quality. The electrical reticulation system will be provided with an electrical management control system.

- HV electrical systems from primary substation HV switchboard including protection requirements and coordination with utility provider and local authority requirements.
- HV consumer network electrical systems including all protection, electrical distribution system, cables/busbar, switchgear, distribution boards etc.
- LV electrical systems including all busbar/cables, distribution boards etc.
- Electrical HV / LV management control systems.
- Earthing & bonding systems.
- Lightning protection system.
- Power factor and power quality requirements.
- HV Generators and LV to HV step up transformers for temporary LV generator interface with electrical system.
- Lighting control system using presence and absence lighting control.
- Emergency lighting.
- Aircraft warning lights system.
- External lighting and secondary external lighting system.
- Electrical and control systems containment.
- BMU (Cradle) power and water supplies and communications systems (terminated at BMU landing points).
- Services to the automatic barriers where relevant.
- Telephone Communications
- IT
- Small Power, Fire, ICT, Door Access with the RIE Link Corridor
- RIE interface with Fire, ICT and PTS Systems

Other

The Consultant shall contribute to the design coordination and documentation including all interface requirements and Technical Advice for the following, but not necessarily be limited to:

- Group 1, 2 and interface where applicable with Group 3 Equipments.
- Lighting layout design.
- Development of reflective ceiling plans.
- Pneumatic tube system.
- Medical gas.
- Renal water systems including de-ionised water systems.
- Coordination with Radiation protection specialist requirements.
- X-ray systems interface including all associated systems such as warning lights.
- Catering equipment and layout.
- Robotics.
- Food waste processing system.
- Vertical transportation systems.
- Sprinkler protection system, including all plant and equipment, pipework and valves.
- Gas suppression systems electrical rooms including; all plant and equipment, gas bottles, and control systems.
- Wet / Dry riser systems including all plant and equipment, pipework and valves.
- Sprinkler and wet riser water storage tanks including water level control.
- Fire protection electrical installation from control panels to all plant and equipment.
- Main and secondary fire control panels.
- Fireman's general smoke ventilation override system and panel.
- Cause and effect matrix developed byrelevant subcontractor(s) which is to outline the interfaces with the relevant systems such as the mechanical control panels, control of smoke dampers, generator control panel, security Access Control remote panels, sprinkler system, building management control system, electrical management control system, disabled alarm system, lift and escalator control systems etc.
- Fire Hydrants.
- Fire alarms and detection system
- Integrated extra low voltage systems.

- Information communication technology and distribution systems.
- Access control and Intruder detection system.
- External and Internal CCTV.
- Building Management Control system Interfaces with the building management control system, fire alarm system and the like
- Mechanical electrical systems including motor control panels etc.
- Public Address
- Telecommunication systems.
- Optic fibre backbone network system.
- IT / Data systems network and systems.
- Telephone communications and distribution system including the fire telephone system.
- Equipment alarms systems.
- Nurse call system.
- Disabled alarm system interfaced with the fire alarm network.
- Induction loops and hand held portable system.
- Television system.
- Central dictation systems.
- Paging and personal attack system.
- Tagging system.
- Telemedicine system.
- Leak detection system.
- Energy metering management system.
- Cold rooms including all plant and equipment
- CPC Assessment
- Weight Schedule
- Minor/Major Equipment Schedule
- Clinical Risk/Category Drawings
- VIE
- Environmental Data Sheets
- Leading M&E RDD Process

- Building Leakage & Pressure Testing

1.17 HELIPAD

The Consultant shall be responsible for elements of the helipad design as per the following:

Scope Item Description	Design Responsibility	Installation By
Helipad Pancake, Perimeter Gutter & Drainage Outlets	**Product Warrant by specialist backed up by RBG**	**Specialist**
Drainage under Pancake connecting with Foam Collection tank	**M&E Consultant**	**Specialist**
Hot Rolled Supporting Structure off DCN Core	**RBG**	**Steelwork S/C**
Foam/Fuel Collection Tank	**M&E Consultant**	**Specialist**
Helideck Lighting & Floodlights	**M& E Consultant**	**Specialist**
Aviation Lights	**M&E Consultant**	**MERCURY**
Fire Fighting Monitors & Foam Generating Pumps, Kit	**Performance Specification from M&E Consultant**	**Specialist**
Access/Egress Ramp 1:12, Supporting Structure & Decking	**HLM design intent/ RBG supporting structure and Aluminium Decking by Specialist**	**Specialist**
Ramp Lighting & Emergency Lighting	**M&E Consultant**	**MERCURY**
Wind Sock	**RBG**	**Specialist**
CCTV **Fire Rated Power Wiring to Helipad Kit & DB's including controls, BMS,Auto Change/Over**	**M&E Consultant**	**Specialist or Mercury still to be decided**

Fire Detection	**M&E Consultant**	**MERCURY**
Trace Heating	**M&E Consultant**	**MERCURY**
Main DB Panel & Lighting Panel	**M & E Consultant**	**MERCURY**

Compliance and Compatibility

The Consultant's design and documentation shall ensure compliance with and/or encompass the following, but not necessarily be limited to:

- Employer's Requirements.
- Compliance with Health Service Notes and Memorandums such as the SHTM's, HTM's, HBN's, SHBN's, SHGN's SHPN's and HGN's.
- Codes and Standards.
- Local authority requirements.
- CIBSE guides.
- IEE regulations.
- Utility provider requirements.
- Compliance with Planning and Building Regulations.
- HVCA TR17.
- Health & Safety.
- Aircraft authority and specialist.
- Specialist medical.
- NHS/ Board objectives.
- Quality Assurance and Quality Control.
- Environmental management plan including WRAP waste management organisation system.
- Fire strategy.
- Cold water system to comply with Hai-Scribe infection control requirements.
- Acoustic and vibration requirements.
- Radio Frequency and Electro Magnetic Frequency requirements.
- Carbon foot print compliance.

- BREEAM Very good rating compliance.
- Input to life cycle analysis and selection and agreement with FM Partners.
- Interface with RIE.
- Energy Model Simulation & Compliance
- MEP building services systems configured to promote flexibility to enable future maintenance, re-modelling, re-planning and replacement without disruption to adjacent areas.
- Electromagnetic Compatibility

2. ITPD and Preferred Bid Design and Design Development

Overview

2.1 It is a fundamental requirement that all Documentation produced during the Concept Design and Design Development stages are in full compliance with the parameters of the Project requirements such as the Planning consents, the Employer's Requirements, the Cost Plan and the Programmes as these may be amended from time to time.

2.2 The Design Development stage involves the development of the Concept Design and enables the tendering and construction of the Project to be executed, particularly for the enabling works and the early release packages. Consequently the particulars highlighted below require the Consultant to undertake iterative Services and revisit the work carried out under Concept Design which must be amended or otherwise.

Tasks

The Consultant shall:

2.3 Supplement Project details provided by the Employer by sourcing relevant information about the Site. Based on these documents make appraisals and establish constraints for the Works.

2.4 Seek clarification or direction on Project requirements as necessary.

2.5 Visit site in addition to as requested by the Employer.

2.6 Contribute to site appraisals and surveys and (re)evaluate Project requirements including the preparation of options/recommendations for consideration by the Employer highlighting advantages and disadvantages (financial and technical) and where relevant any long lead-in procurement building elements.

2.7 Evaluate any amendments to the Project requirements and advise the Employer on options for development of the design having regard to the effect on the Employer's Requirements, the Cost Plan, the Programme and any other relevant Statutory Authority requirements.

2.8 As when requested by the Employer, provide a Documentation Schedule for review by the Employer. This Documentation Schedule shall support the Full Business Case timeline, the Employer's tender letting schedule and construction programme and shall set out the Documentation to be produced by the Consultant including the sequence and the dates for the production of same.

2.9 Update or amend the Documentation Schedule as required by the Employer. Complete/populate the master documentation matrix if utilised by the Employer. This matrix indicates to which tender package each of the Consultant's documents relates to.

2.10 Provide assistance and support the Architect, Structural Engineer and other consultants in the preparation, design, specification and installation details of their respective discipline.

2.11 Prepare the Documentation incorporating the architectural, structural and other consultants' requirements and/or information into the building services design having regards at all times to the Planning constraints, the Employer's Requirements, the Cost Plan and the construction programme. In conjunction with the other consultants, establish all relevant Statutory Authority requirements and incorporate into the design.

2.12 Prepare design studies and make presentations to the Employer. The Consultant shall take account of any comments from the Employer and amend the Documentation as necessary. The Consultant shall also consult with local or other Statutory Authorities and with other interest groups as reasonably required by the Employer.

2.13 In accordance with the agreed Documentation Schedule, prepare and submit to the Employer in a timely manner, the adequately coordinated and progressed design and as the Lead Consultant for the specific design responsibilities, coordinate tasks and submissions from other consultants. Note: all CAD drawings are to be at an appropriate scale as reasonably required by the Employer.

2.14 In conjunction with the other consultants, develop the design incorporating the design solutions and where required, provide documentation for submissions to the relevant Statutory Authorities including for the discharge of Planning consent conditions and/or to seek conditions of approval for Building Regulations compliance.

2.15 Liaise with other consultants and coordinate the provision of information and data as reasonably required by the Cost consultant and the Employer for use in connection with the Cost Plan.

2.16 Prepare and provide Documentation (on a reasonable and realistic basis) in respect of alternative designs and/or construction solutions for the purpose of value engineering and reviewing costs. Repeat the process as reasonably required by the Employer in terms of the construction costs remaining within the Cost Plan.

2.17 Assess and provide comment on alternatives offered by the Employer, its subcontractors and suppliers. Provide design details and information as required by the Cost consultant in pricing options / alternatives. This may be subject to additional fee to be discussed and agreed between the Consultant and the Employer on a case by case basis.

2.18 Provide studies and information on maintenance, lifecycle and other costs for the Project as required by the Employer.

2.19 Assist the Employer in the preparation of Scope of Work packages on a trade by trade basis for inclusion in subcontract and supply procurement.

2.20 Prepare and issue drawings, specifications, schedules and the like as required by the Employer for market testing, tender and costing purposes. The specification is to include the requirements for testing, commissioning, benchmarks and workmanship standards.

2.21 Prepare schedules, perspectives, computer generated images and other similar presentation materials as reasonably required by the Employer to illustrate the proposed design.

2.22 Review and comment on the temporary works in relation to such activities as the crane locations, materials handling areas, storage and compound areas and the like. It is noted that the Consultant have made allowances in the permanent state design to accommodate the normally envisaged temporary loads during the course of the construction works.

2.23 Continuously review the design against the Project requirements including the Employer's Requirements and all relevant Statutory Authority requirements and immediately notify the Employer of any non-compliance together with associated remedial recommendations.

2.24 Prepare and issue a fully coordinated set of Documentation for these design stages in a report format to the Employer. The Documentation shall be at suitable including coordination information such as the overlay drawings as requested by the Employer.

3. CONSTRUCTION DOCUMENTATION AND CONSTRUCTION PHASE

Overview

3.1 This Work Stage shall be the Construction Documentation and Construction Phase of the Project. This Work Stage continues from the Concept Design and Design Development Work Stage and shall enable the remaining tendering and construction of the Project to be progressed. Where necessary, this Work Stage is undertaken in conjunction with the ongoing design development tasks. Consequently all items scheduled below are a continuation of and are in addition to the items scheduled in the Design Development (and where necessary, Concept Design) Work Stage(s) and to the extent that any of the Services carried out under Design Development (and where necessary, Concept Design) must be amended or otherwise, such work shall be deemed to be part of/concurrent to this Work Stage.

3.2 It is a fundamental objective of the Employer that all Documentation produced during this Work Stage is suitable for properly constructing the Project and shall fully reflect the developed design in full compliance with the parameters of the Project requirements such as the Planning consents, Employer's Requirements, the Cost Plan and the Programme as these may be amended from time to time, especially the construction programme.

Tasks

The Consultant shall:

3.3 Receive further Project details and requirements from the Employer if any and together with other relevant information sourced by the Consultant, make further appraisals of Project constraints.

3.4 Evaluate any amendments to the Project requirements and advise on options for consideration by the Employer having regard to the effect on the Employer's Requirements, the Cost Plan, the Programme and any other relevant Statutory Authority requirements

3.5 Visit site in addition to as requested reasonably by the Employer.

3.6 As when requested by the Employer, update and issue the Documentation Schedule for review by the Employer. The Documentation Schedule shall be consistent with the Employer's construction programme and shall set out the Documentation to be produced by the Consultant including the sequence and the dates for production of same.

3.7 Liaise with other consultants to provide integrated and coordinated design information and data as required by the Employer to comply with the Employer's tender letting schedule and with the construction programme to ensure that there is no delay in providing information to subcontractors or in constructing the Works.

3.8 Update or amend the Documentation Schedule as required by the Employer. Update the master documentation matrix in a format requested by the Employer.

3.9 Produce a monthly update of the Documentation Schedule, or at other times as reasonably required by the Employer, showing the Consultant's actual and proposed delivery against the programmed issue dates for each Documentation including the details of the mitigation measures where the Consultant has fallen behind in providing the design information and/or the Documentation was inadequate.

3.10 Provide Documentation in accordance with the Documentation Schedule. All Documentation to be in compliance with the Project requirements. The Documentation shall be suitable of being used for preparing trade packages (including trade bills of quantities) and used for inviting tenders from trade subcontractors and updated to provide adequate details to allow each design element to be constructed which must for example, take due

regard of good health and safety practices, buildability requirements such as construction sequencing and access and construction tolerances.

3.11 Review all relevant subcontractors and/or suppliers' submissions of samples and technical data as requested and report to the Employer in respect of compliance with the Project requirements.

3.12 Evaluate alternatives proposed by the trade subcontractors and in conjunction with other consultants, coordinate and integrate all such preferred alternatives into the Documentation as requested by the Employer. This may be subject to additional fee to be discussed and agreed between the Consultant and the Employer on a case by case basis.

3.13 In conjunction with the other consultants, review and comment on shop drawings, specifications, prototypes, samples and technical data submissions and other information prepared by potential and/or engaged subcontractors or suppliers for compliance with the Project requirements where relevant to the building services design. Provide such comments within7 days of receipt. However, the Consultant shall endeavour to review, comment and return such submissions earlier should the specific need arise as to be discussed between the Consultant and the Employer.

3.14 Review and comment on the documentation of other consultants and subcontractors within 7 days of receipt and where warranted, fully update all Consultant's Documentation where necessary. However, the Consultant shall endeavour to review, comment and return such submissions earlier should the specific need arise as to be discussed between the Consultant and the Employer.

3.15 Notify the Employer in writing, once the Consultant becomes aware of any amendments or additions/deletions in the Documentation which may increase the cost of construction and/or whole life cost of the Project.

3.16 Not used.

3.17 Provide updated, coordinated and dimensioned drawings at suitable scales showing all major in a timely manner for services and other builder's works in connection details including coordination information such as the overlay drawings as requested by the Employer.

3.18 Produce supplementary documentation as may be required by the Employer to clarify the Documentation during construction, including issuing sketches, details, clarifications, further Documentation, investigating site based construction issues related to the Documentation and preparing and issuing design solutions in conjunction with other consultants where applicable.

3.19 Provide Construction Documentation ("For Contract") drawings incorporating all information issued as advices or sketches so that the latest information is shown on the Documentation to be used for construction. All Documentation must be completed and issued in compliance with the Programme and with the general progress of the Works to ensure that such progress is not delayed and/or disrupted.

3.20 Issue updated drawings, specifications, schedules, details and other design information as the Employer may require.

3.21 Revise and resubmit Planning consent submissions to the Planning Authority as required where the progressed design has varied from the original permit approval.

3.22 Regularly check the Documentation against the Project requirements such as the Employer's Requirements all relevant Statutory Authority requirements and immediately notify the Employer of any non-compliance together with associated remedial recommendations.

3.23 Assist in the updating of design and construction programmes as required by the Employer.

3.24 Respond to all correspondence including (but not limited to) Requests for Information within 5 days. However, the Consultant shall endeavour to review, comment and return such submissions earlier should the specific need arise as to be discussed between the Consultant and the Employer.

3.25 Undertake any off-site inspections reasonably requested by the Employer.

3.26 Review mock-ups and samples for compliance with the Project requirements such as the Planning consent and the Employer's Requirements and recommend benchmarks for finish and workmanship with the Employer in respect of subcontractors, suppliers and manufacturers.

3.27 Undertake regular inspections of the Works and provide non conformance report on same to the Employer.

3.28 Assist in the preparation of full documentation and detailing for a marketing and display facilities as appropriate for the Project or as reasonably required by the Employer.

4. DOCUMENTATION DELIVERABLES

Overview

4.1 The Employer intends to engage specialist subcontractors for the following trades to design (For Construction details only) and construct that form part of the Works. Some of these are early release packages. For these trades, the Consultant is to provide documentation that outline the design intent and the performance requirements from which the subcontractor(s) will prepare their construction design (ie. shop drawings):

- Piling
- Structural steel (connection design only)
- Precast concrete
- Major building (M&E) services, (refer MEP Design Demarcation Matrix)
- Lifts, (lift core structure, (to support all kit / railing / beams provided by the lift sub contractor), shall remain with the Consultants)
- Curtain walling system and all associated bracketry and secondary steel
- Aluminium windows & entrance doors
- SFS
- External canopies
- Facade cladding, (excluding render)
- External louvres
- Secondary steelwork generally including wind-posts, masonry fixings, bed joint reinforcement and the like
- ETFE roof coverings
- Roofing, (except green roof)
- Helipad (Deck / pancake and safety systems only; excluding M&E and structural support to underside of deck support which remains with the Consultants, refer to 1.17)
- Glazed balustrades
- Catering

The Lead Consultant for a given package (refer to the Design Consultant Responsibility Matrix) is to coordinate with other consultants in reviewing the design by these specialist subcontractors and confirm that they are acceptable for coordination with the Services and that the design intent and performance specification has been satisfied.

4.2 In some instances, it is intended that elements of the design are undertaken by specialist subcontractors whereby the subcontractor will assume responsibility for the installation documentation of the Consultant's design intent. However, the Consultant will retain responsibility to review and comment on such design proposals and documentation. For example:

- Spatial coordination – The Consultant shall provide in sufficient detail to establish and confirm the coordinated zoning requirement such as the ceiling voids, risers and the like. The detailed design information from the Consultant is to show the spatial inter-relationship of the engineering systems for the production of installation drawings by the relevant subcontractor(s).

- Selection plant and equipment – The Consultant shall provide a description of the main/critical performance requirements and essential design features of plant and equipment. For example: Input/output capacities of plant, the range of operating duties, details of the required quality of construction and finishes, any essential energy saving features, the acoustic performance and the availability of spares. Based on these parameters, the relevant subcontract(s) will propose their plant and equipment selection.

- Commissioning – The Consultant shall incorporate into various systems designs and provide specifications outlining the essential components and features necessary to enable proper preparation and commissioning of the building services.

- Handover information – The Consultant shall provide specifications that define the scope, content and format of operating and maintenance manuals and record drawings appropriate to the Project. The Consultant shall also define the level of documentation, commissioning results and other information to be made available by the relevant subcontract(s) for a proper handover of the Works.

The MEP Design Demarcation Matrix between the (MEP) Services Engineer and the MEP subcontractor(s) is included within the attached Appendix A.

Documentation

4.3 The Documentation Deliverables shall be fully coordinated with other consultants and other relevant parties prior to issue. The Deliverables are to be provided in trade package format.

In addition to the above, please note the following general principal requirements:

a) Drawings are to be prepared in a digital form on standard A size sheet (ie. A0, A1, A2, A3). Drawings are not to be any larger than the A0 size.

b) Building Orientation: North to top of sheet, part floors details to be drawn with North to top of sheet. North arrow must be shown on the drawing title block.

c) Each Documents must contain/show:

- Unique document number
- Full title with no abbreviation
- Drawn (or prepared) by and checked by – sign offs
- All details to have scale identified for each
- Denote full (sheet) size
- Changes from the previous drawing revision are to be numbered individually and highlighted with a bold cloud. Once the drawing is revised again, these clouds will be removed and new/latest clouds added to highlight the new drawing amendments
- Detailed description of the change(s) under each number with a date in the title block (to match the cloud number) so that the change(s) can be easily understood from the previous issue

- All documents to be prepared in black and white and not colour unless advised otherwise by the Employer

- The orientation of all drawings when submitted electronically shall be checked that they are landscape and uploaded in the correct orientation (e.g. not scanned upside down)

d) The text on all Documents including the drawings shall be in UK English. All dimensions shall be given in metric format. Calendar dates shall follow the Day/Month/Year format.

e) When revising a document, such as specifications, the full version is to be issued (ie. do not issue just an addenda/extract of the pages that changed).

f) Revisions to text documents will have the revised text in bold and italics (**this is an example**).Text that has been deleted will be in italics and struck through (~~another example~~).The Table of Contents shall also highlight in bold italic sections modified. Revised text highlighted must be removed by the Originator prior to issuing the next revision or prior to issuing a document For Tender/Contract and For Construction purposes.

g) Text documents will be prepared on standard A4 size sheets. All text documents will have a title page displaying the relevant information. Each page of the document must show (as a minimum) - document number and its revision, the page number and the total number of pages (ie. page X of Y).

4.4 The following sample list of documents for the building services design as provided by the Consultant indicates the level of design documentation proposed. However, the Consultant shall provide any additional documentation which is not listed below which would be required by the Employer to construct the Works in addition to the Design Development and Overall Design Document Deliverables required by the Board.

Documentation	Scale (indicative refer to BCRs)
Mechanical Services Drawings	1:100
Medical Gases Layouts	1:100
Plantrooms Medical Gases	1:20
Medical Gas Services Schematics	
Heating System Zoning Philosophy	
Chilled Water System Zoning Philosophy	
HTG and CHW Layouts	1:100
Plantrooms HTB and CHW	1:20
MTHW Heating Schematics	
Secondary Heating Schematics Plantrooms	
Primary Chilled Water Schematics	
Secondary Chilled Water Schematics Plantrooms	
Ventilation System Zoning Philosophy	
Ventilation Layouts	1:100

Plantrooms Ventilation	
Ventilation Schematics	
Environmental Treatment Layouts	1:100
Pneumatic Tube System Schematics	
Food Waste System Schematics	
Electrical Systems Zoning Philosophy	
Plantrooms LV Power	1:50
Containment/Sub-main Layouts	1:100
Low Voltage Schematics	
Lighting Layouts	1:100
Security Layouts	1:100
Earthing Schematics	
UPS Schematics	
Fire Alarm Layouts	1:100
Nurse Call Layouts	
Public Health Water Services Layouts	
Plantrooms Public Health Water Services	1:20
Hot Water System Zoning Philosophy	
Sanitation and Rainwater Layouts	1:100
Primary Public Health Water Services Schematics	
Secondary Public Health Water Services Schematics	
Renal Water Schematics	
Fire Protection Systems	
Fire Protection Plans	1:100
Sprinkler System Schematics	
Wet Riser System Schematics	
External Services and Energy Centre Mechanical Services	1:100
Oil System Schematics	
Natural Gas System Schematics	
Energy Centre Sections	1:20
External Services and Energy Centre Electrical Services	1:100
Utility Primary Intake Substation Schematics	
MV Power Schematics	
Energy Centre LV Schematics Substations	
External Services and Energy Centre Public Health Services	1:100
External Services and Energy Centre Site Services	1:100

Drawings		
Electrical, Communication and Security Services:		
Legend and symbols		
Existing services diversion plans, sections and details	1:100 1:50	/
Floor plans	1:100	
nt room and service area layouts	1:100	
Service areas	1:100	
Toilets, tearooms, breakout areas and showers	1:100	
External areas	1:100	
Transformer schedules		
Fire services schematic		
Substation	1:100 1:50	/
Equipment and containment for PABX/communications systems		
HV and LV distribution		
Main switch rooms	1:50	
Cable tray reticulation	1:100	
Power, communication and security services riser layouts (if applicable)	1:50	
Services reticulation such as cable tray layout	1:100	
Power, lighting and access control layout including to plant and distribution boards for each level	1:100	
Single line diagrams – main switchboards		
Riser details		
Electrical control systems		
Earthing and bonding		
UPS and other back-up power management system		
Induction loops containment shown on general power drawings		
Essential and non-essential fire services switchboards		
Emergency lighting		
Riser coordination documentation	1:50	
Façade blinds and windows control schematic		
BMU provisions (as per Specialist requirements)		
Small power and ancillary services circuitry for each level including 'add-in' supplies shown on Architects 1:50s		
Room layouts, sections and elevations		

Public Health and Fire Protection Services:	
Legend and symbols	
Existing services diversion plans, sections and details	1:100 / 1:50
Floor plans indicating sewer; storm water; rainwater; tundishes; and down pipes.	1:100
Plant room and service area layouts	1:100
Basement services layouts	1:100
Toilets, tearooms, breakout areas and showers	1:100
External areas	1:100
Public health and fire protection services schematic	
Public health and fire protection services riser layouts	1:100
Services reticulation layout	1:100
Public health and fire protection services layout - all levels	1:100
Riser schematic	
Entry lobby and public spaces	1:100
Public health and fire protection services control systems	
Awnings and canopies rainwater drainage	1:100
Typical drainage details	1:100
Wet or Dry Riser	
Sanitary pipework	
Stormwater pipework	
Water tank room layout	
Foul drainage pump room layout	
Water intake and meter room layout	
Hot water diagram	
Cold water diagram	
Riser co-ordination documentation indicated on mechanical core drawings	
Mechanical Services:	
Legend and symbols	
Floor plans	1:100
int room and service area layouts	1:100
Toilets, tearooms, breakout areas and showers	1:100
Mechanical services layout for each level	
Sections and elevations	
Substation ventilation	1:100; 1:50
PABX ventilation	1:50
Main switch room ventilation	1:50

Services reticulation layout	1:100
Mechanical riser layouts	1:50
Mechanical layout for each level	1:100
Chilled water schematics	
Condenser water schematic	
LPHW schematic	
Ventilation schematic	
Smoke and extract schematic	
Lift and stair pressurization schematic	
Generator oil and bio fuel oil schematic	
Typical details	
Entry lobby and public spaces	1:100
Riser co-ordination documentation	1:20
Specifications and Reports	
Services diversions	
Underground services (excluding drainage)	
Electrical services	
Public health services	
Mechanical services	
Fire protection and alarm services	
Future provisions	
BMS	
Part SPP6 Report	
Maintenance and plant replacement strategy	
Energy metering strategy	
CDM Hazard control sheets	
Design risk registers	
Schedules	
& LV Switchboard	
nt and equipment	
/LV cable Schedules	
/LV Protective Device Schedules	
tribution Board Schedules (Small Power)	

5. COMMISSIONING, COMPLETION AND POST COMPLETION

Overview

5.1 This Work Stage shall be the Commissioning, Completion and Post Completion Phase of the Project and shall enable the Project to be commissioned and occupied. Consequently all items scheduled below are a continuation of and are in addition to the items scheduled in the Design Development, the Construction Documentation and the Construction Phases Work Stages.

5.2 It is a fundamental objective of the Employer that all Documentation produced during this Work Stage are suitable for properly constructing, commissioning and completing the Project in full compliance with the Project requirements such as the Planning consents, the Employer's Requirements, the Cost Plan and the construction and completion programmes.

Tasks

The Consultant shall:

5.3 Receive further Project details and requirements from the Employer if any and together with other relevant information sourced by the Consultant, make further appraisals of Project constraints.

5.4 Visit site in addition to as requested reasonably by the Employer.

5.5 Evaluate any amendments to the Project requirements and advise on options for consideration by the Employer having regard to the effect on the Employer's Requirements, the Cost Plan, the Programme and any other relevant Statutory Authority requirements.

5.6 In conjunction with the other consultants, review as reasonably required by the Employer all subcontractor proposed commissioning procedures and report to the Employer.

5.7 Not used.

5.8 Review and comment on all relevant guarantees, warranties and O & M manuals prepared by subcontractors and suppliers.

5.9 In preparation for Completion, inspect the benchmark areas as required by the Employer and prepare non conformance reports to describe in the opinion of the Consultant the Works that may prevent them to be certified as completed together with recommendations for rectification of them. If required by the Employer and in conjunction with the Employer, the Consultant shall re-inspect the Works to verify that the non conformances have been rectified. These tasks are to be provided in a timely manner and where requested by the Employer, make appropriate representations on Employer's behalf to the Board in regards to the non conformances and their remedial works.

5.10 Review and comment within 7 days, all relevant "As-Built" documents as prepared by the other consultants and/or subcontractors including drawings, specifications, schedules, manuals and maintenance instructions or any other documents as required by the Employer.

5.11 Attend commissioning and witness testing to review the satisfactory function and completion of relevant systems for compliance with the Consultant's design intent and specifications in accordance with the Project requirements.

5.12 Assist the Employer with the preparation and provision of the Project operation and maintenance manuals and as-built record information and the like as necessary for the Completion of the Project.

5.13 Assist in the preparing and updating of completion programmes as required by the Employer.

5.14 Liaise with other consultants and coordinate the provision of information and data as required by the Employer to comply with the construction and/or commissioning programme to ensure that there is no delay in providing information to the relevant parties.

5.15 Check the Documentation produced during this Work Stage against the Planningconsents and other Project requirements such as the Employer's Requirements.Report on any non-compliance and provide mitigation recommendations on same.

5.16 Provide all necessary information to the CDM Coordinator to be included in the Health and Safety File for the purposes of the CDM Regulations.

5.17 Provide the updated specifications to reflect the as-built building services works.

5.18 Not used.

5.19 Provide the Employer with a written statement certifying that the Works are consistent with the Consultant's latest design Documentation and the Project requirements such as the Employer's Requirements as demonstrated on the testing and commissioning results.

5.20 Participate in inspections which shall be conducted at reasonable points during the first 52 weeks, if not at 52 weeks after the date of Completion.

5.21 Reasonably assist the Employer in the settlement of differences in relation to the building services works that may arise between the Board and the Employer or between the Employer and any subcontractor or supplier. Should such differences enter into adjudication or arbitration, the Consultant's assistance may be subject to additional fee which is to be discussed and agreed between the Consultant and the Employer on a case by case basis.

APPENDIX A

MEP Design Demarcation Matrix

SCHEDULE 3

CONSULTANT'S WARRANTY

DATED 2014

[CONSULTANT]

- and -

[BENEFICIARY] [1]

COLLATERAL WARRANTY

relating to
the design and construction of
the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service
and the Department of Clinical Neurosciences in a single building adjoining
the Royal Infirmary of Edinburgh at Little France, Edinburgh

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[1] Parties to collateral warranty to change dependent on beneficiary

COLLATERAL WARRANTY

AMONG:

LOTHIAN HEALTH BOARD, a health board constituted in Scotland under the National Health Service (Constitution of Health Boards) (Scotland) Order 1974 (S.I. 1974/267) as amended by the National Health Service (Constitution of Health Boards) (Scotland) Amendment Order 2003 (S.S.I. 2003/217) pursuant to Section 2 of the National Health Service (Scotland) Act 1978 as amended by section 28 of the National Health Service and Community Care Act 1990 and having its principal address at Waverley Gate, 2-4 Waterloo Place, Edinburgh EH1 3EG (the "**Beneficiary**" which expression shall include its successors in title or permitted assignees under this Agreement and for the Design Build Finance and Maintain Agreement and/or the Beneficiary's appointee);

and

[**Project Co**], a company incorporated in Scotland under the Companies Acts (Registered Number [ ]) and having its Registered Office at **[ ]** ("**Project Co**" which expression shall include its successors in title or permitted assignees under this Agreement);

and

BROOKFIELD MULTIPLEX CONSTRUCTION EUROPE LIMITED, a company incorporated in England and Wales under the Companies Acts (Registered Number 03808946) and having its Registered Office at 99 Bishopsgate, London EC2M 3XD (the "**Contractor**" which expression shall include its successors in title or permitted assignees under this Agreement).

and

[ ] LIMITED, a company incorporated in [Scotland/England and Wales/Northern Ireland] under the Companies Acts (Registered Number [ ]) and having its Registered Office at [ ] (the "**Consultant**").

WHEREAS:

(A) The Beneficiary and Project Co have entered into an agreement for the design, build, finance and maintenance of a project to re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France (the "**Project**") on or about the date hereof (the "**DBFM Agreement**").

(B) Project Co and the Contractor have entered into a contract (the "**Construction Contract**") on or about the date hereof for the design and construction of the Project (the "**Contract Works**").

(C) The Contractor has entered or intends to enter into an agreement with the Consultant whereby the Consultant will provide certain design services (the "**Services**") in connection with the Project ("**the Appointment**") as more particularly described in the Appointment.

(D) It is a condition of the Appointment that the Consultant enters this Agreement with the Beneficiary.

(E) The Beneficiary shall be entitled to rely and is deemed to have relied on the Consultant's reasonable skill, care and diligence in respect of all matters covered by this Agreement insofar as they relate to the Services provided by the Consultant under the Appointment.

NOW IT IS AGREED as follows:

1 WARRANTY AND UNDERTAKING

1.1 The Consultant warrants and undertakes to the Beneficiary that it has complied and will continue to comply with all the terms and obligations and duties under or arising out of the Appointment on the Consultant's part to be performed and observed and shall complete the Services in accordance with the Appointment.

1.2 Without prejudice to Clause 1.1 of this Agreement, the Consultant further warrants and undertakes to the Beneficiary that:

1.2.1 it has exercised and will continue to exercise all the due skill, care and diligence of a properly qualified and competent consultant experienced in providing design services on projects similar in nature, size and complexity to the Project in:

(a) the design of the Contract Works;

(b) the materials selected or specified by or on its behalf for use in the Contract Works (or any part or parts thereof) are in accordance with the guidance contained in the Good Practice Guidance and this Clause 1.2.1(b); and

(c) only materials and goods which are new and of sound and

satisfactory quality shall be specified for use in connection with the Contract Works; and

(d) there shall not be specified for use in connection with the Contract Works any materials or substances which are expressly prohibited by the Construction Contract or which are generally known not to be in accordance with British or European Standards and Codes of Practice at the time of specification or use (as applicable), or any materials or substances which are deleterious to health and safety or to the durability of buildings and/or other structures and/or finishes and/or plant and machinery in the particular circumstances in which they are used, or any materials or substances identified as deleterious, unsatisfactory or unsuitable in the relevant circumstances in the Good Practice Guidance and, in addition to and separate from the foregoing, any substances or combination of substances publicised prior to the time of construction in any Building Research Establishment Limited ("BRE") publications issued as part of the BRE Professional development service which the BRE recommend are not used for building purposes or for the type of buildings comprised in the Project.

(e) the performance of the Services to the Contractor under the Appointment;

For the purposes of Clause 1.2.1, "**Good Practice Guidance**" means the edition of the publication entitles "Good practice in the selection of construction materials" (British Council for Offices (BCO): 2011) or any amended or updated version as at the Commencement Date (as such term is defined in the DBFM Agreement):

1.2.2 the final design and all materials and goods specified therein will correspond as to description, quality and condition with the requirements of the Construction Contract;

1.2.3 the final design will at practical completion or its equivalent under the Construction Contract, as the case may be, comply with all relevant legislation and Good Industry Practice;

2 INSURANCE

2.1 The Consultant shall maintain throughout the duration of provision of the Services and for a period of 12 years after the date of practical completion or

its equivalent under the Construction Contract, professional indemnity insurance in an amount of not less than fifteen million pounds (£15 ,000,000) sterling on an each and every claim basis and for any one occurrence or series of occurrences arising out of any one event with insurers of good repute carrying on business in the European Union provided always that such insurance is available at rates which are commercially reasonable to consultants.

2.2 In determining whether or not insurance is available as aforesaid, the financial characteristics and claims' record of the Consultant shall be ignored.

2.3 The Consultant shall immediately inform the Beneficiary if such insurance ceases to be available at rates which are commercially reasonable in order that the Consultant and the Beneficiary can consider alternative means of best protecting their respective positions in respect of the Project in the absence of such insurance provided that the Beneficiary shall be entitled to require the Consultant to maintain such lesser amount of Professional Indemnity Insurance as is available to the Consultant at rates which are commercially reasonable.

2.4 As and when it is reasonably requested to do so by the Beneficiary the Consultant shall produce for inspection documentary evidence satisfactory to the Beneficiary (acting reasonably) that its Professional Indemnity Insurance is being maintained.

2.5 The Consultant confirms that this Agreement has been disclosed to and has been approved by the Consultant's Professional Indemnity Insurers or Underwriters.

2.6 Should the Consultant be in breach of any of its obligations under this Clause 2 (Insurance), the Beneficiary may itself insure against any risk with respect to which the breach shall have occurred and may recover such sum or sums from the Consultant as a debt.

3 COPYRIGHT

3.1 The Consultant hereby grants to the Beneficiary or its appointee and all those authorised by the Beneficiary an irrevocable, transferable, non-exclusive and royalty-free licence (which shall be capable of assignation) to use and reproduce all information (whether or not stored in computer systems), drawings, models, bills of quantities, specifications, schedules, details, plans, programmes, budgets, reports, calculations or other documents, work or things including all applicable passwords or access codes whatsoever

provided or to be provided by the Consultant in connection with the Services (the "**Documents**") for such purposes as the Beneficiary may at its sole discretion require.

3.2 Such licence shall carry the right to grant sub-licences and shall subsist notwithstanding that the Appointment is terminated or the obligations and duties there under have been completed. For the avoidance of doubt, the grant of such licence or sub-licences shall not impose any additional liability on the Consultant.

3.3 The Consultant shall on reasonable demand provide to the Beneficiary or its appointee and those authorised by the Beneficiary additional copies of any documents on receipt of reasonable copying costs. The Consultant will not be liable for any use by the Beneficiary or any appointee or sub-licensee of any of the Documents for any purpose other than that for which the same were prepared and provided by the Consultant or for any improper or negligent use by the Beneficiary or any appointee or sub-licensee.

3.4 The Consultant agrees to indemnify and keep indemnified the Beneficiary from and against all loss, damage, cost, expense, liability or claim in respect of breach of the copyright or other intellectual property rights of any third party caused by or arising out of the carrying out of the Services or the use of the licence.

4 ASSIGNATION

4.1 This Agreement may be assigned or otherwise transferred, novated, in whole or in part by the Beneficiary to any successor to the Beneficiary's interest in the Project or any part thereof without the consent of the Consultant being required and such assignation shall be effective upon written notice thereof being given to the Consultant. No assignation of this Agreement by any other party shall be permitted.

[Notwithstanding the foregoing, the Beneficiary shall at any time be fully entitled to assign or transfer its rights under this Agreement any number of times without the consent of the Contractor or the Consultant to any undertaking which is a group undertaking in relation to the Beneficiary and/or to any other undertaking in which the Beneficiary or any other group undertaking holds more than 25 per cent of the shares. For these

purposes the expressions "undertaking", "group undertaking" and "shares" have the meanings given in section 1161 of the Companies Act 2006.][2]

4.2 The Consultant agrees that it shall not at any time assert that any permitted assignee in terms of this Agreement is precluded from recovering any loss resulting from any breach of this Agreement by reason that such assignee is not an original party to this Agreement or that no less or a different loss has been suffered by such assignee.

5 NO WAIVER OR VARIATION

5.1 No failure, approval, act or forbearance on the part of the Beneficiary in respect of any right of the Beneficiary pursuant to this Agreement shall constitute any waiver of any right of the Beneficiary under or arising out of this Agreement nor relieve the Consultant of any of its duties or obligations under or arising out of this Agreement.

5.2 The Consultant will not seek to modify or vary any of the obligations for which it is responsible under the Appointment in any respect if that modification or variation will be detrimental to the Beneficiary or affects the Beneficiary's rights or obligations under the DBFM Agreement, the Construction Contract or this Agreement or affects the Consultant's obligations under this Agreement.

6 EQUIVALENT RIGHTS

The obligations of the Consultant under this Agreement shall be no greater in extent or quantity than if the Beneficiary had been named as joint employer with the Contractor under the Appointment. The Consultant shall be entitled in any action or proceedings by the Beneficiary to rely on any limitation in the Appointment and to raise the equivalent rights in defence of liability as it would have against the Contractor under the Appointment (other than retention, counterclaim, set-off or to state a defence of no loss or a different loss has been suffered by the Contractor)

7 NOTICES

7.1 Any notice, consent or demand to be given or made by any party under this Agreement (hereinafter called a "Notice") shall only be validly served if in writing and delivered personally or sent by pre-paid first class recorded delivery post or sent by fax to the following address and marked for the

[2] To be inserted in Project Co's collateral warranty

attention of the following person in the case of each party:

Party	Address	Fax Number	Person
The Beneficiary	[•]	[•]	[•]
Project Co	[•]	[•]	[•]
The Contractor	[•]	[•]	[•]
The Consultant	[•]	[•]	[•]

Any party may by Notice to the other party/parties change its address, fax number or the title of the person for whose attention Notices are to be given or made pursuant to this Clause. Any such Notice shall be deemed to have been received:

7.1.1 if delivered personally, at the time of delivery;

7.1.2 in the case of pre-paid first class recorded delivery post, on the first Business Day after the date of posting; and

7.1.3 in the case of a fax, at the time of transmission.

7.2 If any Notice is delivered or faxed after 5 p.m. on a Business Day, or at any time during a day which is not a Business Day, that Notice shall be deemed to have been received at 9 a.m. on the next Business Day.

7.3 For the purposes of this Clause 7 (*Notices*), "Business Day" means any day which is not a Saturday, a Sunday or a public holiday in Scotland. In proving service it shall be sufficient to prove that the envelope containing such Notice was properly addressed to the relevant party and either delivered personally to that address or delivered into the custody of the postal authorities as a pre-paid first class recorded delivery letter, or that such Notice was transmitted by fax to the correct fax number of the relevant party (as demonstrated by the transmission slip). For the avoidance of doubt, Notices shall not be validly served if sent by e-mail.

7.4 The definitions of words and phrases used in this Agreement shall be those set out in the Construction Contract and Appointment except where expressly

defined in this Agreement.

7.5 This Agreement shall be governed by and construed in accordance with Scots Law and the parties hereto submit to the exclusive jurisdiction of the Scottish Courts.

7.6 Save to the extent expressly provided in this Agreement no provision of this Agreement is intended to or does confer upon any third party any benefit or right enforceable at the option of that third party or any liability whatsoever to any third party, and without prejudice to the generality of the foregoing, there shall not in any circumstances be created by this Agreement a jus quaesitum tertio in favour of any person whatsoever.

[3][8 **STEP IN RIGHTS**

8.1 The Consultant acknowledges that the Contractor has paid all fees and expenses properly due and owing to the Consultant under the Appointment up to the date of this Agreement. The Beneficiary has no liability to the Consultant in respect of fees and expenses under the Appointment unless and until the Beneficiary has given notice under clauses 8.2 or 8.4.

8.2 If so required by notice in writing given by the Beneficiary and subject to clause 8.4 the Consultant agrees that it will, accept the instruction of the Beneficiary or its appointee which, for the avoidance of doubt, and without limitation, may include a third party appointed by the Beneficiary on a commercial arm's length basis, to act as the contractor under the Appointment to the exclusion of the Contractor in respect of the Services upon the terms and conditions of the Appointment. The Contractor acknowledges that the Consultant shall be entitled to rely on a notice given to the Consultant by the Beneficiary under this clause 8.4.

8.3 The Consultant shall not without first giving the Beneficiary not less than twenty eight days written notice exercise or seek to exercise any rights it may have to determine its employment under the Appointment or treat it as having been determined or repudiated by the Contractor (which expression in this and the succeeding clause shall include the appointment of a liquidator, receiver, administrator, administrative receiver or manager of the Contractor) or to discontinue performance of any service or obligations thereunder or to discontinue performance of the Services. The Consultant agrees that any period stipulated in the Appointment for the exercise any the Consultant of a right of termination shall nonetheless be extended as may be necessary to take account of the period of notice required under this clause 8.3.

8.4 The Consultant acknowledges that its right to determine its employment under the Appointment or treat it as determined by or repudiated by the Contractor or to discontinue performance as aforesaid shall cease if within the said period of twenty eight days referred to in clause 8 hereof the Beneficiary:

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[3] Clause 8 to be included in Project co and Security Trustee warranties only

8.4.1 gives the Consultant written notice requiring the Consultant to fulfil the terms of the Appointment as if it and not the Contractor were its employer thereunder; and

8.4.2 acknowledges in such notice that it is assuming all of the obligations of the Contractor under the Appointment, including without prejudice to the foregoing generality payment of any monies due outstanding at the date of the notice or which may subsequently become due under the Appointment.

8.5 In the event of notice being given by the Beneficiary as aforesaid, the Appointment will continue in full force and effect as if no right to determine the Appointment or treat it as determined had arisen. The Consultant shall, where the Beneficiary has given notice under Clause 8.4.1 hereof, assume liability to the Beneficiary in terms of the Appointment in lieu of the liability to the Contractor.

8.6 The Consultant shall, if so required by the Beneficiary following determination of the Appointment, contract direct with the Beneficiary or its nominees by novation or otherwise on the same terms, mutatis mutandis, as are contained in the Appointment provided that the Beneficiary gives the Consultant written notice requiring the Consultant to do so within a period of twenty eight days from the date of determination of the Appointment.

8.7 [The Beneficiary acknowledges that Prudential Trustee Company Limited shall take priority over the rights and benefits available to the Beneficiary under this Agreement.] [If two or more valid notices claiming the benefit of a step in right relating to the Appointment and/or a right to issue instructions to the Consultant are received by the Consultant the deemed order of priority of such notices shall be that issued hereunder by the Beneficiary before any issued by any other party. Only the notice deemed to have first priority shall take effect and no other relevant notice shall bind the Consultant and it is agreed the Beneficiary under this warranty will take priority over IHS Lothian Limited.]

8.8 The Contractor has agreed to be a party to this Agreement for the purposes of acknowledging that the Consultant shall not be in breach of the Appointment by complying with the obligations imposed on it by clauses 8.2 or 8.4.]

IN WITNESS WHEREOF this Agreement consisting of this and the preceding [ ] pages is executed as follows:

SCHEDULE 4

THIRD PARTY AGREEMENTS

The following schedule and contents listed was issued to the Consultant via Aconex Transmission BMCE-TRANSMIT-001242 dated 2 February 2015 from Liane Edwards-Scott timed at 13:20 GMT.

- The Project Agreement (including any document referred to therein either expressly or implied)
  - BCR's
  - PCP's
- Planning permission; property documents
- The Building Contract and the Performance Guarantees
- The Service Contract and the Performance Guarantees, all as the same may be amended or replaced from time to time

SCHEDULE 5

PROJECT SPECIFIC DATA

The following schedule and contents listed was issued to the Consultant via Aconex Transmission BMCE-TRANSMIT-001242 dated 2 February 2015 from Liane Edwards-Scott timed at 13:20 GMT.

The following ITPD data has been in the possession of the Consultant and has been taken into account in the formation of Fee and Programme. It must be noted that internal layouts are not fixed in these drawings and are subject to further review. This will not be considered as a variation to Fee]: The ITPD comprises four volumes of information as follows:

Volume 1 contains background information on the Project, the conditions of participation, the arrangements for the Dialogue, the Informal Submissions that Bidders must provide during the Dialogue Period, Draft Final Tender requirements, envisaged Final Tender requirements and how the Board intends to evaluate the Final Tender, award the Project and communicate with Bidders.

Volume 2 contains the contractual requirements which are set out in the NPD Project Agreement and schedules, (which include the draft Payment Mechanism) and Articles of Association.

Volume 3 contains the specific technical requirements of the Board for the Project including construction (clinical and non-clinical) requirements and Facilities standards, equipping requirements and facilities management requirements.

Volume 4 comprises of details of the Data Room available to Bidders during the Tender Period.

- Volume 1, Project Bid Information

2 Financial Proformas - Annex 1 to Appendix B_iss1_rev
3 Technical Cost Proformas - Annex 1 to Appendix A
ITPD Volume 1 Revision B FINAL_iss1_rev

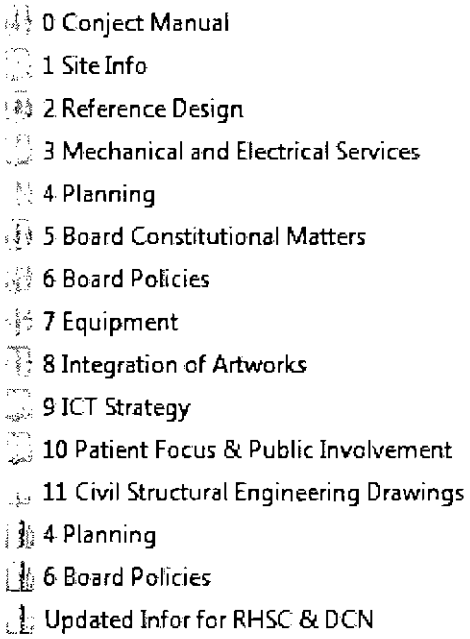
- Volume 2, Contractual Requirements

1 Schedule Part 27 Plans
2 Project Agreement
3 NPD Articles of Association

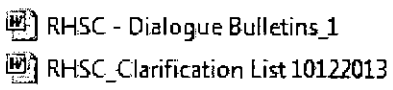
- Volume 3, Technical Requirements

1.1 Board's Construction Requirements
1.2 Service Level Specification
1.3 Equipment

- Volume 4, Data Room



- General ITPD Documents / Trackers:



- Schedule 5 DRAWINGS_SPECS IHSL-XX-XX-DC-4.24
- Building Warrant Tracker IHSL-XX-XX-SH-002 Rev 05
- Contractors Requirements Part 1 & Appendices

SCHEDULE 6

DELIVERABLES TIMETABLE

The Consultant is required to carry out services in conjunction with Schedule 2 (Scope of Services) in accordance with the Building Warrant Matrix (Schedule 5), The Planning Conditions as identified in the Project Agreement (Schedule Part 29) and the following programme documents:

- Schedule 6 141205 HLM - Design Programme FC to Completion Rev01
- Schedule 6 141208 HLM - 1to50 Equipment Layouts and C-Sheets Programme
- Schedule 6, 18 12 14 RHSCDCN_M E_DesignSchedule_Rev00 (2)
- Schedule 6, RBG Deliverables 28th October - T3 coordinated with Dunne IRS Rev 14 corrected RBG Comments
- Schedule 6, RHSC, Design Team Meeting Schedules

SCHEDULE 7

DESIGN CONSULTANT RESPONSIBILITY MATRIX

The following schedule and contents listed was issued to the Consultant via Aconex Transmission BMCE-TRANSMIT-001242 dated 2 February 2015 from Liane Edwards-Scott timed at 13:20 GMT.

- Design Consultant Responsibility Matrix Schedule

SCHEDULE 8

COST PLAN

The following schedule and contents listed was issued to the Consultant via Aconex Transmission BMCE-TRANSMIT-001242 dated 2 February 2015 from Liane Edwards-Scott timed at 13:20 GMT.

- RHSC and DCN Cost Plan

SCHEDULE 9

BREEAM REPORT

The following schedule and contents listed was issued to the Consultant via Aconex Transmission BMCE-TRANSMIT-001242 dated 2 February 2015 from Liane Edwards-Scott timed at 13:20 GMT.

- IHSL-XX-XX-DC-4.11

SCHEDULE 10

BIM PROTOCOL

The following schedule and contents listed was issued to the Consultant via Aconex Transmission BMCE-TRANSMIT-001242 dated 2 February 2015 from Liane Edwards-Scott timed at 13:20 GMT.

- IHSL-XX-XX-DC-4.11, (BIM PCP - Report)
- BMCE_BIM - Model Production Delivery Table-RIBA 2013-APPENDIX B
- BMCE_BIM - Level of Definition Overview sheet-V1.0-APPENDIX C
- BIM Services Obligations - Consultants - V1.0

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

FIRST FLOOR - VENTILATION STRATEGY

Re-provision of RHSC and DCN at Little France

Commercially in Confidence

Date	19/11/2013
Scale	1:200. @ A0
Drawing No.	WW-SZ-01-PL-524-001
Rev	FT

A46676816

Reprovision of RHSC and DCN at Little France

Room Data Sheets

Notes:
Room Data Sheets for Generic and Key Rooms for Financial Close.

Document No	Revision
HLM-SZ-SL-RD-400-001	01

Date
18.09.14
Drawn
HLM
Checked
HLM

Reprovision of RHSC and DCN at Little France

Room Data Sheets

Rev No.	Date	Revision
01	18.09.14	First Issue

Generic Rooms

Code	Description	Room Number
M0251-01	Office: 1:1	1-P1-085
G0180-06	Parking bay: mobile equipment	1-P1-097
J0232-01	Reception: 1 person	2-L2-073
B0305	Single-bed room DCN	2-L2-130
V1643	En-suite: DCN	2-L2-131
Y0646-01	Disposal hold (General Waste)	2-R1-022
X0145	Treatment room: Inpatient	3-C1.1-043
T0152	Staff Base	G-A2-008
G0180-01	Resusitation trolley	G-A2-016
Y0431	Dirty utility	G-A2-022
V1010	WC: ambulant	G-A2-024
G0180-03	Hoist Bay	G-A2-027
T0151	Touchdown Base	G-A2-049
V1643-01	En-suite: RHSC Also used with isolation ensuites	G-A2-051
B0305-01	Single-bed room RHSC	G-A2-052
B0405	Multi-bed room: 4 beds RHSC	G-A2-054
W1594-01	Linen Bay	G-A2-063
B0308	Single-bed room: isolation RHSC	G-A2-072
G0510	Lobby: Isolation RHSC	G-A2-074
V1736	Assisted Bathroom WC	G-A2-076
M0254	Multi disciplinary office	G-A2-077
M0251	Ward Management Office	G-A2-078
Y0646	Disposal hold	G-A2-082
M0724	Interview room	G-A2-083
P0627	Pantry	G-F1-057
V0922	WC: Accessible	G-M1-005
Y1510	DSR	G-M1-050
H1313-01	Meeting room: 4 person	G-Q1-054
H1313-02	Meeting room: 6 person	G-Q1-055

Key Rooms

Code	Description	Room Number
B1609-01	4 beds Low Acuity	1-B1-031
G0510-01	Gowning Lobby: Isolation Room	1-B1-033
B1401-01	Single-bed cubicle: Isolation	1-B1-036
B1401	Single-bed cubicle	1-B1-037
B1609-02	4 beds High Acuity	1-B1-063
B1407-01	Open Plan Bay 3 cots: Neonatal	1-B1-065
B1421	Single cot cubicle: neonatal	1-B1-075
C0230	Consulting/examination room: Orthoptic	1-D3-007
C0517	ABR Room	1-D4-002
C0516	Observation/Control room	1-D4-006
C0515	Testing/Clinic room	1-D4-007
C0110-01	Distraction Free Treatment: SALT	1-D6-035
X0208	Rehabilitation Room:OT	1-D6-048
X0208-01	Rehabilitation Room: Physio	1-D6-053
X0208-02	Rehabilitation Room: Physio (CV Equip)	1-D6-054
X0242	Dressings Room	1-D7-003
S0027-01	Viewing Room	1-J1-003
B1411	Receiving/Resuscitation	1-L1-005
J1155	Waiting	1-L1-027
D1135	Discharge Lounge	1-P1-012
B2517	SDCU Recovery	1-P1-024
B2417	Post Anaesthetic Recovery:RHSC	1-P1-029
B2418	Post Anaesthetic Recovery Room: RHSC	1-P1-030
J1264	Waiting bay: 1 patient trolley/bed place	1-P1-057
E0801-02	Imaging room: Interoperative MRI	1-P1-064
E0604-05	Control room: Interoperative MRI	1-P1-065
N0305-01	Anaesthetic room: DCN	1-P1-069
N0106-03	Operating theatre: DCN	1-P1-070
E0311	Angiography Procedures Room	1-P1-093
X1026	Control room: Angiography Procedures	1-P1-094
B2417-01	Post Anaesthetic Recovery:DCN	1-P1-109
V0726	Changing Room	1-P1-127
D2155	Admissions Lounge	1-P1-128
N0106-01	Operating theatre: RHSC	1-P1-131
N0305	Anaesthetic room: RHSC	1-P1-132
T0526	Preparation room	1-P1-134
N0106-02	Operating theatre: Intraoperative	1-P1-155
G0510-02	Lobby: Isolation Room DCN	2-L2-134
B0308-01	Single-bed room: Isolation DCN	2-L2-135
Q0120	Activities of daily living: kitchen	2-M2-009
X0105-02	Distraction Free Treatment room	2-M2-011
X0318	Multi Purpose Rehabilitation Room	2-M2-023
X0111	Treatment Area	2-M3-003
X0136	EMG/Nerve Conduction Room	2-M4-008
X0125	EEG Recording room	2-M4-019
M0132-01	Open Plan Office	2-R1-055
T0101	Clean Utility: Inpatients RHSC	3-C1.1-042
E0604-06	Control / Observation room	3-C4-007
B0705	Sleep Room	3-C4-008
X1504	Patient Treatment Lounge	3-D9-016
H0202-01	Workshop / Tutorial Room	3-H3-001

L0102-03	Tissue Culture Store	4-H1-016
L0102-01	Molecular Biology Laboratory	4-H1-018
L0102-02	Physiology Laboratory	4-H1-027
X0242-04	Treatment: double-sided couch access (Mental Health)	G-A1-015
X0242-05	Resuscitation Room: 2 places	G-A1-028
X0242-06	Resuscitation Room: 2 places	G-A1-029
X0242-03	Triage room	G-A1-035
X0242-02	Treatment: Single sided couch access (ED only)	G-A1-060
X0242-01	Treatment: double sided couch access (ED only)	G-A2-020
X0206	Plaster Suite	G-D1-008
X0105-01	Treatment room: with Prep Area	G-D1-033
C0224-01	Consulting/examination: RHSC	G-D1-039
C0217-01	Consult/exam: multidisciplinary - RHSC	G-D1-040
C0715	Cardio Pulmonary Exercise Lab	G-D2-005
C0712	Treatment room: Echocardiography	G-D2-006
C0718-02	Lung Function Laboratory	G-D2-013
C0718-01	Excercise Tolerance Test Room	G-D2-014
C0903-01	Dental Surgery Standard	G-D5-008
J0132-03	Multi Functional Activity Zone	G-E1-001
J0132-01	Reception: 2 person	G-E1-002
J0132-02	Sub Wait With Nurse Base	G-E1-003
J1255	Main Waiting: RHSC	G-E1-011
H1107	Group room	G-F1-020
X0613	Therapy room	G-F1-034
D0608-02	Dining / Recreation (Day Prog)	G-F1-036
Q0121	Therapeutic kitchen	G-F1-037
B0510-01	Single-bed room (CAMHS)	G-F1-073
V1610	Shower room: en-suite: anti ligature	G-F1-074
C0217	Consult/exam: multidisciplinary - DCN	G-M1-012
X0105	Treatment room	G-M1-014
C0224	Consulting/examination: DCN	G-M1-018
E0128	Imaging Room: General X-ray	G-Q1-004
E0115	Ultrasound Treatment Room	G-Q1-010
E0716	Imaging Room: Gamma Camera	G-Q1-039
E0604-04	Control room: Gamma Camera	G-Q1-042
E0601	CT Room DCN	G-Q1-059
E0604-02	Control room: CT DCN	G-Q1-071
E0113	Doppler Ultrasound	G-Q1-081
E0715	Injection Room: DCN MRI	G-Q1-108
E0604-03	Control room: MRI DCN	G-Q1-111
E0801	Imaging room: MRI DCN	G-Q1-123
E0801-01	Imaging Room: MRI RHSC	G-Q1-134
E0604-01	Control room: CT/MRI RHSC	G-Q1-135
E0601-01	CT Room RHSC	G-Q1-136
E0135	Dental room	G-Q1-141

ADB	Room Data Sheet	M0251-01

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	M0251-01	Office: 1:1		
Room Number:	1-P1-085		**Revision Date:**	18/09/2014

Activities:	1) Clinical administration 2) Use of computer workstation(s) 3) Use of Telephone 4) Discussions and interviews			
Personnel:	2 x staff			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	M0251-01

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	M0251-01	Office: 1:1		
Room Number:	1-P1-085		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	M0251-01

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	M0251-01	Office: 1:1
Room Number:	1-P1-085	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	M0251-01

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: M0251-01 Dictation/ 1:1/Phone Booth (DCN)
Room Number: 1-P1-085
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BOA2504	BOARD; marker; whiteboard; dry-wipe; with pen holder;magnetic; wall mounted; 600H 900W.		1
2		2	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WKT1003L	WORKTOP; 720 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	G0180-06

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	G0180-06	Parking bay: mobile equipment		
Room Number:	1-P1-097		**Revision Date:**	18/09/2014

Activities:	1) Parking, storage and charging of mobile equipment			
Personnel:	Intermittent use			
Planning Relationships:				
Space Data:	**Area (m^2):**		**Height (mm):**	
	Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To suit surrounding area/design.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	G0180-06

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	G0180-06	Parking bay: mobile equipment
Room Number:	1-P1-097	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 16 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central General Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating Type: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		55:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	G0180-06

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	G0180-06	Parking bay: mobile equipment
Room Number:	1-P1-097	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	N/A, open to circulation.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	G0180-06

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: G0180-06 Image Trolley Bay
Room Number: 1-P1-097
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	IMG021	IMAGE INTENSIFIER UNIT; C-arm; mobile		3
1		1	IMG023	IMAGE INTENSIFIER; monitor; (Part of IMG021)		3
1		1	IMG024	IMAGE INTENSIFIER; monitor trolley; (Part of IMG021)		3
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT121	SOCKET outlet; computer data; double.		1
3		3	RAC196	RACK, x-ray lead apron, 5 hangers hinged, wall mounted		2

ADB	Room Data Sheet	J0232-01

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	J0232-01	Reception: 1 person		
Room Number:	2-L2-073		**Revision Date:**	18/09/2014

Activities:	1) Reception and registration of patients 2) Use of computer workstation(s) 3) Dealing with enquiries 4) Use of Telephone 5) Control of access			
Personnel:	1 x staff 1 x patient/visitor			
Planning Relationships:	Close to, with clear view of, entrance and waiting area.			
Space Data:	**Area (m^2):**		**Height (mm):**	
	Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To suit surrounding area/design.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	J0232-01

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	J0232-01	Reception: 1 person		
Room Number:	2-L2-073		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	5.0	Ventila ion Type: Central Supply And Extract
Mechanical Ventilation (Extract ac/hr):	5.0	
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - Minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	J0232-01

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	J0232-01	Reception: 1 person
Room Number:	2-L2-073	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	N/A, open to circulation.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	J0232-01

Project: 11072 RHSC & DCN
Department: L2 DCN Inpatients - 43 Beds
Room: J0232-01 Reception (1 person)
Room Number: 2-L2-073
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BIN2504	BIN; confidential waste		3
1		1	BIN900	BIN; Recycle waste		3
1		1	CAB056	CABINET; stationery; metal; 10 drawer with lock; 600H 280W 410D		3
1		1	CAS020	FIRST AID BOX		2
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU1000	COUNTER; staff/nurse base; as per detailed design.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
3		3	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
2		2	OUT2512	SOCKET outlet; video entry.		1
1		1	SWC025	SWITCH, light		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TEL901	VIDEO - entry/security; wall mounted, receiving.		1
1		1	TRO905	TROLLEY; Mobile Induction Loop		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1

ADB	Room Data Sheet	B0305

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	B0305	Single-bed room DCN		
Room Number:	2-L2-130		**Revision Date:**	18/09/2014

Activities:	1) Therapeutic and clinical attention from healthcare staff 2) Clinical handwashing 3) Patient records reviewed and recorded 4) Storage of clothing and personal belongings 5) Use of piped medical gases, vacuum and associated equipment 6) Rest and relaxation			
Personnel:	1 x patient 2 x staff 2 x visitors			
Planning Relationships:	En-suite sanitary facilities.			
Space Data:	**Area (m^2):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B0305

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room	B0305	Single-bed room DCN		
Room Number:	2-L2-130		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Natural & Central Supply Air
Mechanical Ventilation (Extract ac/hr):		Via ensuite
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control witch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B0305

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	B0305	Single-bed room DCN
Room Number:	2-L2-130	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B0305

Project: 11072 RHSC & DCN
Department: L2 DCN Inpatients - 43 Beds
Room: B0305 Single Bedroom 3 (Adult)
Room Number: 2-L2-130
Revision Date: 18/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED013	BED Kings Fund; variable height; two-way tilt; adjustable backrest; bedstripper; on castors		3
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BRA004	BRACKET; holder; suction unit; trunking/rail mounted		2
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA007	CHAIR; easy; with open arms; high back; upholstered, wipeable		3
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM905	IT Tablet		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO019	HOOK, single, small, wall mounted		1
1		1	LIG005	LUMINAIRE, bedhead, dimmable, patient reading and general nursing care/examination		1
1		1	LOC002	LOCKER, bedside, 3 compartment, towel rail at rear, on castors, 902H 485W 485D		3
1		1	MAT004	MATTRESS; Kings Fund bed; standard backrest; 1955L 865W 125D		3
1		1	MIR2500	MIRROR; wall mounted; 1600H 400W unbreakable.		1
1		1	MON900	MONITOR; Low end monitor, general Ward /OPD use		3
1		1	MST007	TROLLEY; lockable; closed; with worktop; approx 900H 660W 500D; 600mm facing		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT121	SOCKET outlet; computer data; double.		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
2		2	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	RAC362	RACK; catheter; vertical; 2 compartments; 420H 160W 65D		2
1		1	RAI130	RAIL, clinical equipment, wall mounted, 600mm		1
1		1	SHE2503	SHELF; 300mm deep; folding; length as drawn.		1
1		1	STA142	STAND; infusion; twin hook; breaks; mobile		3

ADB	Schedule of Components by Room	B0305

Project: 11072 RHSC & DCN
Department: L2 DCN Inpatients - 43 Beds
Room: B0305 Single Bedroom 3 (Adult)
Room Number: 2-L2-130
Revision Date: 18/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	STA2504	STAND; Roll stand for monitor		3
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TAB073	TABLE, overbed, cantilevered		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAR900	WARDROBE; lockable; 2700H 750W 500D.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	V1643

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	V1643	En-suite: DCN		
Room Number:	2-L2-131		**Revision Date:**	18/09/2014

Activities:	1) Use of toilet (with assistance if required) 2) Use of wheelchair accessible hand-wash basin 3) Dressing / undressing in privacy 4) Hanging clothes and towels 5) Use of shower (with assistance if required) 6) Use of mobile hoist (if required) 7) Use of call systems			
Personnel:	1 x patient 1 x staff Intermittent use			
Planning Relationships:	En-suite to single-bed room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	V1643

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	V1643	En-suite: DCN		
Room Number:	2-L2-131		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 20 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Dirty Extract
Mechanical Ventilation (Extract ac/hr):	10.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	V1643

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	V1643	En-suite: DCN
Room Number:	2-L2-131	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	V1643

Project: 11072 RHSC & DCN
Department: L2 DCN Inpatients - 43 Beds
Room: V1643 Shower Room:en-suite Bedroom 3
Room Number: 2-L2-131 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS106	BASIN; medium; general pattern; vitreous china; 1 tap right hand hole; no overflow; bottom outlet; 500W 400D. HTM64LBGM		1
1		1	BIN2501	BIN; sanitary disposal		3
1		1	CAL005	CEILING, PULL CORD, patient/staff call.		1
1		1	CHA095	CHAIR; shower; mobile		3
1		1	CIS005	CISTERN, concealed, low level, reversible, 7.5 litres, 300H 500W 150D		1
1		1	CLE924	Toilet Brush and Holder		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO019	HOOK, single, small, wall mounted		1
1		1	LIG063	LUMINAIRE, single fluorescent lamp, wall, 8 watt, 300 mm		1
1		1	MIR023	MIRROR; unbreakable; wall mounted; 650H 300W		1
1		1	OUT025	SOCKET outlet, shaver		1
5		5	RAI048	RAIL, grab, vertical, wall mounted, 600mm		1
2		2	RAI161	RAIL, grab, horizontal, wall mounted, 600mm		1
1		1	RAI174	RAIL, grab, hinged, wall mounted, 650mm with toilet roll holder		1
2		2	RAI175	RAIL; grab; hinged; wall mounted; 750mm.		1
1		1	SHE100	SHELF; 200mm deep; length as drawn.		1
1		1	SHO002	SHOWER; slip resistant floor with drainage outlet; 900W 900D		1
1		1	SHO018	SHOWER, valve, thermostatic mixer (associated with SHO020)		1
1		1	SHO020	SHOWER, adjustable shower head hand spray (associated with SHO018)		1
1		1	STF200	STORAGE UNIT; mid; shelf; 150H 300W 150D		1
1		1	SWC025	SWITCH, light		1
1		1	TAP289	TAP, monobloc, pillar mixer, integral thermostatic, short lever		1
1		1	WAS101	WASTE, unslotted recessed grated, metal, 1.1/4 in, with plug and chain		1
1		1	WAS107	TRAP, bottle, 1.1/4 in, plastic resealing		1
1		1	WCH006	WC with seat, 700mm projection, wall hung, hospital pattern, rimless pan, vitreous china.		1

ADB	Room Data Sheet	Y0646-01

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	Y0646-01	Disposal hold (General Waste)		
Room Number:	2-R1-022		**Revision Date:**	18/09/2014

Activities:	1) Holding domestic, clinical and recyclable waste for disposal or reprocessing			
Personnel:	1 x staff Intermittent use			
Planning Relationships:	Adjacent to main circulation route.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	Y0646-01

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	Y0646-01	Disposal hold (General Waste)
Room Number:	2-R1-022	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Dirty Extract
Mechanical Ventilation (Extract ac/hr):	10.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	100	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		Not Applicable
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	Y0646-01

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	Y0646-01	Disposal hold (General Waste)
Room Number:	2-R1-022	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	Y0646-01

Project: 11072 RHSC & DCN
Department: R1 Clinical / Management Suite
Room: Y0646-01 Disposal Hold (small)
Room Number: 2-R1-022
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN037	BIN wheelie, 770 litre, 1360H1360W 800D		3
1		1	OUT030	SOCKET, outlet switched, 13amp single, splash proof.		1
1		1	PLA002	PLATFORM; step-stand; stackable; portable; 130H 480W 330D		3
1		1	SWC025	SWITCH, light		1

ADB	Room Data Sheet	X0145

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	X0145	Treatment room: Inpatient		
Room Number:	3-C1.1-043		**Revision Date:**	18/09/2014

Activities:	1) Dressing / undressing in privacy 2) Clinical handwashing 3) Assessment / updating of electronic patient records (EPRs) 4) Preparation of trays / packs for clinical procedures 5) Storage of sterile supplies and consumables on a trolley 6) Preparation for clinical procedures 7) Invasive clinical procedures from side of couch 8) Use of mobile diagnostic and therapeutic equipment 9) Holding/storing working supply of clean and sterile materials for immediate use			
Personnel:	1 x patient 2 x staff			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0145

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	X0145	Treatment room: Inpatient		
Room Number:	3-C1.1-043		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7- minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0145

Project	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	X0145	Treatment room: Inpatient		
Room Number:	3-C1.1-043		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0145

Project: 11072 RHSC & DCN
Department: C1.1 Medical Inpatients - 23 Beds
Room: X0145 Treatment Room
Room Number: 3-C1.1-043 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BIN2503	BIN; sharps disposal		3
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BRA004	BRACKET; holder; suction unit; trunking/rail mounted		2
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	DIS011	DISPENSER, barrier cream, disposable single cartridge, wall mounted		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO024	HOOK; hat and coat; 1.		1
1		1	LIG963	LUMINAIRE; examination; ceiling; adjustable.		1
1		1	MSC045	CABINET tall; 600mm facing; 1 door hinged right; o/a height 2100.		1
1		1	MSC046	CABINET tall; 600mm facing; 1 door hinged LEFT; o/a height 2100.		1
1		1	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	MSC082	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
1		1	MSC127	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; wall mounted.		1
1		1	MSC128	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; wall mounted.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	PRI015	PRINTER; label; portable		3
1		1	RAI132	RAIL, clinical equipment, wall mounted, 1200mm		1
1		1	SCA011	SCALE; baby		3
1		1	SCA2501	SCALE; free standing height column		3
1		1	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1

ADB	Schedule of Components by Room	X0145

Project: 11072 RHSC & DCN
Department: C1.1 Medical Inpatients - 23 Beds
Room: X0145 Treatment Room
Room Number: 3-C1.1-043
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TRA1001	TRACK; curtain; door; length and shape as drawn.		1
1		1	TRO133	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 750W 450D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	T0152

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	T0152	Staff Base		
Room Number:	G-A2-008		**Revision Date:**	18/09/2014

Activities:	1) Dealing with enquiries 2) Use of computer workstation(s) 3) Assessment / updating of electronic patient records (EPRs) 4) Supervision and observation of patients 5) Use of Telephone			
Personnel:	1 x staff 1 x visitor			
Planning Relationships:	Within a ward or clinical unit; adjacent to an individual clinical room, or patient bedrooms(s).			
Space Data:	**Area (m^2):**		**Height (mm):**	
	Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To suit surrounding area/design.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	T0152

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	T0152	Staff Base		
Room Number:	G-A2-008		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):		Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	T0152

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	T0152	Staff Base
Room Number:	G-A2-008	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or clear, solar control.
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	T0152

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: T0152 Reception / Touchdown Base
Room Number: G-A2-008
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN2504	BIN; confidential waste		3
3		3	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	CAS020	FIRST AID BOX		2
2		2	CHA063	CHAIR; height adjustable; with arms; high back; swivel; 5 star base; on castors		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU1001	COUNTER; reception; DDA compliant; with below counter storage; as per detailed design.		1
2		2	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT2512	SOCKET outlet; video entry.		1
1		1	PAN063	PANEL; indicator.		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TEL901	VIDEO - entry/security; wall mounted, receiving.		1
1		1	TRO905	TROLLEY; Mobile Induction Loop		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1

ADB	Room Data Sheet	G0180-01

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	G0180-01	Resusitation trolley		
Room Number:	G-A2-016		**Revision Date:**	18/09/2014

Activities:	1) Parking, storage and charging of mobile equipment			
Personnel:	Intermittent use			
Planning Relationships:				
Space Data:	**Area (m^2):**		**Height (mm):**	
	Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To suit surrounding area/design.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	G0180-01

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	G0180-01	Resusitation trolley
Room Number:	G-A2-016	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: None
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	N / A	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating Type: Adjacent Space air Transfer Cooling : None

LIGHTING		
Service Illumination (Lux):	500	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	N	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		55:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	G0180-01

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	G0180-01	Resusitation trolley
Room Number:	G-A2-016	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	N/A. open to circulation
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	G0180-01

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: G0180-01 Resuscitation Trolley Bay
Room Number: G-A2-016
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	RSU010	DEFIBRILLATOR; Manual		3
1		1	SUC004	SUCTION UNIT; electric; portable; 350H 320W 340D		3
1		1	TRO310	TROLLEY, emergency/resuscitation, complete with defibrillator, 955H 825W 575D		3

ADB	Room Data Sheet	Y0431

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	Y0431	Dirty utility		
Room Number:	G-A2-022		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Testing of urine specimens 3) Holding SHARPS in a container 4) Holding items requiring disposal or reprocessing 5) Disposal of liquid waste 6) Disposal of clinical waste 7) Disposal of waste and contaminated materials 8) Disposal of used protective clothing			
Personnel:	1 x staff Intermittent use			
Planning Relationships:	Close to clinical area, particularly treatment rooms.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	Y0431

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	Y0431	Dirty utility
Room Number:	G-A2-022	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Dirty Extract
Mechanical Ventilation (Extract ac/hr):	6.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		None

General Notes: Heating: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		Not Applicable
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	Y0431

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	Y0431	Dirty utility
Room Number:	G-A2-022	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	Y0431

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: Y0431 Dirty Utility
Room Number: G-A2-022
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BOA2504	BOARD; marker; whiteboard; dry-wipe; with pen holder;magnetic; wall mounted; 600H 900W.		1
1		1	CAB047	CABINET; urine test, lockable, wall mounted.		1
1		1	CUP006	CUPBOARD, flammable material, metal, lockable, liquid retaining shelf, floor standing, 760H 460W 485D		3
1		1	CUP2517	CUPBOARD; base unit; 2 door; lockable; 1200mm.		1
1		1	CUP2525	CUPBOARD; wall unit; LH door; 600h; lockable; 600mm.		1
1		1	CUP2526	CUPBOARD; wall unit; RH door; 600h; lockable; 600mm.		1
1		1	DIS004	DISPENSER, disposable bedpans, wall mounted		2
1		1	DIS005	DISPENSER, disposable urine bottles, wall mounted		2
2		2	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2501	DISPENSER; disposable vomit bowls; wall mounted.		2
1		1	DSU001	DISPOSAL UNIT (macerator), disposable bedpan, bedpan liners/urine bottles, 525W 650D		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	MSC045	CABINET tall; 600mm facing; 1 door hinged right; o/a height 2100.		1
1		1	MSC046	CABINET tall; 600mm facing; 1 door hinged LEFT; o/a height 2100.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT075	OUTLET isolator 20amp; TP&N; wall mounted.		1
1		1	OUT301	OUTLET, cold water for equipment		1
1		1	SNS1003L	SINKTOP; inset; single bowl and drainer; stainless steel; left hand drainer.		1
1		1	SWC025	SWITCH, light		1
1		1	TAP809	TAP, bib, lever, hospital pattern, pair hot and cold, 1/2 in.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
2		2	TRO235	TROLLEY, contaminated linen, single ring, stainless steel		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
1		1	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	V1010

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	V1010	WC: ambulant		
Room Number:	G-A2-024		**Revision Date:**	18/09/2014

Activities:	1) Use of toilet by ambulant person. 2) Hand-rinsing 3) Use of call systems			
Personnel:	1 x patient Intermittent use			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	V1010

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	V1010	WC: ambulant
Room Number:	G-A2-024	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Dirty Extract
Mechanical Ventilation (Extract ac/hr):	10.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	45	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		55:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	V1010

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	V1010	WC: ambulant
Room Number:	G-A2-024	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	V1010

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: V1010 WC - Ambulant (Visitors)
Room Number: G-A2-024 **Revision Date:** 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	BAS105	BASIN; small; general pattern; vitreous china; 1 tap hole centred on basin; no overflow; bottom outlet; 400W 300D; HTM64LBGS		1
1		1	BIN2501	BIN; sanitary disposal		3
1		1	CAL005	CEILING, PULL CORD, patient/staff call.		1
1		1	CIS005	CISTERN, concealed, low level, reversible, 7.5 litres, 300H 500W 150D		1
1		1	CLE924	Toilet Brush and Holder		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS015	DISPENSER, toilet paper, dispense individual sheets, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO019	HOOK, single, small, wall mounted		1
1		1	MIR024	MIRROR; unbreakable; wall mounted; 800H 300W.		1
1		1	SEA001	2in1 toilet seat, plastic, double lid with large and small aperture suitable respectively for adults/ adolescents and small children.		1
1		1	SWC025	SWITCH, light		1
1		1	TAP289	TAP, monobloc, pillar mixer, integral thermostatic, short lever		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WCH002	WC with seat, 520-550 projection, wall hung, hospital pattern, rimless pan, vitreous china, HTM64WCH		1

ADB	Room Data Sheet	G0180-03

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	G0180-03	Hoist Bay		
Room Number:	G-A2-027		**Revision Date:**	18/09/2014

Activities:	1) Parking, storage and charging of mobile equipment			
Personnel:	Intermittent use			
Planning Relationships:				
Space Data:	**Area (m^2):**		**Height (mm):**	
	Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To suit surrounding area/design.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	G0180-03

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	G0180-03	Hoist Bay
Room Number:	G-A2-027	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 16 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central General Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating Type: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		55:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	G0180-03

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	G0180-03	Hoist Bay
Room Number:	G-A2-027	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	N/A, open to circulation
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	G0180-03

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: G0180-03 Hoist Bay
Room Number: G-A2-027
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	HOI003	HOIST PATIENT; chair type mobile		3
1		1	MSC123	CABINET top; 400mm facing; (400x300 inserts); with formed plastic liners; 1 door hinged left; wall mounted.		1
1		1	OUT010	SOCKET outlet, switched, 13amp, twin		1

ADB	Room Data Sheet	T0151

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	T0151	Touchdown Base		
Room Number:	G-A2-049		**Revision Date:**	18/09/2014

Activities:	1) Assessment / updating of electronic patient records (EPRs) 2) Use of computer workstation(s) 3) Supervision and observation of patients 4) Use of Telephone			
Personnel:	3 x staff Intermittent use			
Planning Relationships:	Within a ward or clinical unit; adjacent to an individual clinical room, or patient bedroom(s).			
Space Data:	**Area (m^2):**		**Height (mm):**	
	Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To suit surrounding area/design.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM SZ 00 PL 331 001 Anti ligature Strategy for anti ligature provi ion

ADB	Room Environmental Data	T0151

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	T0151	Touchdown Base		
Room Number:	G-A2-049		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Typre: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: None

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):		Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	T0151

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	T0151	Touchdown Base
Room Number:	G-A2-049	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	T0151

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: T0151 Touchdown Base 2
Room Number: G-A2-049
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BOA2504	BOARD; marker; whiteboard; dry-wipe; with pen holder;magnetic; wall mounted; 600H 900W.		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM035	COMPUTER PRINTER; line; small		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM901	DOCKING STATION; tablet		2
1		1	LIG003	LUMINAIRE, reading, adjustable arm, 100 watt		1
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT059	CONNECTION UNIT switched 13amp, indicator light		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT2512	SOCKET outlet; video entry.		1
1		1	PAN063	PANEL; indicator.		1
1		1	PRI015	PRINTER; label; portable		3
1		1	STF151	STORAGE UNIT; lower; 2 drawer; on castors; 600H 500W 450D		3
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TEL901	VIDEO - entry/security; wall mounted, receiving.		1
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	V1643-01

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	V1643-01	En-suite: RHSC Also used with isolation ensuites
Room Number:	G-A2-051	**Revision Date:** 18/09/2014

Activities:	1) Use of shower (with assistance if required) 2) Use of toilet (with assistance if required) 3) Dressing / undressing in privacy 4) Hanging clothes and towels 5) Use of mobile hoist (if required) 6) Use of call systems 7) Use of wheelchair accessible hand-wash basin			
Personnel:	1 x patient 1 x staff Intermittent use			
Planning Relationships:	En-suite to single-bed room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	V1643-01

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room	V1643-01	En-suite: RHSC Also used with isolation ensuites
Room Number:	G-A2-051	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 20 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Dirty Extract
Mechanical Ventilation (Extract ac/hr):	10.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	V1643-01

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	V1643-01	En-suite: RHSC Also used with isolation ensuites
Room Number:	G-A2-051	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	V1643-01

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: V1643-01 En-suite wheelchair-accessible WC, Shower & wash Bedroom 8
Room Number: G-A2-051 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS106	BASIN; medium; general pattern; vitreous china; 1 tap right hand hole; no overflow; bottom outlet; 500W 400D. HTM64LBGM		1
1		1	BIN2501	BIN; sanitary disposal		3
1		1	CAL005	CEILING, PULL CORD, patient/staff call.		1
1		1	CHA095	CHAIR; shower; mobile		3
1		1	CIS005	CISTERN, concealed, low level, reversible, 7.5 litres, 300H 500W 150D		1
1		1	CLE924	Toilet Brush and Holder		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO019	HOOK, single, small, wall mounted		1
1		1	LIG063	LUMINAIRE, single fluorescent lamp, wall, 8 watt, 300 mm		1
1		1	MIR023	MIRROR; unbreakable; wall mounted; 650H 300W		1
1		1	OUT025	SOCKET outlet, shaver		1
5		5	RAI048	RAIL, grab, vertical, wall mounted, 600mm		1
2		2	RAI161	RAIL, grab, horizontal, wall mounted, 600mm		1
1		1	RAI174	RAIL, grab, hinged, wall mounted, 650mm with toilet roll holder		1
2		2	RAI175	RAIL; grab; hinged; wall mounted; 750mm.		1
1		1	SEA001	2in1 toilet seat, plastic, double lid with large and small aperture suitable respectively for adults/ adolescents and small children.		1
1		1	SHE100	SHELF; 200mm deep; length as drawn.		1
1		1	SHO002	SHOWER; slip resistant floor with drainage outlet; 900W 900D		1
1		1	SHO018	SHOWER, valve, thermostatic mixer (associated with SHO020)		1
1		1	SHO020	SHOWER, adjustable shower head hand spray (associated with SHO018)		1
1		1	STF200	STORAGE UNIT; mid; shelf; 150H 300W 150D		1
1		1	SWC025	SWITCH, light		1
1		1	TAP289	TAP, monobloc, pillar mixer, integral thermostatic, short lever		1
1		1	WAS101	WASTE, unslotted recessed grated, metal, 1.1/4 in, with plug and chain		1
1		1	WAS107	TRAP, bottle, 1.1/4 in, plastic resealing		1
1		1	WCH006	WC with seat, 700mm projection, wall hung, hospital pattern, rimless pan, vitreous china.		1

ADB	Room Data Sheet	B0305-01

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	B0305-01	Single-bed room RHSC		
Room Number:	G-A2-052		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Therapeutic and clinical attention from healthcare staff 3) Use of piped medical gases, vacuum and associated equipment 4) Storage of clothing and personal belongings 5) Patient records reviewed and recorded 6) Use of mobile hoist (if required) 7) Rest and relaxation 8) Provision for parent to stay overnight			
Personnel:	1 x patient 2 x staff 2 x visitors			
Planning Relationships:	En-suite sanitary facilities.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B0305-01

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room	B0305-01	Single-bed room RHSC		
Room Number:	G-A2-052		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Natural & Central Supply Air
Mechanical Ventilation (Extract ac/hr):		via ensuite
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating type: Adjacent space transfer air with BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control witch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY	
Hot Surface Max. Temp (DegC):	43
Hot Water Max. Temp (DegC):	41

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B0305-01

Project	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	B0305-01	Single-bed room RHSC		
Room Number:	G-A2-052		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B0305-01

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: B0305-01 Single Bedroom 7 (RHSC)
Room Number: G-A2-052
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED013	BED Kings Fund; variable height; two-way tilt; adjustable backrest; bedstripper; on castors		3
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BED2508	BED; ward; fold down; 760 mm width mattress; vertical with services.		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BRA004	BRACKET; holder; suction unit; trunking/rail mounted		2
1		1	BRA2502	BRACKET; TV; height adjustable; swivel; wall mounted.		1
1		1	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA007	CHAIR; easy; with open arms; high back; upholstered, wipeable		3
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	CUP2600	CUPBOARD, wall mounted, 600H 1800W 500D.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO019	HOOK, single, small, wall mounted		1
1		1	LIG005	LUMINAIRE, bedhead, dimmable, patient reading and general nursing care/examination		1
1		1	LOC002	LOCKER, bedside, 3 compartment, towel rail at rear, on castors, 902H 485W 485D		3
1		1	MAT004	MATTRESS; Kings Fund bed; standard backrest; 1955L 865W 125D		3
1		1	MON912	MONITOR; Oxygen/Saturation		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
2		2	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	RAC362	RACK; catheter; vertical; 2 compartments; 420H 160W 65D		2
1		1	RAI130	RAIL, clinical equipment, wall mounted, 600mm		1
1		1	SCP900	STETHOSCOPE		3
1		1	SHE2503	SHELF; 300mm deep; folding; length as drawn.		1
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1

ADB	Schedule of Components by Room	B0305-01

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: B0305-01 Single Bedroom 7 (RHSC)
Room Number: G-A2-052
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	TAB073	TABLE, overbed, cantilevered		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAR900	WARDROBE; lockable; 2700H 750W 500D.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	B0405

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	B0405	Multi-bed room: 4 beds RHSC		
Room Number:	G-A2-054		**Revision Date:**	18/09/2014

Activities:

1) Clinical handwashing
2) Dressing / undressing in privacy
3) Therapeutic and clinical attention from healthcare staff
4) Use of piped medical gases, vacuum and associated equipment
5) Patient records reviewed and recorded
6) Storage of clothing and personal belongings
7) Use of mobile hoist (if required)
8) Patient may take meals or refreshments in bed, by the bed or in the sitting space
9) Rest and relaxation
10) Use of entertainment services system
11) Provision for parent to stay overnight

Personnel:

4 x patients
2 x staff
4 x visitors

Planning Relationships:

Close to social space.
En-suite sanitary facilities.

Space Data:

Area (m^2):		Height (mm):	2,700

Refer to HLM-SZ-SL-SH-200-001 for room areas.

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B0405

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room	B0405	Multi-bed room: 4 beds RHSC		
Room Number:	G-A2-054		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Natural & Central Supply Air
Mechanical Ventilation (Extract ac/hr):		via ensuite
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control witch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY	
Hot Surface Max. Temp (DegC):	43
Hot Water Max. Temp (DegC):	41

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B0405

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	B0405	Multi-bed room: 4 beds RHSC
Room Number:	G-A2-054	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B0405

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: B0405 4 Bed Room
Room Number: G-A2-054 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
4		4	BED013	BED Kings Fund; variable height; two-way tilt; adjustable backrest; bedstripper; on castors		3
1		1	BED020	BED; fold down; 760 mm width mattress; vertical.		1
3		3	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
3		3	BED2508	BED; ward; fold down; 760 mm width mattress; vertical with services.		1
1		1	BED2509	BED HEAD BUFFER; bed and wall protection; horizontal; wall mounted.		1
1		1	BIN2508	BIN; storage;toy box		3
4		4	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
4		4	BRA004	BRACKET; holder; suction unit; trunking/rail mounted		2
4		4	BRA2502	BRACKET; TV; height adjustable; swivel; wall mounted.		1
4		4	BRA902	Bracket; Monitor oxygen/saturation inside room		2
4		4	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
4		4	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
4		4	CHA007	CHAIR; easy; with open arms; high back; upholstered, wipeable		3
10		10	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM905	IT Tablet		3
4		4	CUP2600	CUPBOARD, wall mounted, 600H 1800W 500D.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
2		2	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
4		4	LIG005	LUMINAIRE, bedhead, dimmable, patient reading and general nursing care/examination		1
4		4	LOC002	LOCKER, bedside, 3 compartment, towel rail at rear, on castors, 902H 485W 485D		3
4		4	MAT004	MATTRESS; Kings Fund bed; standard backrest; 1955L 865W 125D		3
4		4	MON912	MONITOR; Oxygen/Saturation		3
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
14		14	OUT010	SOCKET outlet, switched, 13amp, twin		1
16		16	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
10		10	OUT121	SOCKET outlet; computer data; double.		1
4		4	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
4		4	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
4		4	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
8		8	OUT471	OUTLET; oxygen medical; trunking mounted.		1
4		4	OUT476	OUTLET; vacuum medical; trunking mounted.		1

ADB	Schedule of Components by Room	B0405

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: B0405 4 Bed Room
Room Number: G-A2-054 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	PRI015	PRINTER; label; portable		3
4		4	RAC362	RACK; catheter; vertical; 2 compartments; 420H 160W 65D		2
4		4	RAI130	RAIL, clinical equipment, wall mounted, 600mm		1
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TAB056	TABLE; occasional; round; 415H 610mm dia.		3
4		4	TAB073	TABLE, overbed, cantilevered		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
4		4	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
4		4	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAR2900	WARDROBE; lockable; 2700H 750W 500D.		1
3		3	WAR900	WARDROBE; lockable; 2700H 750W 500D.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	W1594-01

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	W1594-01	Linen Bay		
Room Number:	G-A2-063		**Revision Date:**	18/09/2014

Activities:	1) Holding exchange trolley			
Personnel:	Intermittent use			
Planning Relationships:				
Space Data:	**Area (m^2):**		**Height (mm):**	
	Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To suit surrounding area/design.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	W1594-01

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	W1594-01	Linen Bay
Room Number:	G-A2-063	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 16 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		35:daytime (LAeq, 1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	W1594-01

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	W1594-01	Linen Bay
Room Number:	G-A2-063	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	N/A, open to circulation.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	W1594-01

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: W1594-01 Linen Bay (1 trolley)
Room Number: G-A2-063
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	TRO233	TROLLEY, clean linen exchange, 3 adjustable shelves, large, 1600H 1600W 680D		3

ADB	Room Data Sheet	B0308

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	B0308	Single-bed room: isolation RHSC		
Room Number:	G-A2-072		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Dressing / undressing in privacy 3) Therapeutic and clinical attention from healthcare staff 4) Use of piped medical gases, vacuum and associated equipment 5) Patient records reviewed and recorded 6) Rest and relaxation 7) Patient may take meals or refreshments in bed, by the bed or in the sitting space 8) Use of entertainment services system 9) Storage of clothing and personal belongings 10) Use of mobile hoist (if required)			
Personnel:	1 x patient 2 x staff 2 x visitors			
Planning Relationships:	Access via gowning lobby. En-suite sanitary facilities.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B0308

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	B0308	Single-bed room: isolation RHSC		
Room Number:	G-A2-072		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 21 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Supply via lobby
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating type: Adjacent space transfer air with BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B0308

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	B0308	Single-bed room: isolation RHSC
Room Number:	G-A2-072	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B0308

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: B0308 Single Isolation Bedroom 1 (RHSC)
Room Number: G-A2-072 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED013	BED Kings Fund; variable height; two-way tilt; adjustable backrest; bedstripper; on castors		3
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BED2508	BED; ward; fold down; 760 mm width mattress; vertical with services.		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BRA004	BRACKET; holder; suction unit; trunking/rail mounted		2
1		1	BRA2502	BRACKET; TV; height adjustable; swivel; wall mounted.		1
1		1	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA007	CHAIR; easy; with open arms; high back; upholstered, wipeable		3
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM905	IT Tablet		3
1		1	CUP2600	CUPBOARD, wall mounted, 600H 1800W 500D.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO019	HOOK, single, small, wall mounted		1
1		1	LIG005	LUMINAIRE, bedhead, dimmable, patient reading and general nursing care/examination		1
1		1	LOC002	LOCKER, bedside, 3 compartment, towel rail at rear, on castors, 902H 485W 485D		3
1		1	MAT004	MATTRESS; Kings Fund bed; standard backrest; 1955L 865W 125D		3
1		1	MON912	MONITOR; Oxygen/Saturation		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
2		2	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	RAC362	RACK; catheter; vertical; 2 compartments; 420H 160W 65D		2
1		1	RAI130	RAIL, clinical equipment, wall mounted, 600mm		1
1		1	SCP900	STETHOSCOPE		3
1		1	SHE2503	SHELF; 300mm deep; folding; length as drawn.		1

ADB	Schedule of Components by Room	B0308

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: B0308 Single Isolation Bedroom 1 (RHSC)
Room Number: G-A2-072 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	STA142	STAND; infusion; twin hook; breaks; mobile		3
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TAB073	TABLE, overbed, cantilevered		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAR900	WARDROBE; lockable; 2700H 750W 500D.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	G0510

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	G0510	Lobby: Isolation RHSC		
Room Number:	G-A2-074		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Dispensing disposable aprons. 3) Dispensing disposable gloves. 4) Disposal of non-clinical waste 5) Donning gown and gloves. 6) Removal and disposal of gown and gloves			
Personnel:	1 x persons			
Planning Relationships:	Direct access to single-bed room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	G0510

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	G0510	Lobby: Isolation RHSC		
Room Number:	G-A2-074		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	69.0	Ventila ion Type: Central Supply
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating type: Warm Air - reheat Battery with: BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	G0510

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	G0510	Lobby: Isolation RHSC
Room Number:	G-A2-074	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	G0510

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: G0510 Isolation Bedroom Entrance Lobby
Room Number: G-A2-074 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	DIS010	DISPENSER; pack; wall mounted; 600H 600W 300D		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
4		4	HOO018	HOOK; coat; single.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	V1736

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	V1736	Assisted Bathroom WC		
Room Number:	G-A2-076		**Revision Date:**	18/09/2014

Activities:	1) Use of bath (with assistance) 2) Use of toilet (with assistance if required) 3) Use of wheelchair accessible hand-wash basin 4) Dressing / undressing in privacy 5) Hanging clothes and towels 6) Use of sanitary chair/commode 7) Use of shower chair 8) Use of mobile hoist (if required) 9) Use of call systems			
Personnel:	1 x patient 1 x staff Intermittent use			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	V1736

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	V1736	Assisted Bathroom WC
Room Number:	G-A2-076	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 20 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Dirty Extract
Mechanical Ventilation (Extract ac/hr):	10.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY	
Hot Surface Max. Temp (DegC):	43
Hot Water Max. Temp (DegC):	41

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	V1736

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	V1736	Assisted Bathroom WC
Room Number:	G-A2-076	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	V1736

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: V1736 Patients' Assisted Bathroom
Room Number: G-A2-076 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS106	BASIN; medium; general pattern; vitreous china; 1 tap right hand hole; no overflow; bottom outlet; 500W 400D. HTM64LBGM		1
1		1	BAT015	BATH; variable height; with control panel and all services.		1
1		1	BIN2501	BIN; sanitary disposal		3
1		1	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA094	CHAIR; bathroom		3
1		1	CIS005	CISTERN, concealed, low level, reversible, 7.5 litres, 300H 500W 150D		1
1		1	CLE924	Toilet Brush and Holder		3
1		1	CUP245	CUPBOARD; 1 shelf; lockable; wall mounted; 600H 600W 300D.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO019	HOOK, single, small, wall mounted		1
1		1	MIR023	MIRROR; unbreakable; wall mounted; 650H 300W		1
1		1	MIR2500	MIRROR; wall mounted; 1600H 400W unbreakable.		1
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT032	SOCKET outlet switched 13amp double; splashproof.		1
1		1	RAI048	RAIL, grab, vertical, wall mounted, 600mm		1
3		3	RAI048	RAIL, grab, vertical, wall mounted, 600mm		1
1		1	RAI061	RAIL; towel; single stainless steel; 15mm dia. 450mm.		1
2		2	RAI161	RAIL, grab, horizontal, wall mounted, 600mm		1
1		1	RAI174	RAIL, grab, hinged, wall mounted, 650mm with toilet roll holder		1
1		1	RAI175	RAIL; grab; hinged; wall mounted; 750mm.		1
1		1	SEA001	2in1 toilet seat, plastic, double lid with large and small aperture suitable respectively for adults/ adolescents and small children.		1
1		1	SWC025	SWITCH, light		1
1		1	TAP289	TAP, monobloc, pillar mixer, integral thermostatic, short lever		1
1		1	TRA1001	TRACK; curtain; door; length and shape as drawn.		1
1		1	TRO279	TROLLEY PATIENT, shower, 1900W 760D		3
1		1	WAS101	WASTE, unslotted recessed grated, metal, 1.1/4 in, with plug and chain		1
1		1	WAS107	TRAP, bottle, 1.1/4 in, plastic resealing		1
1		1	WCH006	WC with seat, 700mm projection, wall hung, hospital pattern, rimless pan, vitreous china.		1

ADB	Room Data Sheet	M0254

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	M0254	Multi disciplinary office		
Room Number:	G-A2-077		**Revision Date:**	18/09/2014

Activities:	1) Clinical administration 2) Use of computer workstation(s) 3) Use of Telephone 4) Use of Printer 5) Storage of Files and records 6) Secure holding/storing of personal belongings 7) Displaying of notices, information and/or messages			
Personnel:	10 x staff			
Planning Relationships:				
Space Data	**Area (m)**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	M0254

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	M0254	Multi disciplinary office
Room Number:	G-A2-077	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	M0254

Project	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	M0254	Multi disciplinary office		
Room Number:	G-A2-077		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	M0254

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: M0254 Multi-Disciplinary Office
Room Number: G-A2-077 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN2504	BIN; confidential waste		3
1		1	BIN900	BIN; Recycle waste		3
2		2	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BOA2500	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 900H 600W.		1
1		1	CAB057	CABINET; lateral filing; 4 rails; 2 door; 1830H 910W 560D		3
6		6	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
6		6	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
6		6	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
6		6	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
6		6	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
3		3	HOO024	HOOK; hat and coat; 1.		1
10		10	LOC012	LOCKER; wall mounted; 340H 300W 300D.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
13		13	OUT010	SOCKET outlet, switched, 13amp, twin		1
13		13	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	PRI015	PRINTER; label; portable		3
2		2	STF238	STORAGE UNIT; tall; open shelf carcase; adjustable shelves and pack dispenser; 1600H 600W 300D		1
8		8	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAB022	TABLE; foldaway; wall mounted; 1000H 850W 600D		1
4		4	TEL1000	TELEPHONE; handset.		3
2		2	TRO254	TROLLEY; ward; case notes; capacity up to 40 foolscap or x-ray folders; all-round bumper; 940H 930W 570D		3
2		2	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
2		2	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	M0251

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	M0251	Ward Management Office		
Room Number:	G-A2-078		**Revision Date:**	18/09/2014

Activities:	1) Clinical administration 2) Use of computer workstation(s) 3) Use of Telephone 4) Use of Printer 5) Discussions and interviews 6) Storage of Files and records 7) Secure holding/storing of personal belongings 8) Assessment / updating of electronic patient records (EPRs) 9) Displaying of notices, information and/or messages			
Personnel:	1 x staff Up to x 2 others.			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	M0251

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	M0251	Ward Management Office
Room Number:	G-A2-078	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	M0251

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	M0251	Ward Management Office
Room Number:	G-A2-078	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	M0251

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: M0251 Ward Management Office
Room Number: G-A2-078
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN2504	BIN; confidential waste		3
2		2	BOA2501	BOARD; combined magnetic display/whiteboard; dry-wipe; with pen holder; wall mounted; 900H 600W		1
1		1	CAB2503	CABINET; filing; 4 drawer; lockable; 1320H 465W 620D		3
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DES022	DESK; cantilever; single pedestal 3 drawer; cable management; modesty panel; 1600W 800D		3
1		1	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
3		3	HOO020	HOOK, single, large, wall mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	SWC025	SWITCH, light		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1

ADB	Room Data Sheet	Y0646

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	Y0646	Disposal hold		
Room Number:	G-A2-082		**Revision Date:**	18/09/2014

Activities:	1) Holding domestic, clinical and recyclable waste for disposal or reprocessing			
Personnel:	1 x staff Intermittent use			
Planning Relationships:	Adjacent to main circulation route.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	Y0646

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	Y0646	Disposal hold
Room Number:	G-A2-082	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	6.0	Ventila ion Type: Central Dirty Extract
Mechanical Ventilation (Extract ac/hr):	10.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	100	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		Not Applicable
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	Y0646

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	Y0646	Disposal hold
Room Number:	G-A2-082	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	Y0646

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: Y0646 Disposal Hold
Room Number: G-A2-082
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN037	BIN wheelie, 770 litre, 1360H1360W 800D		3
1		1	BIN950	BIN, wheelie, 360L		3
1		1	BIN951	BIN, wheelie, 240L		3
1		1	OUT030	SOCKET, outlet switched, 13amp single, splash proof.		1
1		1	PLA002	PLATFORM; step-stand; stackable; portable; 130H 480W 330D		3
1		1	SWC025	SWITCH, light		1
1		1	TRO900	TROLLEY; linen cage		3

ADB	Room Data Sheet	M0724

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	M0724	Interview room		
Room Number:	G-A2-083		**Revision Date:**	18/09/2014

Activities:	1) Discussions and interviews 2) Use of Telephone 3) Use of laptop computer(s) 4) Provision of information to patients, carers and visitors			
Personnel:	1 x patient 1 x staff 2 x escorts/visitors			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	M0724

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	M0724	Interview room		
Room Number:	G-A2-083		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):		10 litres a person per second
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Ceiling Cassette - Chilled Water

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	M0724

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	M0724	Interview room
Room Number:	G-A2-083	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	M0724

Project: 11072 RHSC & DCN
Department: A2 Paediatric Acute Receiving Unit - 34 Beds
Room: M0724 Patient Interview Room
Room Number: G-A2-083 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
2		2	CHA005	CHAIR; easy; low back; upholstered		3
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CHA079	UNIT CHAIR/SETTEE; 2 seater; easy; with arms; fully upholstered		3
3		3	HOO024	HOOK; hat and coat; 1.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	SWC034	SWITCH, dimmer, modulating		1
1		1	TAB056	TABLE; occasional; round; 415H 610mm dia.		3
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2

ADB	Room Data Sheet	P0627

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	P0627	Pantry		
Room Number:	G-F1-057		**Revision Date:**	18/09/2014

Activities:	1) Use of Microwave oven 2) Storage of small amounts of dry goods in cupboard(s) 3) Storage of refrigerated provisions 4) Holding/storing trays, crockery and cutlery 5) Crockery and cutlery are washed mechanically 6) Disposal of waste and contaminated materials 7) Hand-rinsing 8) Preparation of beverages, meals and snacks			
Personnel:	1 staff Intermittent use			
Planning Relationships:	Close to in-patient beds and ward dining room, if provided.			
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	P0627

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	P0627	Pantry
Room Number:	G-F1-057	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	6.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY	
Hot Surface Max. Temp (DegC):	43
Hot Water Max. Temp (DegC):	41

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	P0627

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	P0627	Pantry
Room Number:	G-F1-057	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	P0627

Project: 11072 RHSC & DCN
Department: F1 Child & Adolescent Mental Health Services - 12 Beds
Room: P0627 Pantry
Room Number: G-F1-057 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS015	BASIN; small; stainless steel; apron front; 1 tap hole; 500W 400D		1
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	CUP2501	CUPBOARD; base unit; LH door; lockable; 500mm.		1
2		2	CUP2507	CUPBOARD; base unit; 4 drawer; lockable; 500mm.		1
1		1	CUP2509	CUPBOARD; base unit; LH door; lockable; 600mm.		1
2		2	CUP2525	CUPBOARD; wall unit; LH door; 600h; lockable; 600mm.		1
1		1	CUP2526	CUPBOARD; wall unit; RH door; 600h; lockable; 600mm.		1
1		1	DIS007	DISPENSER, paper towel roll, wall mounted		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
3		3	OUT052	CONNECTION UNIT, switched, 13 amp		1
3		3	OUT315	OUTLET, drinking water for equipment		1
1		1	OVE015	OVEN; microwave; super heavy duty; 1850watt; capacity 26 litres; stainless steel; 370H 465W 615D		3
1		1	REF120	REFRIGERATOR, capacity 160 litre refrigerator, 1650H 550W 610D		3
1		1	SNS1003L	SINKTOP; inset; single bowl and drainer; stainless steel; left hand drainer.		1
1		1	SWC025	SWITCH, light		1
1		1	TAP1000	TAP; hospital pattern; bib; integral thermostatic mixer; single lever with fixed horizontal nozzle. HTM64 TBH2a.		1
1		1	TAP2501	Tap; deck mounted mixer tap		1
1		1	TAP900	Hydro tap, provision of boiling and chilled filtered water, push button activated, complete with drain and underbench filtration unit		1
1		1	TOA2501	TOASTER; automatic; electric; 4 slices		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
1		1	WAS107	TRAP, bottle, 1.1/4 in, plastic resealing		1
1		1	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
1		1	WAS2500	DISHWASHER; under bench; high temperature; 2 drawer		2
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	V0922

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	V0922	WC: Accessible		
Room Number:	G-M1-005		**Revision Date:**	18/09/2014

Activities:	1) Independent use of wheelchair accessible toilet and adjacent hand-rinse basin 2) Use of call systems			
Personnel:	1 x patient 1 x escort Intermittent use			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	V0922

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	V0922	WC: Accessible
Room Number:	G-M1-005	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Dirty Extract
Mechanical Ventilation (Extract ac/hr):	10.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	45	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		55:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	V0922

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	V0922	WC: Accessible
Room Number:	G-M1-005	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	V0922

Project: 11072 RHSC & DCN
Department: M1 DCN Outpatients
Room: V0922 WC - Wheelchair accessible
Room Number: G-M1-005
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS105	BASIN; small; general pattern; vitreous china; 1 tap hole centred on basin; no overflow; bottom outlet; 400W 300D; HTM64LBGS		1
1		1	BIN2501	BIN; sanitary disposal		3
1		1	CAL005	CEILING, PULL CORD, patient/staff call.		1
1		1	CIS005	CISTERN, concealed, low level, reversible, 7.5 litres, 300H 500W 150D		1
1		1	CLE924	Toilet Brush and Holder		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS015	DISPENSER, toilet paper, dispense individual sheets, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO019	HOOK, single, small, wall mounted		1
1		1	MIR2500	MIRROR; wall mounted; 1600H 400W unbreakable.		1
3		3	RAI048	RAIL, grab, vertical, wall mounted, 600mm		1
1		1	RAI161	RAIL, grab, horizontal, wall mounted, 600mm		1
1		1	RAI175	RAIL; grab; hinged; wall mounted; 750mm.		1
1		1	SWC025	SWITCH, light		1
1		1	TAP289	TAP, monobloc, pillar mixer, integral thermostatic, short lever		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WCH006	WC with seat, 700mm projection, wall hung, hospital pattern, rimless pan, vitreous china.		1

ADB	Room Data Sheet	Y1510

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	Y1510	DSR		
Room Number:	G-M1-050		**Revision Date:**	18/09/2014

Activities:	1) Disposal of liquid waste 2) Filling and emptying cleaning equipment and containers 3) Holding/storing cleaning equipment 4) Hand-rinsing 5) Use of sink			
Personnel:	1 x staff Intermittent use			
Planning Relationships:	Close to areas served.			
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	Y1510

Project:	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	Y1510	DSR
Room Number:	G-M1-050	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Dirty Extract
Mechanical Ventilation (Extract ac/hr):	10.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	100	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		Not Applicable
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	60	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection: Smoke

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	Y1510

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	Y1510	DSR
Room Number:	G-M1-050	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	Y1510

Project: 11072 RHSC & DCN
Department: M1 DCN Outpatients
Room: Y1510 DSR
Room Number: G-M1-050 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
4		4	BUC004	Bucket; plastic hand pails		3
1		1	CIS004	CISTERN disposal unit; concealed; reversible. To suit disposal unit HTM64.		1
1		1	CLE008	SCRUBBING/POLISHING MACHINE, single brush, 110v machine		3
1		1	CLE018	CLEANER VACUUM, dry suction, tub, with accessories, filtered air exhaust		3
1		1	CLE900	CLEANER VACUUM; Vacumat; 22T; Taski-Johnson Diversey		3
2		2	CLE901	MOPS; box		3
1		1	CLE904	Fleece poles		3
1		1	CLE905	High dusters		3
1		1	CLE909	HS Pad drive		3
1		1	CLE910	Scrubbing brush 17		3
1		1	CLE911	Water tank		3
1		1	CLE912	Strainer		3
1		1	CLE913	Mop frame		3
1		1	CLE914	Mop handle		3
1		1	CLE916	DUST PAN		3
1		1	CLE917	SQUEEGEE SWEEPER		3
1		1	CLE922	FREEDOM HANDLE		3
1		1	CLE923	Doodle bug hand scrubber		3
1		1	CLE929	Wands (Dusting)		3
1		1	CLE930	Wands Sleeves		3
1		1	CLE931	Interchange Handles		3
2		2	CLI017	CLIP; spring; 32mm dia. 3; mounted on a wooden batten; wall mounted.		1
6		6	CON061	CONE, warning, 'wet floor'		3
1		1	CUP2517	CUPBOARD; base unit; 2 door; lockable; 1200mm.		1
1		1	CUP263	CUPBOARD; 2 shelves; lockable; wall mounted; 600H 1200W 300D.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DSU013	DISPOSAL UNIT, hopper with flushing rim, 110mm outlet, no tap holes no overflow, back inlet, stainless steel, 900H 600W 600D		1
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
6		6	HOO020	HOOK, single, large, wall mounted		1
1		1	LAD002	LADDER; 3 tread; platform type 750mm height; folding		3
2		2	LOC012	LOCKER; wall mounted; 340H 300W 300D.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	SHE1002	SHELF; 300mm deep; length as drawn.		1
1		1	SWC025	SWITCH, light		1
2		2	TAP809	TAP, bib, lever, hospital pattern, pair hot and cold, 1/2 in.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRO068	TROLLEY, cleaners, mop bucket, 3 shelves tray and waste sack holder, 980H 1170W 550D		3

ADB	Schedule of Components by Room	Y1510

Project: 11072 RHSC & DCN
Department: M1 DCN Outpatients
Room: Y1510 DSR
Room Number: G-M1-050
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
1		1	WAS105	WASTE DISPOSAL UNIT; sink waste.		1
2		2	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
1		1	WKT300R	WORKTOP; dished; stainless steel; with right hand sink bowl; cantilevered from wall; 1200W 650D; HTM63		1

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ADB	Room Data Sheet	H1313-01

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	H1313-01	Meeting room: 4 person		
Room Number:	G-Q1-054		**Revision Date:**	18/09/2014

Activities:	1) Meetings and discussions. 2) Use of Multimedia equipment 3) Use of laptop computer(s)			
Personnel:	4 x staff Intermittent use			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	H1313-01

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	H1313-01	Meeting room: 4 person		
Room Number:	G-Q1-054		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):		10 litres a second per person
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - Minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Ceiling Cassette - Chilled Water

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	H1313-01

Project	11072	RHSC & DCN
Department:	00	Generic Rooms (Financial Close)
Room:	H1313-01	Meeting room: 4 person
Room Number:	G-Q1-054	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	H1313-01

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: H1313-01 Meeting Room - 4 person
Room Number: G-Q1-054
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BOA006	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 1200H 1800W.		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
4		4	CHA018	CHAIR; upright; with arms; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
3		3	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TAB002	TABLE; 650H 1200W 600D		3
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1

ADB	Room Data Sheet	H1313-02

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	H1313-02	Meeting room: 6 person		
Room Number:	G-Q1-055		**Revision Date:**	18/09/2014

Activities:	1) Meetings and discussions. 2) Use of Multimedia equipment 3) Use of laptop computer(s)			
Personnel:	6 x staff Intermittent use			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	H1313-02

Project:	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	H1313-02	Meeting room: 6 person		
Room Number:	G-Q1-055		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):		10 litres a second per person
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Ceiling Cassette - Chilled Water

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	H1313-02

Project	11072	RHSC & DCN		
Department:	00	Generic Rooms (Financial Close)		
Room:	H1313-02	Meeting room: 6 person		
Room Number:	G-Q1-055		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	H1313-02

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: H1313-02 Meeting Room - 6 person
Room Number: G-Q1-055
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BOA006	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 1200H 1800W.		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
6		6	CHA018	CHAIR; upright; with arms; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
3		3	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
2		2	TAB122	Table; committee; unit type; 720H 1400W 700D		3
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1

ADB	Room Data Sheet	B1609-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B1609-01	4 beds Low Acuity		
Room Number:	1-B1-031		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Patient records reviewed and recorded 3) Patient examinations and assessment 4) Therapeutic and clinical attention from healthcare staff 5) Use of piped medical gases, vacuum and associated equipment 6) Rest and relaxation			
Personnel:	4 x patients 5 x staff 6 x visitors			
Planning Relationships:				
Space Data:	**Area (m^2):**		**Height (mm):**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B1609-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B1609-01	4 beds Low Acuity
Room Number:	1-B1-031	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Natural & Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B1609-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B1609-01	4 beds Low Acuity
Room Number:	1-B1-031	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B1609-01

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: B1609-01 Open Plan Bay (4 beds)
Room Number: 1-B1-031
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
4		4	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
2		2	BED003	BED; cot; baby; dropside; standard size		3
2		2	BED016	BED, CCU/ITU, radio translucent rising backrest, two-way tilt, height adjustable (685-860), on castors		3
4		4	BED2501	Mobile bed divider 1600W 1350H		3
4		4	BIN2503	BIN; sharps disposal		3
4		4	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
4		4	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
8		8	CHA2512	CHAIR; upright; with arms; vinyl plastic; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
4		4	COM904	CIS; CART; with CPU ; screen; keyboard & mouse		3
4		4	CON902	Remote monitor control (cabling integrated into the pendant or WiFi)		3
4		4	DIS013	DISPENSER, paper towel, wall mounted		2
4		4	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
4		4	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
4		4	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
4		4	DRA900	Drawer for monitoring consumables.		1
2		2	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
9		9	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
8		8	HOO900	Drip hook for water bag required.		1
8		8	HOO901	Integral adjustable drip stand with 6 hanging hooks.		1
4		4	HOO902	Hook for suction support: Upper Medirail mounted.		1
4		4	LIG900	Uplighter, pendant mounted.		1
4		4	LIG901	Small examination light.		1
2		2	MAT006	MATTRESS; ITU/CCU bed; extra care		3
2		2	MAT901	MATTRESS, reliever		3
4		4	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
4		4	MON909	MONITOR; Transport monitor for ITU/Theatre/High Acuity		3
2		2	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
4		4	OUT005	SOCKET outlet, switched, 13amp, single		1
21		21	OUT010	SOCKET outlet, switched, 13amp, twin		1
192		192	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
16		16	OUT095	Earth bonding point, pendant mounted.		1
4		4	OUT121	SOCKET outlet; computer data; double.		1
16		16	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
16		16	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
16		16	OUT470	OUTLET, oxygen, medical		1
16		16	OUT475	OUTLET, vacuum, medical		1
4		4	OUT480	OUTLET, gas scavenging (AGS), medical		1

ADB	Schedule of Components by Room	B1609-01

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: B1609-01 Open Plan Bay (4 beds)
Room Number: 1-B1-031
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
8		8	OUT900	Data Input Box for CIS with 16 input channels (Lantronix): uses 1 plug, 1 data point		3
4		4	PEN1000L	PENDANT; critical care; twin arm; left hand monitor arm, with elbow joints; multi movement.		1
4		4	PEN1000R	PENDANT; critical care; twin arm; right hand monitor arm, with elbow joints; multi movement.		1
4		4	PEN1004	PENDANT; critical care; CIS; single arm with elbow joints; multi movement (to NHSL specification).		1
4		4	PRI015	PRINTER; label; portable		3
8		8	RAI900	Lower Medirail with mounts for suction pressure, suction control unused suction catheters.		1
4		4	RAI901	Monitor module rack pole mounted plus CO2/Press.		1
4		4	RAI903	Shelf and mount for monitor (tilt and swivel of screen required)		1
4		4	RAI904	Integral drip stand for transducers with hooks		1
8		8	SHE900	Shelf for airway consumables		1
4		4	SHE901	Lower height adjustable shelf for small monitors.		1
2		2	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SUP2501	SUPPORT LEG; for 720 high worktop		1
4		4	SUR985	Humidifier: 1 plug, 1 Data (Lantronix) cable		3
4		4	SUR986	Docking station with 7 volumetric pumps: 1 plug, I Data (Lantronix) cable		3
4		4	SUR987	Nebuliser mounted on Medirail : 1 plug		3
8		8	SUR989	Alaris volumetric pumps: 2 plugs		3
4		4	SUR991	Double oxygen flow meter: Upper Medirail mounted		3
4		4	SUR992	Air flow meter: Upper Medirail mounted		3
4		4	SUR993	Airway pressure monitor: Upper Medirail mounted		3
4		4	SUR999	Enteral feed pump		3
1		1	SWC025	SWITCH, light		1
4		4	SWC034	SWITCH, dimmer, modulating		1
4		4	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
4		4	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
4		4	TEL1000	TELEPHONE; handset.		3
4		4	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
4		4	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
4		4	UPS003	Uninterrupted power supply (UPS).		1
4		4	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
4		4	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	G0510-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	G0510-01	Gowning Lobby: Isolation Room		
Room Number:	1-B1-033		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Dispensing disposable aprons. 3) Dispensing disposable gloves. 4) Disposal of non-clinical waste 5) Donning gown and gloves. 6) Removal and disposal of gown and gloves			
Personnel:	1 x persons			
Planning Relationships:	Direct access to single-bed room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	G0510-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room	G0510-01	Gowning Lobby: Isolation Room
Room Number:	1-B1-033	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	69.0	Ventila ion Type: Central Supply HBN4 Dependant
Mechanical Ventilation (Extract ac/hr):		Ventila ion Type: HBN4 Dependant
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating type: Warm Air - Reheat Battery with local / BMS Adjustable Sensor Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY	
Hot Surface Max. Temp (DegC):	43
Hot Water Max. Temp (DegC):	41

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	G0510-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	G0510-01	Gowning Lobby: Isolation Room
Room Number:	1-B1-033	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	G0510-01

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: G0510-01 Gowning Lobby Cubicle 10
Room Number: 1-B1-033
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	DIS010	DISPENSER; pack; wall mounted; 600H 600W 300D		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO019	HOOK, single, small, wall mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	B1401-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B1401-01	Single-bed cubicle: Isolation		
Room Number:	1-B1-036		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Patient records reviewed and recorded 3) Patient examinations and assessment 4) Therapeutic and clinical attention from healthcare staff 5) Use of piped medical gases, vacuum and associated equipment 6) Rest and relaxation			
Personnel:	1 x patient 5 x staff 2 x visitors			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm)**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B1401-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B1401-01	Single-bed cubicle: Isolation
Room Number:	1-B1-036	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 21-25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Supply via lobby
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating type: Adjacent space transfer air with BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B1401-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B1401-01	Single-bed cubicle: Isolation
Room Number:	1-B1-036	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B1401-01

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: B1401-01 Single Bed Isolation Cubicle 10
Room Number: 1-B1-036
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	PEN1000L	PENDANT; critical care; twin arm; left hand monitor arm, with elbow joints; multi movement.		1
1		1	PEN1000R	PENDANT; critical care; twin arm; right hand monitor arm, with elbow joints; multi movement.		1
1		1	PEN1004	PENDANT; critical care; CIS; single arm with elbow joints; multi movement (to NHSL specification).		1
1		1	PRI015	PRINTER; label; portable		3
2		2	RAI900	Lower Medirail with mounts for suction pressure, suction control unused suction catheters.		1
1		1	RAI901	Monitor module rack pole mounted plus CO2/Press.		1
1		1	RAI903	Shelf and mount for monitor (tilt and swivel of screen required)		1
1		1	RAI904	Integral drip stand for transducers with hooks		1
2		2	SHE900	Shelf for airway consumables		1
1		1	SHE901	Lower height adjustable shelf for small monitors.		1
1		1	SUR985	Humidifier: 1 plug, 1 Data (Lantronix) cable		3
1		1	SUR986	Docking station with 7 volumetric pumps: 1 plug, I Data (Lantronix) cable		3
1		1	SUR987	Nebuliser mounted on Medirail : 1 plug		3
2		2	SUR989	Alaris volumetric pumps: 2 plugs		3
1		1	SUR991	Double oxygen flow meter: Upper Medirail mounted		3
1		1	SUR992	Air flow meter: Upper Medirail mounted		3
1		1	SUR993	Airway pressure monitor: Upper Medirail mounted		3
1		1	SUR999	Enteral feed pump		3
1		1	SWC025	SWITCH, light		1
1		1	SWC034	SWITCH, dimmer, modulating		1
1		1	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	VEN2500	Ventilator free standing: 1 plug, 1 Data (Lantronix) cable (would be the Servo i)		3
2		2	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Schedule of Components by Room	B1401-01

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: B1401-01 Single Bed Isolation Cubicle 10
Room Number: 1-B1-036
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED003	BED; cot; baby; dropside; standard size		3
1		1	BED2501	Mobile bed divider 1600W 1350H		3
1		1	BIN2503	BIN; sharps disposal		3
1		1	BRA2502	BRACKET; TV; height adjustable; swivel; wall mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
2		2	CHA2512	CHAIR; upright; with arms; vinyl plastic; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM904	CIS; CART; with CPU ; screen; keyboard & mouse		3
1		1	CON902	Remote monitor control (cabling integrated into the pendant or WiFi)		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRA900	Drawer for monitoring consumables.		1
1		1	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO900	Drip hook for water bag required.		1
2		2	HOO901	Integral adjustable drip stand with 6 hanging hooks.		1
1		1	HOO902	Hook for suction support: Upper Medirail mounted.		1
1		1	LIG900	Uplighter, pendant mounted.		1
1		1	LIG901	Small examination light.		1
1		1	MAT901	MATTRESS, reliever		3
1		1	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
1		1	MON909	MONITOR; Transport monitor for ITU/Theatre/High Acuity		3
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
5		5	OUT010	SOCKET outlet, switched, 13amp, twin		1
48		48	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
4		4	OUT095	Earth bonding point, pendant mounted.		1
1		1	OUT121	SOCKET outlet; computer data; double.		1
4		4	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
4		4	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
4		4	OUT470	OUTLET, oxygen, medical		1
4		4	OUT475	OUTLET, vacuum, medical		1
1		1	OUT480	OUTLET, gas scavenging (AGS), medical		1
2		2	OUT900	Data Input Box for CIS with 16 input channels (Lantronix): uses 1 plug, 1 data point		3

ADB	Room Data Sheet	B1401

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B1401	Single-bed cubicle		
Room Number:	1-B1-037		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Patient records reviewed and recorded 3) Patient examinations and assessment 4) Therapeutic and clinical attention from healthcare staff 5) Use of piped medical gases, vacuum and associated equipment 6) Rest and relaxation			
Personnel:	1 x patient 5 x staff 2 x visitors			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm)**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligatureStrategy for anti-ligature provision

ADB	Room Environmental Data	B1401

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room	B1401	Single-bed cubicle		
Room Number:	1-B1-037		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18-25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Natural & Central Supply Air
Mechanical Ventilation (Extract ac/hr):		via ensuite
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - Minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control witch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B1401

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B1401	Single-bed cubicle
Room Number:	1-B1-037	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B1401

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: B1401 Single Bed Cubicle 9
Room Number: 1-B1-037
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED003	BED; cot; baby; dropside; standard size		3
1		1	BED2501	Mobile bed divider 1600W 1350H		3
1		1	BIN2503	BIN; sharps disposal		3
1		1	BRA2502	BRACKET; TV; height adjustable; swivel; wall mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
2		2	CHA2512	CHAIR; upright; with arms; vinyl plastic; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM904	CIS; CART; with CPU ; screen; keyboard & mouse		3
1		1	CON902	Remote monitor control (cabling integrated into the pendant or WiFi)		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRA900	Drawer for monitoring consumables.		1
1		1	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO900	Drip hook for water bag required.		1
2		2	HOO901	Integral adjustable drip stand with 6 hanging hooks.		1
1		1	HOO902	Hook for suction support: Upper Medirail mounted.		1
1		1	LIG900	Uplighter, pendant mounted.		1
1		1	LIG901	Small examination light.		1
1		1	MAT901	MATTRESS, reliever		3
1		1	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
1		1	MON909	MONITOR; Transport monitor for ITU/Theatre/High Acuity		3
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
5		5	OUT010	SOCKET outlet, switched, 13amp, twin		1
48		48	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
4		4	OUT095	Earth bonding point, pendant mounted.		1
1		1	OUT121	SOCKET outlet; computer data; double.		1
4		4	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
4		4	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
4		4	OUT470	OUTLET, oxygen, medical		1
4		4	OUT475	OUTLET, vacuum, medical		1
1		1	OUT480	OUTLET, gas scavenging (AGS), medical		1
2		2	OUT900	Data Input Box for CIS with 16 input channels (Lantronix): uses 1 plug, 1 data point		3

ADB	Schedule of Components by Room	B1401

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: B1401 Single Bed Cubicle 9
Room Number: 1-B1-037
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	PEN1000L	PENDANT; critical care; twin arm; left hand monitor arm, with elbow joints; multi movement.		1
1		1	PEN1000R	PENDANT; critical care; twin arm; right hand monitor arm, with elbow joints; multi movement.		1
1		1	PEN1004	PENDANT; critical care; CIS; single arm with elbow joints; multi movement (to NHSL specification).		1
1		1	PRI015	PRINTER; label; portable		3
2		2	RAI900	Lower Medirail with mounts for suction pressure, suction control unused suction catheters.		1
1		1	RAI901	Monitor module rack pole mounted plus CO2/Press.		1
1		1	RAI903	Shelf and mount for monitor (tilt and swivel of screen required)		1
1		1	RAI904	Integral drip stand for transducers with hooks		1
2		2	SHE900	Shelf for airway consumables		1
1		1	SHE901	Lower height adjustable shelf for small monitors.		1
1		1	SUR985	Humidifier: 1 plug, 1 Data (Lantronix) cable		3
1		1	SUR986	Docking station with 7 volumetric pumps: 1 plug, I Data (Lantronix) cable		3
1		1	SUR987	Nebuliser mounted on Medirail : 1 plug		3
2		2	SUR989	Alaris volumetric pumps: 2 plugs		3
1		1	SUR991	Double oxygen flow meter: Upper Medirail mounted		3
1		1	SUR992	Air flow meter: Upper Medirail mounted		3
1		1	SUR993	Airway pressure monitor: Upper Medirail mounted		3
1		1	SUR999	Enteral feed pump		3
1		1	SWC025	SWITCH, light		1
1		1	SWC034	SWITCH, dimmer, modulating		1
1		1	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	VEN2500	Ventilator free standing: 1 plug, 1 Data (Lantronix) cable (would be the Servo i)		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Design Character	B1609-02

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B1609-02	4 beds High Acuity
Room Number:	1-B1-063	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Room Data Sheet	B1609-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B1609-02	4 beds High Acuity		
Room Number:	1-B1-063		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Patient records reviewed and recorded 3) Patient examinations and assessment 4) Therapeutic and clinical attention from healthcare staff 5) Use of piped medical gases, vacuum and associated equipment 6) Rest and relaxation			
Personnel:	4 x patients 5 x staff 6 x visitors			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B1609-02

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B1609-02	4 beds High Acuity
Room Number:	1-B1-063	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Natural & Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Schedule of Components by Room	B1609-02

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: B1609-02 Open Plan Bay (4 beds)
Room Number: 1-B1-063
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
4		4	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
2		2	BED003	BED; cot; baby; dropside; standard size		3
2		2	BED016	BED, CCU/ITU, radio translucent rising backrest, two-way tilt, height adjustable (685-860), on castors		3
4		4	BED2501	Mobile bed divider 1600W 1350H		3
4		4	BIN2503	BIN; sharps disposal		3
4		4	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
4		4	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
8		8	CHA2512	CHAIR; upright; with arms; vinyl plastic; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
4		4	COM904	CIS; CART; with CPU ; screen; keyboard & mouse		3
4		4	CON902	Remote monitor control (cabling integrated into the pendant or WiFi)		3
4		4	DIS013	DISPENSER, paper towel, wall mounted		2
4		4	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
4		4	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
4		4	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
4		4	DRA900	Drawer for monitoring consumables.		1
2		2	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
9		9	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
8		8	HOO900	Drip hook for water bag required.		1
8		8	HOO901	Integral adjustable drip stand with 6 hanging hooks.		1
4		4	HOO902	Hook for suction support: Upper Medirail mounted.		1
4		4	LIG900	Uplighter, pendant mounted.		1
4		4	LIG901	Small examination light.		1
2		2	MAT006	MATTRESS; ITU/CCU bed; extra care		3
2		2	MAT901	MATTRESS, reliever		3
4		4	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
4		4	MON909	MONITOR; Transport monitor for ITU/Theatre/High Acuity		3
2		2	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
4		4	OUT005	SOCKET outlet, switched, 13amp, single		1
21		21	OUT010	SOCKET outlet, switched, 13amp, twin		1
192		192	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
16		16	OUT095	Earth bonding point, pendant mounted.		1
4		4	OUT121	SOCKET outlet; computer data; double.		1
16		16	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
16		16	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
16		16	OUT470	OUTLET, oxygen, medical		1
16		16	OUT475	OUTLET, vacuum, medical		1
4		4	OUT480	OUTLET, gas scavenging (AGS), medical		1

ADB	Schedule of Components by Room	B1609-02

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: B1609-02 Open Plan Bay (4 beds)
Room Number: 1-B1-063
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
8		8	OUT900	Data Input Box for CIS with 16 input channels (Lantronix): uses 1 plug, 1 data point		3
4		4	PEN1000L	PENDANT; critical care; twin arm; left hand monitor arm, with elbow joints; multi movement.		1
4		4	PEN1000R	PENDANT; critical care; twin arm; right hand monitor arm, with elbow joints; multi movement.		1
4		4	PEN1004	PENDANT; critical care; CIS; single arm with elbow joints; multi movement (to NHSL specification).		1
4		4	PRI015	PRINTER; label; portable		3
8		8	RAI900	Lower Medirail with mounts for suction pressure, suction control unused suction catheters.		1
4		4	RAI901	Monitor module rack pole mounted plus CO2/Press.		1
4		4	RAI903	Shelf and mount for monitor (tilt and swivel of screen required)		1
4		4	RAI904	Integral drip stand for transducers with hooks		1
8		8	SHE900	Shelf for airway consumables		1
4		4	SHE901	Lower height adjustable shelf for small monitors.		1
2		2	SUP2500	SUPPORT LEG; for 920 high worktop		1
4		4	SUR985	Humidifier: 1 plug, 1 Data (Lantronix) cable		3
4		4	SUR986	Docking station with 7 volumetric pumps: 1 plug, I Data (Lantronix) cable		3
4		4	SUR987	Nebuliser mounted on Medirail : 1 plug		3
8		8	SUR989	Alaris volumetric pumps: 2 plugs		3
4		4	SUR991	Double oxygen flow meter: Upper Medirail mounted		3
4		4	SUR992	Air flow meter: Upper Medirail mounted		3
4		4	SUR993	Airway pressure monitor: Upper Medirail mounted		3
4		4	SUR999	Enteral feed pump		3
1		1	SWC025	SWITCH, light		1
4		4	SWC034	SWITCH, dimmer, modulating		1
4		4	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
4		4	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
4		4	TEL1000	TELEPHONE; handset.		3
4		4	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
4		4	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
4		4	UPS003	Uninterrupted power supply (UPS).		1
4		4	VEN2500	Ventilator free standing: 1 plug, 1 Data (Lantronix) cable (would be the Servo i)		3
4		4	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
4		4	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	B1407-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B1407-01	Open Plan Bay 3 cots: Neonatal		
Room Number:	1-B1-065		**Revision Date:**	18/09/2014

Activities:	1) Observation, medical and nursing care and treatment of baby needing intensive care and/or segregation facilities 2) Feeding a baby in an incubator, or sitting in a chair 3) Holding/storing sterile equipment 4) Disposal of waste and contaminated materials 5) Preparation of intravenous fluids for infusion 6) Donning gown and gloves. 7) Disposal of used protective clothing 8) Nappy changing			
Personnel:	3 x neonates 2 x staff (up to 5 per cot in an emergency). 6 x visitors			
Planning Relationships:	Staff base; located nearby.			
Space Data:	**Area (m²):**		**Height (mm):**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B1407-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room	B1407-01	Open Plan Bay 3 cots: Neonatal
Room Number:	1-B1-065	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18-25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Natural & Central Supply Air
Mechanical Ventilation (Extract ac/hr):		via ensuite
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control witch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY	
Hot Surface Max. Temp (DegC):	43
Hot Water Max. Temp (DegC):	41

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B1407-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B1407-01	Open Plan Bay 3 cots: Neonatal
Room Number:	1-B1-065	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B1407-01

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: B1407-01 Open Plan Bay (3 cots)
Room Number: 1-B1-065
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
3		3	BIN2503	BIN; sharps disposal		3
3		3	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
3		3	CHA017	CHAIR; upright; upholstered; stacking		3
3		3	CHA054	CHAIR nursing with side panels		3
3		3	CHA2509	CHAIR; height adjustable 540-790		3
3		3	COM904	CIS; CART; with CPU ; screen; keyboard & mouse		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
3		3	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
3		3	DRA900	Drawer for monitoring consumables.		1
6		6	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
3		3	HOO900	Drip hook for water bag required.		1
3		3	HOO902	Hook for suction support: Upper Medirail mounted.		1
3		3	INC004	INCUBATOR; baby		3
3		3	LIG901	Small examination light.		1
3		3	LOC002	LOCKER, bedside, 3 compartment, towel rail at rear, on castors, 902H 485W 485D		3
3		3	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
3		3	MON909	MONITOR; Transport monitor for ITU/Theatre/High Acuity		3
3		3	OUT005	SOCKET outlet, switched, 13amp, single		1
12		12	OUT010	SOCKET outlet, switched, 13amp, twin		1
72		72	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
6		6	OUT095	Earth bonding point, pendant mounted.		1
3		3	OUT121	SOCKET outlet; computer data; double.		1
6		6	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
6		6	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
6		6	OUT470	OUTLET, oxygen, medical		1
6		6	OUT475	OUTLET, vacuum, medical		1
3		3	OUT480	OUTLET, gas scavenging (AGS), medical		1
3		3	OUT900	Data Input Box for CIS with 16 input channels (Lantronix): uses 1 plug, 1 data point		3
3		3	PEN1004	PENDANT; critical care; CIS; single arm with elbow joints; multi movement (to NHSL specification).		1
3		3	PEN1005	PENDANT; critical care; single arm (to NHSL specification).		1
3		3	RAI900	Lower Medirail with mounts for suction pressure, suction control unused suction catheters.		1
3		3	RAI903	Shelf and mount for monitor (tilt and swivel of screen required)		1
6		6	RAI904	Integral drip stand for transducers with hooks		1
2		2	SHE901	Lower height adjustable shelf for small monitors.		1
2		2	STA142	STAND; infusion; twin hook; breaks; mobile		3
6		6	SUR990	Alaris volumetric pumps: 2 plugs		3

ADB	Schedule of Components by Room	B1407-01

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: B1407-01 Open Plan Bay (3 cots)
Room Number: 1-B1-065
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
3		3	SUR991	Double oxygen flow meter: Upper Medirail mounted		3
3		3	SUR992	Air flow meter: Upper Medirail mounted		3
3		3	SUR993	Airway pressure monitor: Upper Medirail mounted		3
3		3	SUR999	Enteral feed pump		3
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
6		6	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
3		3	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
3		3	TRO902	GRATNELL TROLLEY 500x500 x870mm		3
3		3	UPS003	Uninterrupted power supply (UPS).		1
2		2	VEN2501	Ventilator free standing: 1 plug, 1 Data (Lantronix) cable (would be the SIPAP)		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	B1421

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B1421	Single cot cubicle: neonatal		
Room Number:	1-B1-075		**Revision Date:**	18/09/2014

Activities:	1) Observation, medical and nursing care and treatment of baby needing intensive care and/or segregation facilities 2) Feeding a baby in an incubator, or sitting in a chair 3) Disposal of waste and contaminated materials 4) Use of scrub-up trough 5) Medication prepared for administration 6) Preparation of intravenous fluids for infusion 7) Donning gown and gloves. 8) Disposal of used protective clothing 9) Nappy changing
Personnel:	1 x patient 5 x staff 2 x visitors
Planning Relationships:	Within view from the staff communications base.

Space Data:	**Area (m²):**		**Height (mm):**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B1421

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room	B1421	Single cot cubicle: neonatal
Room Number:	1-B1-075	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18-25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Natural & Central Supply Air
Mechanical Ventilation (Extract ac/hr):		via ensuite
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control witch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY	
Hot Surface Max. Temp (DegC):	41
Hot Water Max. Temp (DegC):	43

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B1421

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B1421	Single cot cubicle: neonatal
Room Number:	1-B1-075	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B1421

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: B1421 Single Cot Cubicle
Room Number: 1-B1-075 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED020	BED; fold down; 760 mm width mattress; vertical.		1
1		1	BIN2503	BIN; sharps disposal		3
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	BRA2501	BRACKET; holder; suction unit; pendant mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CHA054	CHAIR nursing with side panels		3
1		1	CHA2509	CHAIR; height adjustable 540-790		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
2		2	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRA900	Drawer for monitoring consumables.		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO900	Drip hook for water bag required.		1
1		1	HOO902	Hook for suction support: Upper Medirail mounted.		1
1		1	INC004	INCUBATOR; baby		3
1		1	LIG901	Small examination light.		1
1		1	LOC002	LOCKER, bedside, 3 compartment, towel rail at rear, on castors, 902H 485W 485D		3
1		1	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
1		1	MON909	MONITOR; Transport monitor for ITU/Theatre/High Acuity		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
6		6	OUT010	SOCKET outlet, switched, 13amp, twin		1
24		24	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT095	Earth bonding point, pendant mounted.		1
1		1	OUT121	SOCKET outlet; computer data; double.		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
2		2	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
2		2	OUT470	OUTLET, oxygen, medical		1
2		2	OUT475	OUTLET, vacuum, medical		1
1		1	OUT480	OUTLET, gas scavenging (AGS), medical		1
1		1	OUT900	Data Input Box for CIS with 16 input channels (Lantronix): uses 1 plug, 1 data point		3
1		1	PEN1004	PENDANT; critical care; CIS; single arm with elbow joints; multi movement (to NHSL specification).		1
1		1	PEN1005	PENDANT; critical care; single arm (to NHSL specification).		1
1		1	PRI015	PRINTER; label; portable		3
1		1	RAI900	Lower Medirail with mounts for suction pressure, suction control unused suction catheters.		1

ADB	Schedule of Components by Room	B1421

Project: 11072 RHSC & DCN
Department: B1 PICU and HDU's - 24 Beds
Room: B1421 Single Cot Cubicle
Room Number: 1-B1-075
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	RAI903	Shelf and mount for monitor (tilt and swivel of screen required)		1
2		2	RAI904	Integral drip stand for transducers with hooks		1
1		1	SHE901	Lower height adjustable shelf for small monitors.		1
1		1	STA142	STAND; infusion; twin hook; breaks; mobile		3
2		2	SUR990	Alaris volumetric pumps: 2 plugs		3
1		1	SUR991	Double oxygen flow meter: Upper Medirail mounted		3
1		1	SUR992	Air flow meter: Upper Medirail mounted		3
1		1	SUR993	Airway pressure monitor: Upper Medirail mounted		3
1		1	SUR999	Enteral feed pump		3
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
2		2	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRO902	GRATNELL TROLLEY 500x500 x870mm		3
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	C0230

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0230	Consulting/examination room: Orthoptic		
Room Number:	1-D3-007		**Revision Date:**	18/09/2014

Activities:	1) Consultations. 2) Assessment / updating of electronic patient records (EPRs) 3) Clinical handwashing 4) Storage of sterile supplies and consumables on a trolley 5) Minimally invasive clinical procedures undertaken from one or both sides of the couch.			
Personnel:	1 x patient 2 x staff 2 x escorts			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM SZ SL SH 200 001 for room area			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0230

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0230	Consulting/examination room: Orthoptic		
Room Number:	1-D3-007		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	3.0	Ventila ion Type: Central Supply and extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0230

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0230	Consulting/examination room: Orthoptic
Room Number:	1-D3-007	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A
Notes:	Blinds will be required to darken room for general ophthalmic examination.

ADB	Schedule of Components by Room	C0230

Project: 11072 RHSC & DCN
Department: D3 Orthoptics
Room: C0230 C/E Orthoptic (6 metre room)
Room Number: 1-D3-007
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BLI2500	Blind; total blackout boxed; length as indicated. Wipeable.		1
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	CAS900	OPHTHALMOSCOPE; Indirect		3
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
1		1	CHA031	CHAIR; child; upright; stacking; seat height 380mm		3
2		2	CHA083	CHAIR, stacking, polypropylene, with back and seat pads		3
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DIA2501	DIAGNOSTIC SET; retinoscope/opthalmoscope; wall mounted.		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO024	HOOK; hat and coat; 1.		1
1		1	LEN900	LENS SET; Trial		3
1		1	LIG003	LUMINAIRE, reading, adjustable arm, 100 watt		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
3		3	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
2		2	STF125	STORAGE UNIT; lower; cupboard; 1 door; 1 shelf; 550H 500W 450D		1
3		3	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	SYN001	SYNOPTOPHORE; includes set of 12 pairs of slides; with accessories set; orthoptics		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TES005	Bailey-Lovie-LugMar; 6m; with controls; wall mounted		2
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	C0517

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0517	ABR Room		
Room Number:	1-D4-002		**Revision Date:**	18/09/2014

Activities:	1) Audiometric examination and test procedures 2) Use of specialised visual aids and multi-media equipment 3) Use of recording equipment 4) Use of computer workstation(s) 5) Recording of patient data/notes
Personnel:	1 x patient 3 x staff 2 x escorts
Planning Relationships:	Easy access from waiting area. Adjacent to Audiology observation and control room. Clinical handwash to be located outside of the room/booth.

Space Data:	**Area (m²):**		**Height (mm):**	2,700

Refer to HLM SZ SL SH 200 001 for room area
Height is the nominal internal dimension of a standard booth and is subject to design/local decision.

Room area includes booth wall thickness but excludes surrounding void and space for ba in

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM SZ 00 PL 331 001 Anti ligature Strategy for anti ligature provi ion

ADB	Room Environmental Data	C0517

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0517	ABR Room
Room Number:	1-D4-002	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed / Trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0517

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0517	ABR Room
Room Number:	1-D4-002	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	C0517

Project: 11072 RHSC & DCN
Department: D4 Audiology
Room: C0517 ABR Room
Room Number: 1-D4-002
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	ALA020	LAMP INDICATING fire alarm initiation, wall mounted		1
1		1	AUD005	AUDIOMETER; clinical; diagnostic; 195H 475W 450D		3
1		1	AUD8000	EVOKED POTENTIAL instrument; complete unit with Videotoscopy; 380H 365W 255D		3
1		1	AUD8001	TYMPANOMETER; High Frequency; 380H 365W 255D		3
1		1	AUD8002	Automated Auditory Brainstem Responses (AABR)		3
1		1	AUR2500	AURICLE; with videotoscopy		3
2		2	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
1		1	CHA006	CHAIR; easy; with open arms; low back; upholstered		3
1		1	CHA091	CHAIR; easy; reclining; 1000H 630W 1880D		3
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
3		3	CUP2563	CUPBOARD; 2 shelves; free standing; 800H x 600W x 500D		3
1		1	DES2504	DESK UNIT; free standing with drawers; cable management; adjustable legs; modesty panel; 1600W 800D		3
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
11		11	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TRO021	TROLLEY; 4 sets of runners; 850H 600W 600D		3

ADB	Room Data Sheet	C0516

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0516	Observation/Control room		
Room Number:	1-D4-006		**Revision Date:**	18/09/2014

Activities:	1) Observing activities within Audiology booth through panel 2) Use of computer workstation(s)			
Personnel:	3 x staff.			
Planning Relationships:	Adjacent to paediatric audiology booth.			
Space Data	**Area (m)**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0516

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0516	Observation/Control room
Room Number:	1-D4-006	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radient Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750-850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0516

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0516	Observation/Control room
Room Number:	1-D4-006	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Observation panel, one-way viewing from control room into booth.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	C0516

Project: 11072 RHSC & DCN
Department: D4 Audiology
Room: C0516 Obs/Control
Room Number: 1-D4-006
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	AMP2500	AMPLIFIER SYSTEM		1
1		1	AUD005	AUDIOMETER; clinical; diagnostic; 195H 475W 450D		3
1		1	AUR2500	AURICLE; with videotoscopy		3
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
1		1	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CHA032	CHAIR; child; upright; stacking; seat height 420mm		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	CON2503	Control Unit for induction loop.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	MON017	MONITOR and CONTROL for CCTV; complete with flat screen monitor; keyboard; digital recorder (computer) and power supply.		1
1		1	MSC2533	CABINET base; drawer line, 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 680.		1
1		1	MSC2535	CABINET base; drawer lined, 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 680.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
10		10	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
3		3	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT2502	LOOP; induction.		1
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
2		2	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	SWC033	SWITCH dimmer; 3 position; wall mounted		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	C0515

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0515	Testing/Clinic room		
Room Number:	1-D4-007		**Revision Date:**	18/09/2014

Activities:	1) Assessment / updating of electronic patient records (EPRs) 2) Use of monitoring/diagnostic or therapeutic equipment 3) Use of mobile diagnostic and therapeutic equipment 4) Audiometric examination and test procedures			
Personnel:	1 x patient 1 x staff 2 x escorts			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0515

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0515	Testing/Clinic room
Room Number:	1-D4-007	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	3.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0515

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0515	Testing/Clinic room
Room Number:	1-D4-007	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A
Notes:	Blinds will be required to darken room for general ophthalmic examination.

ADB	Schedule of Components by Room	C0515

Project: 11072 RHSC & DCN
Department: D4 Audiology
Room: C0515 Testing/Clinic Room
Room Number: 1-D4-007
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	ALA020	LAMP INDICATING fire alarm initiation, wall mounted		1
1		1	AMP2500	AMPLIFIER SYSTEM		1
1		1	AUD003	METER; sound level; 265H 75W 60D		3
1		1	AUD005	AUDIOMETER; clinical; diagnostic; 195H 475W 450D		3
1		1	AUD8001	TYMPANOMETER; High Frequency; 380H 365W 255D		3
1		1	AUR2500	AURICLE; with videotoscopy		3
2		2	BEN002	PLAY-BENCH UNIT; with 3 storage boxes; 360H 1035W 470D		3
1		1	BLI2500	Blind; total blackout boxed; length as indicated. Wipeable.		1
2		2	CAM031	CAMERA; CCTV; pan/tilt/zoom.		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CHA032	CHAIR; child; upright; stacking; seat height 420mm		3
1		1	CHA2514	D CHAIR; with safety straps		3
1		1	COM031	COMPUTER: standard with keyboard and screen.		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	DES022	DESK; cantilever; single pedestal 3 drawer; cable management; modesty panel; 1600W 800D		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
13		13	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT2502	LOOP; induction.		1
2		2	SPE2500	SPEAKERS; high specification		1
1		1	SWC033	SWITCH dimmer; 3 position; wall mounted		1
1		1	TAB054	TABLE, occasional, undershelf, 450H 610W 610D		3
4		4	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
2		2	VRA2500	VRA record unit; 3 toy stack		2

ADB	Room Data Sheet	C0110-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0110-01	Distraction Free Treatment: SALT		
Room Number:	1-D6-035		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Use of monitoring/diagnostic or therapeutic equipment 3) Use of computer workstation(s) 4) Use of Telephone			
Personnel:	1 x patient 2 x staff 2 x escorts			
Planning Relationships:				
Space Data:	**Area (m^2):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0110-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0110-01	Distraction Free Treatment: SALT
Room Number:	1-D6-035	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	3.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0110-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0110-01	Distraction Free Treatment: SALT
Room Number:	1-D6-035	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	C0110-01

Project: 11072 RHSC & DCN
Department: D6 RHSC Therapies
Room: C0110-01 Standard Distraction Free Treatment Room
Room Number: 1-D6-035 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BOA037	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 900H 1200W.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
3		3	CHA017	CHAIR; upright; upholstered; stacking		3
2		2	CHA2500	Chair; childs; upright; lockable; height adjustable		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM035	COMPUTER PRINTER; line; small		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	CUP2999	CUPBOARD, built in, sliding doors, distraction free treatment		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	EXE2518	EXERCISE MAT; 1520W 2130L		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO024	HOOK; hat and coat; 1.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
5		5	OUT010	SOCKET outlet, switched, 13amp, twin		1
5		5	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	PEG002	PEGS; equipment; medium; 2; wide spacing; wall mounted.		1
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	STF151	STORAGE UNIT; lower; 2 drawer; on castors; 600H 500W 450D		3
1		1	STO023	STOOL; laboratory; complete with footring		3
1		1	SWC025	SWITCH, light		1
1		1	TAB2506	TABLE; for child; adjustable height; 900W 600D		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	X0208

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0208	Rehabilitation Room:OT		
Room Number:	1-D6-048		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Assessment / rehabilitative work under supervision of occupational therapy staff 3) Assessment / updating of electronic patient records (EPRs) 4) Use of monitoring/diagnostic or therapeutic equipment 5) Use of mobile diagnostic and therapeutic equipment 6) Storage / preparation of dressing/instrument trolleys 7) Sterile supplies and consumables are held			
Personnel:	6 x patients 4 x staff 6 x escorts			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m²):**		**Height (mm):**	3,200
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0208

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0208	Rehabilitation Room:OT		
Room Number:	1-D6-048		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7- minimum
Humidity (%RH):		
General Notes:	Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air	

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting
General Notes:	Control: Switch	

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		
General Notes:	Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)	

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	
General Notes:	Maximum cold water discharge temperature (degC): 20	

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0208

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0208	Rehabilitation Room:OT
Room Number:	1-D6-048	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0208

Project: 11072 RHSC & DCN
Department: D6 RHSC Therapies
Room: X0208 Rehabilitation Room (Physio)
Room Number: 1-D6-048
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
2		2	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	BRA904	BRACKET; for Wii		2
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CAM2500	VIDEO MONITORING EQUIPMENT; camera.		2
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
2		2	CHA031	CHAIR; child; upright; stacking; seat height 380mm		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	EXE002	EXERCISE BARS; junior foldable parallel; 650mm H X 1860mm L X 360mm W		3
1		1	EXE004	EXERCISE BARS; foldable parallel; 1000mm H X 2300mm L X 610mm W		3
1		1	EXE2501	Motamed Bike (Wheelchair Accessible)		3
1		1	EXE2512	RECUMBENT BIKE; 1660 x660		3
1		1	EXE2513	RACK; gym ball storage; adjustable; wall mounted		2
1		1	EXE2517	EXERCISE STAIR; corner		3
2		2	EXE2518	EXERCISE MAT; 1520W 2130L		3
1		1	GAM1002	Gaming; Wii		1
1		1	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	MIR2501	MIRROR; unbreakable; wall mounted; 1600 H 1600W.		1
1		1	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	MSC127	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; wall mounted.		1
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
6		6	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT059	CONNECTION UNIT switched 13amp, indicator light		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
2		2	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PEG002	PEGS; equipment; medium; 2; wide spacing; wall mounted.		1

ADB	Schedule of Components by Room	X0208

Project: 11072 RHSC & DCN
Department: D6 RHSC Therapies
Room: X0208 Rehabilitation Room (Physio)
Room Number: 1-D6-048
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	PLI042	PLINTH; 3 section; variable height 380/1010H 2100W 1000D		3
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	STO004	STOOL, height adjustable, swivel, mobile		3
1		1	STO023	STOOL; laboratory; complete with footring		3
1		1	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAB2506	TABLE; for child; adjustable height; 900W 600D		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
2		2	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	X0208-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0208-01	Rehabilitation Room: Physio		
Room Number:	1-D6-053		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Invasive clinical procedures from side of couch 3) Assessment / updating of electronic patient records (EPRs) 4) Use of mobile diagnostic and therapeutic equipment 5) Rehabilitation exercises			
Personnel:	6 x patients 4 x staff 6 x escorts			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	3,200
	Refer to HLM SZ SL SH 200 001 for room area			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0208-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0208-01	Rehabilitation Room: Physio
Room Number:	1-D6-053	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0208-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0208-01	Rehabilitation Room: Physio
Room Number:	1-D6-053	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0208-01

Project: 11072 RHSC & DCN
Department: D6 RHSC Therapies
Room: X0208-01 Rehabilitation Room (Physio)
Room Number: 1-D6-053
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CAM2500	VIDEO MONITORING EQUIPMENT; camera.		2
4		4	CHA031	CHAIR; child; upright; stacking; seat height 380mm		3
8		8	CHA317	CHAIR, upright, upholstered, stacking, wipeable		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2502	DISPENSER; plinth roller towel		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	EXE007	EXERCISE BARS; wall; 2400H 920W.		2
1		1	EXE008	EXERCISE BENCH; 400H 3400W 260D		3
1		1	EXE2513	RACK; gym ball storage; adjustable; wall mounted		2
2		2	EXE2518	EXERCISE MAT; 1520W 2130L		3
1		1	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	MIR2501	MIRROR; unbreakable; wall mounted; 1600 H 1600W.		1
1		1	MSC082	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
1		1	MSC128	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; wall mounted.		1
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
6		6	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT059	CONNECTION UNIT switched 13amp, indicator light		1
2		2	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	PEG002	PEGS; equipment; medium; 2; wide spacing; wall mounted.		1
1		1	PLI041	PLINTH; 3 section; variable height 380/1010H 1880W 710D		3
1		1	RIN005	RING; basket ball; includes: ring; fixing; basket ball and net; 500mm dia.		2
2		2	SCR2503	SCREEN, mobile 2500L 480W 1700H		3
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
2		2	STO004	STOOL, height adjustable, swivel, mobile		3
1		1	STO023	STOOL; laboratory; complete with footring		3
1		1	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3

ADB	Schedule of Components by Room	X0208-01

Project: 11072 RHSC & DCN
Department: D6 RHSC Therapies
Room: X0208-01 Rehabilitation Room (Physio)
Room Number: 1-D6-053
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	X0208-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0208-02	Rehabilitation Room: Physio (CV Equip)		
Room Number:	1-D6-054		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Assessment / updating of electronic patient records (EPRs) 3) Use of mobile diagnostic and therapeutic equipment 4) Rehabilitation exercises 5) Relaxation activities 6) Use of bicycle / exercise equipment.			
Personnel:	6 x patients 4 x staff 6 x escorts			
Planning Relationships:				
Space Data:	**Area (m^2):**		**Height (mm)**	3,200
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0208-02

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0208-02	Rehabilitation Room: Physio (CV Equip)
Room Number:	1-D6-054	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0208-02

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0208-02	Rehabilitation Room: Physio (CV Equip)
Room Number:	1-D6-054	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0208-02

Project: 11072 RHSC & DCN
Department: D6 RHSC Therapies
Room: X0208-02 Rehabilitation Room (inc CV equip)
Room Number: 1-D6-054
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
4		4	CHA031	CHAIR; child; upright; stacking; seat height 380mm		3
8		8	CHA317	CHAIR, upright, upholstered, stacking, wipeable		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2502	DISPENSER; plinth roller towel		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DIS2505	DISPENSER; WATER COOLER, mains supply.		1
1		1	EXE014	EXERCISE BICYCLE; ergometer; 1170 x 530		3
1		1	EXE2509	CROSS TRAINER; 2030 x 940		3
1		1	EXE2511	ROWING MACHINE; 2090 x 540		3
1		1	EXE2513	RACK; gym ball storage; adjustable; wall mounted		2
2		2	EXE2518	EXERCISE MAT; 1520W 2130L		3
1		1	EXE901	MACHINE; unweighting system		3
1		1	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	MIR2501	MIRROR; unbreakable; wall mounted; 1600 H 1600W.		1
1		1	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	MSC127	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; wall mounted.		1
2		2	MSC157	CABINET tall; 400mm facing; with 6 shelves; 1 door hinged right; on plinth; o/a height 2100.		1
1		1	MSC158	CABINET tall; 400mm facing; with 6 shelves; 1 door hinged left; on plinth; o/a height 2100.		1
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
6		6	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
5		5	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT315	OUTLET, drinking water for equipment		1
1		1	PEG002	PEGS; equipment; medium; 2; wide spacing; wall mounted.		1
1		1	PLI041	PLINTH; 3 section; variable height 380/1010H 1880W 710D		3
2		2	SCR2503	SCREEN, mobile 2500L 480W 1700H		3
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
2		2	STO004	STOOL, height adjustable, swivel, mobile		3

ADB	Schedule of Components by Room	X0208-02

Project: 11072 RHSC & DCN
Department: D6 RHSC Therapies
Room: X0208-02 Rehabilitation Room (inc CV equip)
Room Number: 1-D6-054
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	STO023	STOOL; laboratory; complete with footring		3
1		1	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	X0242

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0242	Dressings Room		
Room Number:	1-D7-003		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Dressing / undressing in privacy 3) Assessment / updating of electronic patient records (EPRs) 4) Invasive clinical procedures from side of couch 5) Preparation of trays / packs for clinical procedures 6) Sterile packs, lotions and drugs prepared for immediate use 7) Storage of sterile supplies and consumables on a trolley 8) Use of mobile diagnostic and therapeutic equipment			
Personnel:	1 x patient 1 x staff 2 x escorts			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m²):**		**Height (mm):**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0242

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0242	Dressings Room
Room Number:	1-D7-003	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	3.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0242

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0242	Dressings Room
Room Number:	1-D7-003	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0242

Project: 11072 RHSC & DCN
Department: D7 Plastics Dressings Clinic
Room: X0242 Dressings Room (Burns)
Room Number: 1-D7-003
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	BRA902	Bracket; Monitor oxygen/saturation inside room		2
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
2		2	CHA083	CHAIR, stacking, polypropylene, with back and seat pads		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM034	COMPUTER PRINTER, inkjet, colour		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DEV900	DEVICE; Ditto Diversional		3
1		1	DIS011	DISPENSER, barrier cream, disposable single cartridge, wall mounted		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS016	DISPENSER, paper sheet (for couch/trolley), wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO024	HOOK; hat and coat; 1.		1
1		1	LIG050	LUMINAIRE operating (minor)		1
1		1	MON900	MONITOR; Low end monitor, general Ward /OPD use		3
1		1	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	MSC082	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
1		1	MSC127	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; wall mounted.		1
1		1	MSC128	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; wall mounted.		1
1		1	MSC2511	CUPBOARD; 600mm facing; medicine; 1 door hinged left; 1700mm.		1
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
6		6	OUT010	SOCKET outlet, switched, 13amp, twin		1
3		3	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT121	SOCKET outlet; computer data; double.		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT453	OUTLET, 4kPa compressed air, medical		1
1		1	OUT470	OUTLET, oxygen, medical		1

ADB	Schedule of Components by Room	X0242

Project: 11072 RHSC & DCN
Department: D7 Plastics Dressings Clinic
Room: X0242 Dressings Room (Burns)
Room Number: 1-D7-003
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	OUT475	OUTLET, vacuum, medical		1
1		1	RAI132	RAIL, clinical equipment, wall mounted, 1200mm		1
1		1	STA102	STAND; 2 lotion bowls; stainless steel		3
1		1	STF286	STORAGE UNIT; upper; cupboard; medicine; 2 door; lockable; 550H 600W 300D		1
1		1	STO013	STOOL; swivel; with back; 710 height		3
1		1	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRO1000	TROLLEY PATIENT; ARJO Huntleigh - AKRON Streamline 2 section 2221A, height adjustable 460-910H 640W 1880D		3
1		1	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	S0027-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	S0027-01	Viewing Room		
Room Number:	1-J1-003		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Storage of working supply of linen 3) Preparation of the body for viewing. 4) Viewing Body			
Personnel:	1 x body (child) 1 x staff 2 x relatives			
Planning Relationships:	En-suite sanitary facilities.			
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	S0027-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	S0027-01	Viewing Room		
Room Number:	1-J1-003		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	6.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Ceiling Cassette - Chilled Water

LIGHTING		
Service Illumination (Lux):	300	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	S0027-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	S0027-01	Viewing Room
Room Number:	1-J1-003	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Observation panel, viewing from sitting room
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	S0027-01

Project: 11072 RHSC & DCN
Department: J1 Bereavement Suite
Room: S0027-01 Body Viewing Room
Room Number: 1-J1-003
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED004	BED, divan style, fixed height, with legs, on lockable castors, 1950L 900W		3
1		1	BED2500	Moses basket		3
1		1	BLI2501	BLIND; ROLLER; length as drawn.		1
1		1	BOO016	BOOKCASE; 3 shelves; cupboard under; 1800H 940W 350D		2
2		2	CHA078	UNIT CHAIR; easy; with arms; fully upholstered		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
3		3	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	SPA2505	Fittings with basin and storage to artist design. To include tall shelved cupboard for linen storage.		1
1		1	SWC033	SWITCH dimmer; 3 position; wall mounted		1
1		1	TAB053	TABLE, occasional, square, 415H 610W 610D		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	B1411

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B1411	Receiving/Resuscitation		
Room Number:	1-L1-005		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Medical and nursing procedures requiring all sides access to patient whilst 1-4 staff using mobile equipment 3) Minimally invasive clinical procedures undertaken from one or both sides of the couch. 4) Non invasive clinical procedures from side of couch or plinth 5) Examinations carried out from one or both sides of the couch 6) Recording of patient data/notes			
Personnel:	1 x patient 8 x staff			
Planning Relationships:				
Space Data:	**Area (m^2):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B1411

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B1411	Receiving/Resuscitation		
Room Number:	1-L1-005		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 21 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	6.0	
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4- minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B1411

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B1411	Receiving/Resuscitation
Room Number:	1-L1-005	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B1411

Project: 11072 RHSC & DCN
Department: L1 DCN Acute Care - 24 Beds
Room: B1411 Receiving/Resuscitation Area
Room Number: 1-L1-005 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	ANA001	ANAESTHETIC MACHINE/WORKSTATION electrically powered piston ventilator, mobile, 1350H 750W 650D		3
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BOA2500	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 900H 600W.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2503	COMPUTER MONITOR, PACS REVIEW STATION; 2 21", high-resolution screens,		3
1		1	DIA2500	DIAGNOSTIC SET; auroscope/opthalmoscope; wall mounted.		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	INF001	INFUSION volumetric pump; 356H 178W 178D		3
1		1	LIG081	LUMINAIRE fitted with single fluorescent lamp with switch; below drug cupboard; 8watt; 400mm.		1
1		1	LIG963	LUMINAIRE; examination; ceiling; adjustable.		1
1		1	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
1		1	MON909	MONITOR; Transport monitor for ITU/Theatre/High Acuity		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
5		5	OUT010	SOCKET outlet, switched, 13amp, twin		1
16		16	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
4		4	OUT121	SOCKET outlet; computer data; double.		1
4		4	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT215	SOCKET outlet, telephone		1
2		2	OUT453	OUTLET, 4kPa compressed air, medical		1
2		2	OUT461	OUTLET, nitrous oxide, medical		1
2		2	OUT470	OUTLET, oxygen, medical		1
2		2	OUT475	OUTLET, vacuum, medical		1
2		2	PEN002	PENDANT; Anaesthetic; medical & power supply unit; vertical movement; ceiling mounted; outlets comprising.		1
1		1	PRI015	PRINTER; label; portable		3
1		1	REF091	REFRIGERATOR; drug; capacity 35 litres; external temperature gauge; lockable; wall mounted; 510H 380W 445D		2
1		1	STF127	STORAGE UNIT; lower; cupboard; 2 door; 1 shelf; 550H 600W 450D		1

ADB	Schedule of Components by Room	B1411

Project: 11072 RHSC & DCN
Department: L1 DCN Acute Care - 24 Beds
Room: B1411 Receiving/Resuscitation Area
Room Number: 1-L1-005
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	STF290	STORAGE UNIT; upper; cupboard; controlled drugs; 1 door; lockable; with inner lockable cupboard and warning light; 550H 600W 300D		1
1		1	SUC004	SUCTION UNIT; electric; portable; 350H 320W 340D		3
1		1	SUP2500	SUPPORT LEG; for 920 high worktop		1
2		2	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
2		2	TEL2500	TELEPHONE; handset, wall mounted.		2
2		2	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
1		1	TRO282	TROLLEY PATIENT; accident; image top; with tilt and brakes; 540-1000H 740W 2110D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	J1155

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	J1155	Waiting		
Room Number:	1-L1-027		**Revision Date:**	18/09/2014

Activities:	1) Patients, relatives and escorts wait to be seen 2) Displaying information			
Personnel:	5 x patients 5 x escorts			
Planning Relationships:	Adjacent to reception area. Close to clinical or work area. Close to WC facilities.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To suit surrounding area/design.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	J1155

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	J1155	Waiting
Room Number:	1-L1-027	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	5.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	5.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	J1155

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	J1155	Waiting
Room Number:	1-L1-027	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	N/A, open to circulation.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	J1155

Project: 11072 RHSC & DCN
Department: L1 DCN Acute Care - 24 Beds
Room: J1155 Patient Waiting Area
Room Number: 1-L1-027 **Revision Date:** 18/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN900	BIN; Recycle waste		3
1		1	BOA2502	BOARD; display/notice; magnetic; wall mounted; 900H 1200W		1
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
6		6	CHA017	CHAIR; upright; upholstered; stacking		3
3		3	CHA047	CHAIR; easy; with open arms; high back; with wings; upholstered		3
1		1	CHA900	Bariatric Chair		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU1001	COUNTER; reception; DDA compliant; with below counter storage; as per detailed design.		1
1		1	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
9		9	OUT010	SOCKET outlet, switched, 13amp, twin		1
3		3	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT2512	SOCKET outlet; video entry.		1
1		1	RAC094	RACK; magazine; double sided; mobile		3
1		1	RAC440	RACK; leaflet; wall mounted; 915H 250W 105D.		1
2		2	SWC025	SWITCH, light		1
2		2	TAB056	TABLE; occasional; round; 415H 610mm dia.		3
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TEL901	VIDEO - entry/security; wall mounted, receiving.		1
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3

ADB	Room Data Sheet	D1135

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	D1135	Discharge Lounge		
Room Number:	1-P1-012		**Revision Date:**	18/09/2014

Activities:	1) Rest and relaxation 2) Viewing television and/or DVDs / videos 3) Reading 4) Consumption of beverages, meals and snacks.			
Personnel:	10 x patients 2 x staff 10 x visitors			
Planning Relationships:	External view/outlook.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	D1135

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	D1135	Discharge Lounge
Room Number:	1-P1-012	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	6.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	D1135

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	D1135	Discharge Lounge
Room Number:	1-P1-012	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	D1135

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: D1135 SDCU Discharge Lounge
Room Number: 1-P1-012 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BOA2502	BOARD; display/notice; magnetic; wall mounted; 900H 1200W		1
4		4	BRA003	BRACKET, holder, suction unit, wall mounted		2
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
4		4	CHA017	CHAIR; upright; upholstered; stacking		3
4		4	CHA031	CHAIR; child; upright; stacking; seat height 380mm		3
1		1	CHA063	CHAIR; height adjustable; with arms; high back; swivel; 5 star base; on castors		3
6		6	CHA078	UNIT CHAIR; easy; with arms; fully upholstered		3
4		4	CHA091	CHAIR; easy; reclining; 1000H 630W 1880D		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
2		2	CUP2517	CUPBOARD; base unit; 2 door; lockable; 1200mm.		1
1		1	CUP2525	CUPBOARD; wall unit; LH door; 600h; lockable; 600mm.		1
3		3	CUP2526	CUPBOARD; wall unit; RH door; 600h; lockable; 600mm.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
4		4	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
12		12	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
2		2	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
4		4	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	RAC440	RACK; leaflet; wall mounted; 915H 250W 105D.		1
1		1	SNS1003L	SINKTOP; inset; single bowl and drainer; stainless steel; left hand drainer.		1
2		2	SUP2501	SUPPORT LEG; for 720 high worktop		1
2		2	SWC025	SWITCH, light		1
1		1	TAB109	TABLE; occasional; square		3
1		1	TAP359	TAP, pillar, high neck, long lever, pair hot and cold, 1/2 in		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TRO1010	TROLLEY, low, for tv		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1

ADB	Schedule of Components by Room	D1135

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: D1135 SDCU Discharge Lounge
Room Number: 1-P1-012 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
2		2	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	TVM2501	TV / monitor flat screen		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
1		1	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
2		2	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	B2517

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B2517	SDCU Recovery		
Room Number:	1-P1-024		**Revision Date:**	18/09/2014

Activities:	1) Post anaesthetic recovery of patients 2) Medical and nursing procedures 3) Observation by medical and nursing staff 4) Clinical handwashing 5) Use of mobile equipment and services may be used 6) Manoeuvring beds. 7) Use of monitoring/diagnostic or therapeutic equipment 8) Use of piped medical gases, vacuum and associated equipment			
Personnel:	8 x patients 4 x staff 8 x visitors			
Planning Relationships:	Part of multi-bay area. Overall area to include staff communication base and utilities. Close to operating theatre.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B2517

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B2517	SDCU Recovery
Room Number:	1-P1-024	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 20 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	15.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	15.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B2517

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B2517	SDCU Recovery
Room Number:	1-P1-024	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B2517

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: B2517 SDCU Recovery
Room Number: 1-P1-024 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
4		4	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
8		8	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
8		8	BRA003	BRACKET, holder, suction unit, wall mounted		2
8		8	BRA015	BRACKET, flat panel monitor, height adjustable, wall mounted		2
8		8	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
16		16	CHA017	CHAIR; upright; upholstered; stacking		3
8		8	CHA083	CHAIR, stacking, polypropylene, with back and seat pads		3
4		4	DIS013	DISPENSER, paper towel, wall mounted		2
4		4	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
4		4	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
8		8	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
12		12	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
8		8	LIG005	LUMINAIRE, bedhead, dimmable, patient reading and general nursing care/examination		1
8		8	MON900	MONITOR; Low end monitor, general Ward /OPD use		3
8		8	MST005	TROLLEY; half size open frame; up to 5 sets of runners; 400mm facing; approx 850H 450W 350D		3
9		9	OUT010	SOCKET outlet, switched, 13amp, twin		1
24		24	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
9		9	OUT121	SOCKET outlet; computer data; double.		1
8		8	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
8		8	OUT471	OUTLET; oxygen medical; trunking mounted.		1
8		8	OUT476	OUTLET; vacuum medical; trunking mounted.		1
8		8	RAI136	RAIL; clinical equipment; wall mounted; 2100mm.		1
8		8	SHE2503	SHELF; 300mm deep; folding; length as drawn.		1
8		8	STA142	STAND; infusion; twin hook; breaks; mobile		3
1		1	STO002	STOOL, height adjustable, 380H 480 dia.		3
8		8	SUR991	Double oxygen flow meter: Upper Medirail mounted		3
8		8	SUR992	Air flow meter: Upper Medirail mounted		3
1		1	SWC025	SWITCH, light		1
8		8	SWC035	SWITCH; dimmer trunking mounted.		1
4		4	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
8		8	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
8		8	TRO296	TROLLEY PATIENT; tilting/reclining		3
8		8	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
4		4	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
4		4	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	B2417

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B2417	Post Anaesthetic Recovery:RHSC		
Room Number:	1-P1-029		**Revision Date:**	18/09/2014

Activities:	1) Post anaesthetic recovery of patients 2) Medical and nursing procedures 3) Observation by medical and nursing staff 4) Clinical handwashing 5) Use of mobile equipment and services may be used 6) Manoeuvring beds. 7) Use of monitoring/diagnostic or therapeutic equipment 8) Use of piped medical gases, vacuum and associated equipment			
Personnel:	7 x patients (1 per bay) 7 x staff 7 x visitors			
Planning Relationships:	Part of multi-bay area. Overall area to include staff communication base and utilities. Close to operating theatre.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B2417

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B2417	Post Anaesthetic Recovery:RHSC		
Room Number:	1-P1-029		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 20 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	15.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	15.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B2417

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B2417	Post Anaesthetic Recovery:RHSC
Room Number:	1-P1-029	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B2417

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: B2417 Post Anaethetic Recovery:RHSC
Room Number: 1-P1-029 **Revision Date:** 18/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
7		7	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
7		7	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
7		7	BIN2509	BIN; sharps disposal; 7 litre; rail mounted		3
7		7	BRA004	BRACKET; holder; suction unit; trunking/rail mounted		
7		7	BRA015	BRACKET, flat panel monitor, height adjustable, wall mounted		
7		7	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
7		7	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
7		7	DIS013	DISPENSER, paper towel, wall mounted		
7		7	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		
7		7	DIS2500	DISPENSER; danicentre; combined glove/apron.		
9		9	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		
15		15	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
7		7	LIG005	LUMINAIRE, bedhead, dimmable, patient reading and general nursing care/examination		1
7		7	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
3		3	OUT005	SOCKET outlet, switched, 13amp, single		1
7		7	OUT010	SOCKET outlet, switched, 13amp, twin		1
28		28	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
7		7	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT215	SOCKET outlet, telephone		1
7		7	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
14		14	OUT471	OUTLET; oxygen medical; trunking mounted.		1
7		7	OUT476	OUTLET; vacuum medical; trunking mounted.		1
14		14	RAI136	RAIL; clinical equipment; wall mounted; 2100mm.		1
7		7	SHE2503	SHELF; 300mm deep; folding; length as drawn.		1
4		4	STA142	STAND; infusion; twin hook; breaks; mobile		3
7		7	STA2508	STAND; drip, rail mounted		3
7		7	STO002	STOOL, height adjustable, 380H 480 dia.		3
1		1	SWC025	SWITCH, light		1
7		7	SWC035	SWITCH; dimmer trunking mounted.		1
7		7	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		
7		7	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
10		10	TRO021	TROLLEY; 4 sets of runners; 850H 600W 600D		3
3		3	TRO133	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 750W 450D		3
1		1	TRO235	TROLLEY, contaminated linen, single ring, stainless steel		3
7		7	TRO296	TROLLEY PATIENT; tilting/reclining		3
7		7	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1

ADB	Schedule of Components by Room	B2417

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: B2417 Post Anaethetic Recovery:RHSC
Room Number: 1-P1-029
Revision Date: 18/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
7		7	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
7		7	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	B2418

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B2418	Post Anaesthetic Recovery Room: RHSC		
Room Number:	1-P1-030		**Revision Date:**	18/09/2014

Activities:	1) Post anaesthetic recovery of patients 2) Medical and nursing procedures 3) Observation by medical and nursing staff 4) Clinical handwashing 5) Use of mobile equipment and services may be used 6) Manoeuvring beds. 7) Use of monitoring/diagnostic or therapeutic equipment 8) Use of piped medical gases, vacuum and associated equipment			
Personnel:	1 x patients 1 x staff 1 x visitors			
Planning Relationships:	Close to operating theatre.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B2418

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B2418	Post Anaesthetic Recovery Room: RHSC		
Room Number:	1-P1-030		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 20 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	15.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	15.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed / Trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B2418

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B2418	Post Anaesthetic Recovery Room: RHSC
Room Number:	1-P1-030	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B2418

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: B2418 Post Anaesthetic Recovery Room
Room Number: 1-P1-030 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BIN2509	BIN; sharps disposal; 7 litre; rail mounted		3
1		1	BRA004	BRACKET; holder; suction unit; trunking/rail mounted		2
1		1	BRA015	BRACKET, flat panel monitor, height adjustable, wall mounted		2
1		1	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
3		3	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	LIG005	LUMINAIRE, bedhead, dimmable, patient reading and general nursing care/examination		1
1		1	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT215	SOCKET outlet, telephone		1
2		2	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
2		2	OUT471	OUTLET; oxygen medical; trunking mounted.		1
2		2	OUT476	OUTLET; vacuum medical; trunking mounted.		1
2		2	RAI136	RAIL; clinical equipment; wall mounted; 2100mm.		1
1		1	SHE2503	SHELF; 300mm deep; folding; length as drawn.		1
1		1	STA2508	STAND; drip, rail mounted		3
1		1	STO002	STOOL, height adjustable, 380H 480 dia.		3
1		1	SWC025	SWITCH, light		1
1		1	SWC035	SWITCH; dimmer trunking mounted.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRO021	TROLLEY; 4 sets of runners; 850H 600W 600D		3
1		1	TRO181	TROLLEY, general purpose, 3 tier, buffered, 950H 890W 590D		3
1		1	TRO296	TROLLEY PATIENT; tilting/reclining		3
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	J1264

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	J1264	Waiting bay: 1 patient trolley/bed place		
Room Number:	1-P1-057		**Revision Date:**	18/09/2014

Activities:	1) Parking, storage of patients' trolley(s) 2) Patient may wait on trolley/bed, under nursing observation			
Personnel:	1 x Patient			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	
	Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To suit surrounding area/design.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	J1264

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	J1264	Waiting bay: 1 patient trolley/bed place
Room Number:	1-P1-057	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 16 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central General Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating Type: Adjacent Space Transfer Air Cooling: None

LIGHTING		
Service Illumination (Lux):	200	@ Floor 0m AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		55:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	J1264

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	J1264	Waiting bay: 1 patient trolley/bed place
Room Number:	1-P1-057	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	N/A, open to circulation.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	J1264

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: J1264 Trolley Bay
Room Number: 1-P1-057
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	PEG2500	HOOK; Pat Slide.		1
1		1	SLI2500	PATSLIDE		3
1		1	TRO283	TROLLEY PATIENT; non-ferrous materials; full length tilt; adjustable head rest; side rails; 2075L 625D		3

ADB	Room Data Sheet	E0801-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0801-02	Imaging room: Interoperative MRI		
Room Number:	1-P1-064		**Revision Date:**	18/09/2014

Activities:	1) Patient is positioned or repositioned for examination 2) Use of radiation protection equipment 3) Imaging x-ray examination of patient 4) Use of oxygen and vacuum services for resuscitation 5) Storage of small items of equipment 6) Storage of Positioning aids e.g. wedges pillows and other immobilisation devices 7) Clinical handwashing			
Personnel:	1 x patient			
Planning Relationships:	Adjacent to viewing/reporting area. Direct access from changing cubicles - optional.			
Space Data:	**Area (m^2):**		**Height (mm):**	3,100
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	E0801-02

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	E0801-02	Imaging room: Interoperative MRI
Room Number:	1-P1-064	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	8.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air - Reheat Battery with BMS Adjustable Sensor. Cooling: Comfort Cooled

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ General working plane 1000 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0801-02

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0801-02	Imaging room: Interoperative MRI		
Room Number:	1-P1-064		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings Floor Recess required Radiation protection to be agreed with NHSL RPO
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or in accordance with radiation protection advice, blackout/dim-out.
Internal Glazing:	Viewing panel from control room, radiation protection.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0801-02

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: E0801-02 MRI Room
Room Number: 1-P1-064 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ANA007	ANAESTHETIC MACHINE/WORKSTATION; MRI compatible; electrically powered piston ventilator; mobile; 1350H 750W 650D		3
1		1	BIN2506	BIN; disposal; general purpose; MRI compatible; plastic		3
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	BUT2500	Quench button.		5
2		2	CAM2505	CAMERA CCTV; pan/tilt/zoom; MRI compatible.		5
1		1	CHR901	CHAIR; MR Compatible		3
1		1	CUP112	CUPBOARD UNIT; non-ferrous; open; 3 adjustable shelf; on plinth; 850H 1000W 500D.		1
1		1	CUP116	CUPBOARD/DRAWER UNIT; non-ferrous; 2 drawer; 1 adjustable shelf; on plinth; 850H 1000W 500D.		1
2		2	DET2500	Ferromagnetic detector		1
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	IMG086	TABLE PATIENT - MRI imager; floating top; (Part of IMG081)		5
1		1	IMG2501	Coil Holder.		5
2		2	IMG2507	Wave Guide.		5
1		1	IMG2508	IMAGER; MAGNETIC RESONANCE IMAGING (MRI); closed bore; 3 Tesla unit		5
1		1	INF901	INFUSION volumetric pump; MR Compatible 356H 178W 178D		3
1		1	MON051	MONITOR; patient; MR compatible; vital signs; multi-parameter; includes pulse oximeter		3
5		5	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT463	OUTLET; nitrous oxide; medical, trunking mounted.		1
2		2	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	OUT481	OUTLET; gas scavenging (AGS); medical, trunking mounted.		1
2		2	STA2510	STAND; drip, twin hooks, MR compatible		3
2		2	STO900	STOOL; MR Compatible		3
1		1	SUC902	SUCTION UNIT; pipeline; high pressure; theatre; MRI compatible		3
1		1	SWC025	SWITCH, light		1
2		2	SWC062	EMERGENCY STOP switch button, wall mounted		1
1		1	SYR005	SYRINGE INJECTOR; MRI compatible; automatic; hi pressure injection; media contrast		5
1		1	TAB903	TABLE operating patient; MR Compatible Top powered with 250mm transverse top; complete with specialty accessories; 715H 600W 2102D		3
1		1	TRO139	TROLLEY; dressing/instrument; MRI compatible; 870H 450W 450D		3
1		1	TRO901	TROLLEY; Coil cupd		3
1		1	TVM2503	TV / monitor flat screen with DVD player, MRI compatible		3

ADB	Schedule of Components by Room	E0801-02

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: E0801-02 MRI Room
Room Number: 1-P1-064
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	UPS003	Uninterrupted power supply (UPS).		1

ADB	Room Data Sheet	E0604-05

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-05	Control room: Interoperative MRI		
Room Number:	1-P1-065		**Revision Date:**	18/09/2014

Activities:	1) Radiographer operates an x-ray Simulator 2) Monitoring of patient on Simulator couch through leaded glass window 3) Use of computer workstation(s) 4) Viewing of X-ray films 5) Displaying notices 6) Maintenance and storage of EBME equipment records and reports 7) Viewing diagnostic images on VDT			
Personnel:	2 x staff Access to visitors, researchers			
Planning Relationships:	Direct access to/from MRIr room. Access may be required to medical conference room.			
Space Data:	**Area (m^2):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	E0604-05

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	E0604-05	Control room: Interoperative MRI
Room Number:	1-P1-065	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0604-05

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-05	Control room: Interoperative MRI		
Room Number:	1-P1-065		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to MRI Room to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Viewing panel to MRI room, radiation protection.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0604-05

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: E0604-05 Control Room - MRI
Room Number: 1-P1-065 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN2504	BIN; confidential waste		3
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	BUT2500	Quench button.		5
3		3	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	COM913	Hard drive for MRI scanner		5
1		1	CUP332	CUPBOARD; key; 30 hooks; lockable; wall mounted; 305H 230W 70D.		1
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	IMG112	CONTROL CONSOLE; for MRI		5
1		1	IMG2507	Wave Guide.		5
2		2	LOC012	LOCKER; wall mounted; 340H 300W 300D.		1
1		1	MON2504	MONITOR and CONTROL for CCTV; complete with flat screen monitor; keyboard; digital recorder (computer) and power supply		5
1		1	MON906	MONITOR; Clinical slave		2
2		2	MSC2508	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; shelves; 1 door hinged left; wall mounted.		1
2		2	MSC2510	CABINET base; 1000mm facing; (1000x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	OUT002	OUTLET, cable 13amp		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
9		9	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
8		8	OUT121	SOCKET outlet; computer data; double.		1
5		5	OUT126	SOCKET outlet switched 13amp double; with data protection mains RF filter/suppressor.		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	OUT2500	OUTLET; connection for IPOD.		1
1		1	PAN2500	PANEL; syringe injector controller.		5
1		1	PRI015	PRINTER; label; portable		3
1		1	REC032	RECORDER/DVD; playback		3
1		1	STF130	STORAGE UNIT; lower; cupboard; 2 door; 1 shelf; on castors; 600H 600W 550D		3
1		1	STF165	STORAGE UNIT; lower; 6 drawer; on castors; 600H 600W 450D		3

ADB	Schedule of Components by Room	E0604-05

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: E0604-05 Control Room - MRI
Room Number: 1-P1-065
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
4		4	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
2		2	SWC082	EMERGENCY STOP; switch button; wall mounted		1
1		1	TEL1000	TELEPHONE; handset.		3
2		2	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
3		3	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	N0305-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	N0305-01	Anaesthetic room: DCN		
Room Number:	1-P1-069		**Revision Date:**	18/09/2014

Activities:	1) Storage of anaesthetic accessories and equipment 2) Secure storage of controlled and scheduled drugs 3) Holding/storing sterile equipment 4) Holding / storing stock of infusion fluids 5) Storage of refrigerated drugs/medicines 6) Displaying operating lists 7) Recording of patient data/notes 8) Collection of used anaesthetic accessories for reprocessing 9) Collection of waste materials for disposal 10) Clinical handwashing 11) Administration of intravenous analgesia 12) Maintenance of general anaesthesia 13) Use of monitoring/diagnostic or therapeutic equipment			
Personnel:	1 x patient 4 x staff			
Planning Relationships:	Direct access from corridor and into theatre.			
Space Data:	**Area (m^2):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	N0305-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	N0305-01	Anaesthetic room: DCN		
Room Number:	1-P1-069		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):		In line with SHTM 03-01
Pressure Relative to Adjoining Space:		
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air via AHU Battery with Local / BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		10,000-100,000 @ Bed / Trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	N0305-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	N0305-01	Anaesthetic room: DCN
Room Number:	1-P1-069	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	N0305-01

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: N0305-01 Anaesthetic Room 2 (DCN)
Room Number: 1-P1-069 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ANA001	ANAESTHETIC MACHINE/WORKSTATION electrically powered piston ventilator, mobile, 1350H 750W 650D		3
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	CHA024	CHAIR, anaesthetist, height adjustable		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
2		2	CUP2510	CUPBOARD; base unit; LH door; ; 600mm.		1
1		1	CUP2519	CUPBOARD; wall unit; LH door; 600h; lockable; 500mm.		1
1		1	CUP2551	CUPBOARD; wall unit; 2 glass door; 600h; lockable; 1000mm.		1
2		2	CUP2566	CUPBOARD; base unit; RH door; 500mm.		1
2		2	CUP2572	CUPBOARD; base unit; 4 drawer; 500mm.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	LIG081	LUMINAIRE fitted with single fluorescent lamp with switch; below drug cupboard; 8watt; 400mm.		1
1		1	LIG963	LUMINAIRE; examination; ceiling; adjustable.		1
1		1	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
19		19	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT049	CONNECTION UNIT, switched, 13amp, flex outlet		1
1		1	OUT050	OUTLET, controlled drugs cupboard		1
1		1	OUT054	CONNECTION UNIT, unswitched, 13 amp, neon indicator		1
4		4	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	OUT453	OUTLET, 4kPa compressed air, medical		1
1		1	OUT461	OUTLET, nitrous oxide, medical		1
2		2	OUT470	OUTLET, oxygen, medical		1
2		2	OUT475	OUTLET, vacuum, medical		1
1		1	OUT480	OUTLET, gas scavenging (AGS), medical		1
1		1	REF091	REFRIGERATOR; drug; capacity 35 litres; external temperature gauge; lockable; wall mounted; 510H 380W 445D		2
1		1	STA142	STAND; infusion; twin hook; breaks; mobile		3
2		2	STA2509	STAND; sharps bin, mobile, 30 litre		3
2		2	STF290	STORAGE UNIT; upper; cupboard; controlled drugs; 1 door; lockable; with inner lockable cupboard and warning light; 550H 600W 300D		1
1		1	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SWC025	SWITCH, light		1

ADB	Schedule of Components by Room	N0305-01

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: N0305-01 Anaesthetic Room 2 (DCN)
Room Number: 1-P1-069 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
2		2	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
1		1	TAP892	TAP, bib, 2x8 mm thermostatic mixer, automatic action, sensor operated, non-touch		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
2		2	TRO021	TROLLEY; 4 sets of runners; 850H 600W 600D		3
1		1	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
1		1	TRO204	TROLLEY instrument tray MAYO, 650W 450D		3
1		1	TRO282	TROLLEY PATIENT; accident; image top; with tilt and brakes; 540-1000H 740W 2110D		3
1		1	TRO601	TROUGH scrub-up; hospital pattern; stainless steel; single; 75mm upstand; 800W 450D. HTM64SUH1.		1
2		2	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
1		1	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	N0106-03

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	N0106-03	Operating theatre: DCN		
Room Number:	1-P1-070		**Revision Date:**	18/09/2014

Activities:

1) Connection of patient to anaesthetic machine
2) Assembly and connecting of mobile equipment
3) Use of surgical instruments on instrument trolley
4) Surgical procedures performed under local or general anaesthetic
5) Viewing film and/or computer generated images
6) Checking, weighing and recording used swab
7) Displaying operating lists
8) Recording of patient data/notes
9) Transfer of patient from operating table to bed/trolley
10) Computer information accessed
11) Assessment / updating of electronic patient records (EPRs)
12) Maintenance of general anaesthesia
13) Use of mobile image intensifier
14) Use of monitoring/diagnostic or therapeutic equipment

Personnel:

1 x patient
7 x staff

Planning Relationships:

Direct access to preparation room.
Direct access to anaesthesia room (when provided).
Direct access or adjacent to scrub-up room.
Direct access to utility room.
Direct access to corridor/exit bay.

Space Data:

Area (m^2):		Height (mm):	3,000

Refer to HLM-SZ-SL-SH-200-001 for room areas.

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	N0106-03

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	N0106-03	Operating theatre: DCN		
Room Number:	1-P1-070		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):		In line with SHTM 03-01
Pressure Relative to Adjoining Space:		
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air via AHU Battery with Local / BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		10,000 - 100,000 @ Bed / Trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	50	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	N0106-03

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	N0106-03	Operating theatre: DCN		
Room Number:	1-P1-070		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or clear, solar control, privacy control (tbc)
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A
Notes:	windows are currently on the change control matrix (Board decision - tbc)

ADB	Schedule of Components by Room	N0106-03

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: N0106-03 Operating Theatre 2 (DCN)
Room Number: 1-P1-070 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ANA004	ANAESTHETIC MACHINE/WORKSTATION with ventilator, with accessories, mobile, 1580H 565W 695D		3
2		2	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	CAN010	CANOPY : ultra clean ventilation (UCV) operating theatre, 2000mm clear from floor level to underside, 3200W x3200D, sliding screens.		1
1		1	CHA024	CHAIR, anaesthetist, height adjustable		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DIA002	DIATHERMY APPARATUS; Surgical with 2 suction jars, mobile		3
1		1	DIA004	DIATHERMY UNIT; surgical; monopolar; bipolar; argon compatible; 111H 356W 439D		3
1		1	DIA005	SMOKE EVACUATION SYSTEM; (diathermy) complete with trolley; 860H 487W 643D		3
4		4	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRI2500	DRILL; 7 bar power drill		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	IMG2509	IMAGING; Camera box.		1
2		2	INF001	INFUSION volumetric pump; 356H 178W 178D		3
4		4	LIG071	ILLUMINATED SIGN RADIATION ON, wall mounted		1
1		1	LIG2504	Head light source		3
1		1	LIG2505	LIGHT; Operating 3 arm		1
1		1	LIG2506	LIGHT; green blue light source.		1
1		1	MON042	MONITOR sedation depth; 169H 175W 100D		3
1		1	MON2501	MONITOR; flat screen; recessed; wall mounted; double PACS theatre specific		5
1		1	MON2513	MONITOR; 42inch, wall mounted		5
1		1	MON2517	MONITOR; HD screen on arm		3
1		1	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
19		19	OUT010	SOCKET outlet, switched, 13amp, twin		1
24		24	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
8		8	OUT121	SOCKET outlet; computer data; double.		1
10		10	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT2500	OUTLET; connection for IPOD.		1
1		1	OUT2503	SOCKET; outlet switched 13amp double; ceiling mounted.		1
4		4	OUT453	OUTLET, 4kPa compressed air, medical		1
4		4	OUT454	OUTLET, 7kPa compressed air, medical		1
4		4	OUT461	OUTLET, nitrous oxide, medical		1
8		8	OUT470	OUTLET, oxygen, medical		1
8		8	OUT475	OUTLET, vacuum, medical		1
4		4	OUT480	OUTLET, gas scavenging (AGS), medical		1
15		15	OUT904	OUTLET; socket, AV and control system, typt tbc		1

ADB	Schedule of Components by Room	N0106-03

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: N0106-03 Operating Theatre 2 (DCN)
Room Number: 1-P1-070 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	PAN053	PANEL operating theatre; to meet the theatre requirements.		1
1		1	PEG002	PEGS; equipment; medium; 2; wide spacing; wall mounted.		1
3		3	PEN002	PENDANT; Anaesthetic; medical & power supply unit; vertical movement; ceiling mounted; outlets comprising.		1
1		1	PEN006A	PENDANT SURGICAL; touch screen monitor; medical and power supply unit; tandem; lateral and vertical movement; ceiling mounted; outlets comprising.		1
3		3	PLA002	PLATFORM; step-stand; stackable; portable; 130H 480W 330D		3
1		1	PRI015	PRINTER; label; portable		3
1		1	SCA012	SCALE; swab; includes Mains adaptor		3
1		1	SCA2503	SCALPEL; harmonic		3
2		2	STA101	STAND; lotion bowl; single; stainless steel; (Bowls not included)		3
2		2	STA142	STAND; infusion; twin hook; breaks; mobile		3
2		2	STA2509	STAND; sharps bin, mobile, 30 litre		3
3		3	STO006	STOOL, surgeon/anaesthetist, height adjustable, includes anti-static seat pads		3
2		2	SUC002	SUCTION UNIT; pipeline; high pressure; theatre		3
2		2	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SUR971	Swab bucket		3
2		2	SWC025	SWITCH, light		1
3		3	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
2		2	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TRF002	AUTOTRANSFUSION cell separator; mobile; built in air and foam detector; 1620H 270W 585D		3
2		2	TRO021	TROLLEY; 4 sets of runners; 850H 600W 600D		3
4		4	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
2		2	TRO133	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 750W 450D		3
2		2	TRO201	TROLLEY, instruments, stainless steel, buffered, 870H 920W 620D		3
1		1	TRO204	TROLLEY instrument tray MAYO, 650W 450D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAR053	WARMER, blood/fluid, maintains temperature between 36 and 43 deg.C at flow rates up to 500 ml/min, 35H 235W 273D		3
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	E0311

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0311	Angiography Procedures Room		
Room Number:	1-P1-093		**Revision Date:**	18/09/2014

Activities:	1) Patient is positioned or repositioned for examination 2) Use of radiation protection equipment 3) Imaging x-ray examination of patient 4) Use of oxygen and vacuum services for resuscitation 5) Storage of small items of equipment 6) Storage of Positioning aids e.g. wedges pillows and other immobilisation devices 7) Clinical handwashing			
Personnel:	1 x patient 4 x staff			
Planning Relationships:	Adjacent to viewing/reporting area.			
Space Data:	**Area (m²):**		**Height (mm)**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

Radiation protection requirements are subject to RPA advice upon selection of equipment.

The "radiation in use" warning lamp should be installed at eye level outside the entrance(s) to the room.

ADB	Room Environmental Data	E0311

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	E0311	Angiography Procedures Room
Room Number:	1-P1-093	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type:Central Supply & Extract
Mechanical Ventilation (Extract ac/hr):		In Line with SHTM 03-01
Pressure Relative to Adjoining Space:	0	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air via AHU Battery with local / BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		10,000 - 100,000 @ Floor
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0311

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0311	Angiography Procedures Room		
Room Number:	1-P1-093		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings Floor Recess required
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Viewing panel from control room, radiation protection.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0311

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: E0311 Angiography Procedures Room
Room Number: 1-P1-093 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ANA001	ANAESTHETIC MACHINE/WORKSTATION electrically powered piston ventilator, mobile, 1350H 750W 650D		3
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
2		2	BIN2509	BIN; sharps disposal; 7 litre; rail mounted		3
4		4	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
2		2	CAM2500	VIDEO MONITORING EQUIPMENT; camera.		2
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM2503	COMPUTER MONITOR, PACS REVIEW STATION; 2 21", high-resolution screens,		3
1		1	CYL2500	CYLINDER; oxygen		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
2		2	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
2		2	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
3		3	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	IMG101	MONITOR viewing; flat panel display for image intensifier; ceiling mounted		5
1		1	IMG105	TABLE PATIENT - image intensifier; X-ray; floating top; (Part of IMG026; or IMG030)		5
2		2	IMG111	CONTROL CONSOLE - tableside gantry control for digital imaging system		5
2		2	IMG121	IMAGE CS RAIL; ceiling suspensions for monitors		5
1		1	IMG131	SHIELD lead acrylic; overhead suspended on bracket; 760W 610D lead equivalent 0.5mm Pb; ceiling mounted		5
1		1	IMG905	Biplane Imaging System		5
5		5	LIG071	ILLUMINATED SIGN RADIATION ON, wall mounted		1
1		1	LIG963	LUMINAIRE; examination; ceiling; adjustable.		1
1		1	MAC2500	ACT Machine on trolley		3
1		1	MON1002	MONITOR; ACCU platelet		3
1		1	MON900	MONITOR; Low end monitor, general Ward /OPD use		3
2		2	MSC091	CABINET base; 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
2		2	MSC096	CABINET base; 400mm facing; (400x600 inserts); with 3 telescopic runners; 1 door hinged left; on plinth; o/a height 900.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT009	SOCKET outlet switched 13 amp twin; floor mounted.		1
11		11	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT121	SOCKET outlet; computer data; double.		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT453	OUTLET, 4kPa compressed air, medical		1
1		1	OUT461	OUTLET, nitrous oxide, medical		1
1		1	OUT470	OUTLET, oxygen, medical		1
2		2	OUT475	OUTLET, vacuum, medical		1

ADB	Schedule of Components by Room	E0311

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: E0311 Angiography Procedures Room
Room Number: 1-P1-093 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	OUT480	OUTLET, gas scavenging (AGS), medical		1
1		1	PEG2500	HOOK; Pat Slide.		1
1		1	PEN002	PENDANT; Anaesthetic; medical & power supply unit; vertical movement; ceiling mounted; outlets comprising.		1
1		1	PLA002	PLATFORM; step-stand; stackable; portable; 130H 480W 330D		3
2		2	RAC360	RACK; catheter and guide wire storage; rotary; mobile; wire basket; top 600x600mm; 800mm dia. 230H 600W 600D		3
1		1	SCR066	SCREEN shielding; radiation protection; lead sheets; mobile; 1140H 1070L; lead equivalent 0.8 mm Pb @ 110 keV.		5
1		1	SLI2500	PATSLIDE		3
1		1	STA2504	STAND; Roll stand for monitor		3
3		3	STO002	STOOL, height adjustable, 380H 480 dia.		3
2		2	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	SYR001	SYRINGE INJECTOR, automatic, high pressure injection, contrast media.		5
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
2		2	THE900	THERMOMETER; Tympanic		3
1		1	TRO070	TROLLEY, for single cylinder, type F or G, 1155H 510W 405D		3
2		2	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
2		2	TRO133	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 750W 450D		3
4		4	TRO901	TROLLEY; Coil cupd		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1
2		2	XRA018	X-RAY CS RAIL; ceiling suspensions; 2455mm (3655 w/optional extension rail)		5

ADB	Room Data Sheet	X1026

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X1026	Control room: Angiography Procedures		
Room Number:	1-P1-094		**Revision Date:**	18/09/2014

Activities:	1) Radiographers operate orthovoltage/superficial machine seated at control desk. 2) Displays of patient data and position on treatment couch are monitored via CCTV - this must be screened from public view 3) Viewing of X-ray films 4) Use of computer workstation(s) 5) Holding patient notes / images 6) Accommodation of computer equipment and operator of the Verification Control and Record (VCR) equipment. 7) Audible warning may be given as per approved code of practice of the Ionising Radiations Regulation 1985, page 29, Para 22			
Personnel:	2 x Staff			
Planning Relationships:	Adjacent to orthovoltage/superficial treatment room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X1026

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X1026	Control room: Angiography Procedures
Room Number:	1-P1-094	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb)(degC):18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):		In line with SHTM 03-01
Pressure Relative to Adjoining Space:		
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air via AHU Battery with BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		10,000 - 100,000 @ Bed / Trolley 1450 AFFL
Colour Rendering Required:	N	Colour Rendering Characteristics (Ra): 80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X1026

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X1026	Control room: Angiography Procedures		
Room Number:	1-P1-094		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Viewing panel to procedures room, radiation protection.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	X1026

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: X1026 Angiography Procedures Control Room
Room Number: 1-P1-094 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN2504	BIN; confidential waste		3
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
2		2	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	COM898	COMPUTER CPU		3
1		1	CRD051	CONTROL CONSOLE and COMPUTER for catheter laboratories; (Part of CRD021 or CRD023)		5
2		2	CUP378	CUPBOARD/DRAWER UNIT; 1 drawer; 1 shelf; on castors; 660H 480W 390D		3
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	LIG060	LUMINAIRE fitted with twin fluorescent lamp.		1
1		1	LIG074	ILLUMINATED SIGN DO NOT ENTER		1
1		1	MON906	MONITOR; Clinical slave		2
1		1	MON924	MONITOR; for use with remote camera, with bracket		2
4		4	MSC263	CABINET/DRAWER features; base; 400mm facing; 4 drawer; on plinth; o/a height 900.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
10		10	OUT010	SOCKET outlet, switched, 13amp, twin		1
10		10	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	PRI015	PRINTER; label; portable		3
2		2	RAC195	RACK; x-ray lead apron; 5 hangers; wall mounted		2
2		2	SUP2500	SUPPORT LEG; for 920 high worktop		1
3		3	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TEL1000	TELEPHONE; handset.		3
3		3	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WKT1003L	WORKTOP; 720 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	B2417-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B2417-01	Post Anaesthetic Recovery:DCN		
Room Number:	1-P1-109		**Revision Date:**	18/09/2014

Activities:	1) Post anaesthetic recovery of patients 2) Medical and nursing procedures 3) Observation by medical and nursing staff 4) Clinical handwashing 5) Use of mobile equipment and services may be used 6) Manoeuvring beds. 7) Use of monitoring/diagnostic or therapeutic equipment 8) Use of piped medical gases, vacuum and associated equipment			
Personnel:	8 x patients (1 per bay) 4 x staff			
Planning Relationships:	Part of multi-bay area. Overall area to include staff communication base and utilities. Close to operating theatre.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B2417-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B2417-01	Post Anaesthetic Recovery:DCN		
Room Number:	1-P1-109		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 20 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	15.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	15.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B2417-01

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B2417-01	Post Anaesthetic Recovery:DCN		
Room Number:	1-P1-109		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B2417-01

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: B2417-01 Recovery (8 bays)
Room Number: 1-P1-109 **Revision Date:** 18/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
8		8	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
8		8	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
8		8	BIN2509	BIN; sharps disposal; 7 litre; rail mounted		3
8		8	BRA003	BRACKET, holder, suction unit, wall mounted		2
8		8	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
8		8	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
8		8	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
8		8	DIS013	DISPENSER, paper towel, wall mounted		2
8		8	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
8		8	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
9		9	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
16		16	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
8		8	LIG005	LUMINAIRE, bedhead, dimmable, patient reading and general nursing care/examination		1
8		8	LIG963	LUMINAIRE; examination; ceiling; adjustable.		1
8		8	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
16		16	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
8		8	MST005	TROLLEY; half size open frame; up to 5 sets of runners; 400mm facing; approx 850H 450W 350D		3
8		8	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
8		8	OUT005	SOCKET outlet, switched, 13amp, single		1
16		16	OUT010	SOCKET outlet, switched, 13amp, twin		1
32		32	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
16		16	OUT121	SOCKET outlet; computer data; double.		1
8		8	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	OUT215	SOCKET outlet, telephone		1
16		16	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
16		16	OUT471	OUTLET; oxygen medical; trunking mounted.		1
16		16	OUT476	OUTLET; vacuum medical; trunking mounted.		1
8		8	RAI136	RAIL; clinical equipment; wall mounted; 2100mm.		1
8		8	STA142	STAND; infusion; twin hook; breaks; mobile		3
8		8	STO024	STOOL, dental, with back support, mobile		3
8		8	SWC025	SWITCH, light		1
8		8	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
8		8	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
8		8	TRO021	TROLLEY; 4 sets of runners; 850H 600W 600D		3

ADB	Schedule of Components by Room	B2417-01

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: B2417-01 Recovery (8 bays)
Room Number: 1-P1-109
Revision Date: 18/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
8		8	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
8		8	WAR053	WARMER, blood/fluid, maintains temperature between 36 and 43 deg.C at flow rates up to 500 ml/min, 35H 235W 273D		3
8		8	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
8		8	WAS1000	TRAP; concealed waste; for back outlet basins.		1
8		8	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	V0726

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	V0726	Changing Room		
Room Number:	1-P1-127		**Revision Date:**	18/09/2014

Activities:	1) Semi-ambulant user may undress/dress in privacy 2) Hanging clothing 3) Use of call systems			
Personnel:	1 x patient Intermittent use			
Planning Relationships:	Adjacent to sub-waiting area Close to WC facilities.			
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	V0726

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	V0726	Changing Room
Room Number:	1-P1-127	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	6.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	10.0	
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	45	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		55:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY	
Hot Surface Max. Temp (DegC):	43
Hot Water Max. Temp (DegC):	41

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	V0726

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	V0726	Changing Room
Room Number:	1-P1-127	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	V0726

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: V0726 Changing Cubicle
Room Number: 1-P1-127 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	CAL005	CEILING, PULL CORD, patient/staff call.		1
1		1	CHA017	CHAIR; upright; upholstered; stacking		3
2		2	HOO024	HOOK; hat and coat; 1.		1
1		1	LOC005	LOCKER, CLOTHES, SINGLE, 1800H 300W 550D		3
1		1	MIR010	MIRROR; wall mounted; 800H 300W.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	RAI048	RAIL, grab, vertical, wall mounted, 600mm		1
1		1	SWC025	SWITCH, light		1

ADB	Room Data Sheet	D2155

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	D2155	Admissions Lounge		
Room Number:	1-P1-128		**Revision Date:**	18/09/2014

Activities:	1) Patients, relatives and escorts wait to be seen 2) Displaying information			
Personnel:	6 x patients 1 x staff 3 x visitors			
Planning Relationships:	Adjacent to reception area. Close to clinical or work area. Close to WC facilities.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	D2155

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	D2155	Admissions Lounge
Room Number:	1-P1-128	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	6.0	Ventila ion Type: Comfort Cooled Fresh Air
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY	
Hot Surface Max. Temp (DegC):	43
Hot Water Max. Temp (DegC):	41

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	D2155

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	D2155	Admissions Lounge
Room Number:	1-P1-128	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	D2155

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: D2155 Admissions Lounge
Room Number: 1-P1-128 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
5		5	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
7		7	CHA017	CHAIR; upright; upholstered; stacking		3
5		5	CHA091	CHAIR; easy; reclining; 1000H 630W 1880D		3
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
6		6	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOL020	HOLDER, sharps box, up to 7 litre capacity, rail/trolley hang or wall mounted, 170H 125W 100D		3
4		4	LOC008	LOCKER clothes; single; 2 compartments; 1800H 300W 550D		3
2		2	MSC2508	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; shelves; 1 door hinged left; wall mounted.		1
2		2	MSC2510	CABINET base; 1000mm facing; (1000x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
6		6	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	RAC440	RACK; leaflet; wall mounted; 915H 250W 105D.		1
1		1	SUP2500	SUPPORT LEG; for 920 high worktop		1
2		2	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
4		4	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TVM006	TELEVISION monitor; colour; 585mm		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	N0106-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	N0106-01	Operating theatre: RHSC		
Room Number:	1-P1-131		**Revision Date:**	18/09/2014

Activities:	1) Connection of patient to anaesthetic machine 2) Assembly and connecting of mobile equipment 3) Use of surgical instruments on instrument trolley 4) Surgical procedures performed under local or general anaesthetic 5) Viewing film and/or computer generated images 6) Checking, weighing and recording used swab 7) Displaying operating lists 8) Recording of patient data/notes 9) Transfer of patient from operating table to bed/trolley 10) Computer information accessed 11) Assessment / updating of electronic patient records (EPRs) 12) Maintenance of general anaesthesia 13) Use of mobile image intensifier 14) Use of monitoring/diagnostic or therapeutic equipment
Personnel:	1 x patient 7 x staff
Planning Relationships:	Direct access to preparation room. Direct access to anaesthesia room (when provided). Direct access or adjacent to scrub-up room. Direct access to utility room. Direct access to corridor/exit bay.

Space Data:	**Area (m²):**		**Height (mm):**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	N0106-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	N0106-01	Operating theatre: RHSC
Room Number:	1-P1-131	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Suppy and Extract
Mechanical Ventilation (Extract ac/hr):		In line with SHTM 03-01
Pressure Relative to Adjoining Space:		
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air via AHU Battery with Local / BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		10,000 - 100,000 @ Bed / Trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	50	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	N0106-01

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	N0106-01	Operating theatre: RHSC		
Room Number:	1-P1-131		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or clear, solar control, privacy control (tbc)
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A
Notes:	windows are currently on the change control matrix (Board decision - tbc)

ADB	Schedule of Components by Room	N0106-01

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: N0106-01 Operating Theatre 3 (RHSC)
Room Number: 1-P1-131 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ANA004	ANAESTHETIC MACHINE/WORKSTATION with ventilator, with accessories, mobile, 1580H 565W 695D		3
1		1	BLA902	UNDERBLANKET; Gel 195P		3
2		2	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	CAN010	CANOPY : ultra clean ventilation (UCV) operating theatre, 2000mm clear from floor level to underside, 3200W x3200D, sliding screens.		1
1		1	CHA024	CHAIR, anaesthetist, height adjustable		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DIA004	DIATHERMY UNIT; surgical; monopolar; bipolar; argon compatible; 111H 356W 439D		3
1		1	DIA005	SMOKE EVACUATION SYSTEM; (diathermy) complete with trolley; 860H 487W 643D		3
4		4	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	IMG2509	IMAGING; Camera box.		1
2		2	INF001	INFUSION volumetric pump; 356H 178W 178D		3
3		3	LIG071	ILLUMINATED SIGN RADIATION ON, wall mounted		1
1		1	LIG2502	LUMINAIRE; double arm; operating theatre; table with satellite; shadowless; lux 140000 and lux 110000.		1
1		1	LIG2504	Head light source		3
3		3	LIG902	ILLUMINATED SIGN; LASER ON (entrance to theatre).		1
1		1	MON042	MONITOR sedation depth; 169H 175W 100D		3
1		1	MON2501	MONITOR; flat screen; recessed; wall mounted; double PACS theatre specific		5
1		1	MON2513	MONITOR; 42inch, wall mounted		5
1		1	MON2517	MONITOR; HD screen on arm		3
1		1	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
1		1	MST901	TROLLEY; lockable; closed; with worktop; approx 1200H 1300W 500D		3
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
20		20	OUT010	SOCKET outlet, switched, 13amp, twin		1
24		24	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
8		8	OUT121	SOCKET outlet; computer data; double.		1
10		10	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT2500	OUTLET; connection for IPOD.		1
1		1	OUT2503	SOCKET; outlet switched 13amp double; ceiling mounted.		1
4		4	OUT453	OUTLET, 4kPa compressed air, medical		1
4		4	OUT454	OUTLET, 7kPa compressed air, medical		1
4		4	OUT461	OUTLET, nitrous oxide, medical		1
8		8	OUT470	OUTLET, oxygen, medical		1
8		8	OUT475	OUTLET, vacuum, medical		1
8		8	OUT480	OUTLET, gas scavenging (AGS), medical		1

ADB	Schedule of Components by Room	N0106-01

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: N0106-01 Operating Theatre 3 (RHSC)
Room Number: 1-P1-131 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
15		15	OUT904	OUTLET; socket, AV and control system, typt tbc		1
1		1	PAN053	PANEL operating theatre; to meet the theatre requirements.		1
1		1	PEG002	PEGS; equipment; medium; 2; wide spacing; wall mounted.		1
4		4	PEN002	PENDANT; Anaesthetic; medical & power supply unit; vertical movement; ceiling mounted; outlets comprising.		1
3		3	PLA002	PLATFORM; step-stand; stackable; portable; 130H 480W 330D		3
1		1	PRI015	PRINTER; label; portable		3
1		1	SCA012	SCALE; swab; includes Mains adaptor		3
2		2	STA101	STAND; lotion bowl; single; stainless steel; (Bowls not included)		3
2		2	STA142	STAND; infusion; twin hook; breaks; mobile		3
2		2	STA2509	STAND; sharps bin, mobile, 30 litre		3
3		3	STO006	STOOL, surgeon/anaesthetist, height adjustable, includes anti-static seat pads		3
2		2	SUC002	SUCTION UNIT; pipeline; high pressure; theatre		3
2		2	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SUR971	Swab bucket		3
2		2	SWC025	SWITCH, light		1
3		3	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
1		1	TAB071	TABLE operating patient, powered with 250mm transverse top, complete with specialty accessories, 715H 600W 2102D		3
2		2	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TRF002	AUTOTRANSFUSION cell separator; mobile; built in air and foam detector; 1620H 270W 585D		3
1		1	TRO021	TROLLEY; 4 sets of runners; 850H 600W 600D		3
2		2	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
1		1	TRO133	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 750W 450D		3
1		1	TRO204	TROLLEY instrument tray MAYO, 650W 450D		3
2		2	TRO205	TROLLEY, stainless steel, 1 shelf, 900H 600W 600D		3
2		2	TRO921	TROLLEY, instrument, stainless steel, buffered, 870H 1200W 620D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAR053	WARMER, blood/fluid, maintains temperature between 36 and 43 deg.C at flow rates up to 500 ml/min, 35H 235W 273D		3
1		1	WAR901	Blanket Warmer		3
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	N0305

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	N0305	Anaesthetic room: RHSC		
Room Number:	1-P1-132		**Revision Date:**	18/09/2014

Activities:	1) Storage of anaesthetic accessories and equipment 2) Secure storage of controlled and scheduled drugs 3) Holding/storing sterile equipment 4) Holding / storing stock of infusion fluids 5) Storage of refrigerated drugs/medicines 6) Displaying operating lists 7) Recording of patient data/notes 8) Collection of used anaesthetic accessories for reprocessing 9) Collection of waste materials for disposal 10) Clinical handwashing 11) Administration of intravenous analgesia 12) Maintenance of general anaesthesia 13) Use of monitoring/diagnostic or therapeutic equipment			
Personnel:	1 x patient 4 x staff 2 x relatives			
Planning Relationships:	Direct access from corridor and into theatre.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	N0305

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	N0305	Anaesthetic room: RHSC		
Room Number:	1-P1-132		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):		In line with SHTM 03-01
Pressure Relative to Adjoining Space:		
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air via AHU Battery with Local / BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		10,000-100,000 @ Bed / Trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	N0305

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	N0305	Anaesthetic room: RHSC
Room Number:	1-P1-132	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	N0305

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: N0305 Anaesthetic Room 3 (RHSC)
Room Number: 1-P1-132 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ANA001	ANAESTHETIC MACHINE/WORKSTATION electrically powered piston ventilator, mobile, 1350H 750W 650D		3
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	CHA024	CHAIR, anaesthetist, height adjustable		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
2		2	CUP2510	CUPBOARD; base unit; LH door; ; 600mm.		1
1		1	CUP2519	CUPBOARD; wall unit; LH door; 600h; lockable; 500mm.		1
1		1	CUP2551	CUPBOARD; wall unit; 2 glass door; 600h; lockable; 1000mm.		1
2		2	CUP2566	CUPBOARD; base unit; RH door; 500mm.		1
2		2	CUP2572	CUPBOARD; base unit; 4 drawer; 500mm.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	LIG081	LUMINAIRE fitted with single fluorescent lamp with switch; below drug cupboard; 8watt; 400mm.		1
1		1	LIG963	LUMINAIRE; examination; ceiling; adjustable.		1
1		1	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
19		19	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT049	CONNECTION UNIT, switched, 13amp, flex outlet		1
1		1	OUT050	OUTLET, controlled drugs cupboard		1
1		1	OUT054	CONNECTION UNIT, unswitched, 13 amp, neon indicator		1
4		4	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	OUT453	OUTLET, 4kPa compressed air, medical		1
1		1	OUT461	OUTLET, nitrous oxide, medical		1
2		2	OUT470	OUTLET, oxygen, medical		1
2		2	OUT475	OUTLET, vacuum, medical		1
1		1	OUT480	OUTLET, gas scavenging (AGS), medical		1
1		1	REF091	REFRIGERATOR; drug; capacity 35 litres; external temperature gauge; lockable; wall mounted; 510H 380W 445D		2
1		1	STA142	STAND; infusion; twin hook; breaks; mobile		3
2		2	STA2509	STAND; sharps bin, mobile, 30 litre		3
2		2	STF290	STORAGE UNIT; upper; cupboard; controlled drugs; 1 door; lockable; with inner lockable cupboard and warning light; 550H 600W 300D		1
1		1	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SWC025	SWITCH, light		1

ADB	Schedule of Components by Room	N0305

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: N0305 Anaesthetic Room 3 (RHSC)
Room Number: 1-P1-132 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
2		2	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
1		1	TAP892	TAP, bib, 2x8 mm thermostatic mixer, automatic action, sensor operated, non-touch		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
2		2	TRO021	TROLLEY; 4 sets of runners; 850H 600W 600D		3
1		1	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
1		1	TRO204	TROLLEY instrument tray MAYO, 650W 450D		3
1		1	TRO282	TROLLEY PATIENT; accident; image top; with tilt and brakes; 540-1000H 740W 2110D		3
1		1	TRO601	TROUGH scrub-up; hospital pattern; stainless steel; single; 75mm upstand; 800W 450D. HTM64SUH1.		1
2		2	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
1		1	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	T0526

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	T0526	Preparation room		
Room Number:	1-P1-134		**Revision Date:**	18/09/2014

Activities:	1) Preparation of trays and trolleys laid up for surgical/clinical procedures 2) Holding sterile pre-set trays 3) Storage of sterile equipment, consumable supplies and packs 4) Storage of non-sterile medical items, equipment and supplies 5) Storage of sterile fluids 6) Holding instrument trolleys 7) Storage of sundries and small items			
Personnel:	2 x staff			
Planning Relationships:	Direct access to operating theatre. Acce from corridor for delivery of upplie			
Space Data	**Area (m)**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	T0526

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	T0526	Preparation room		
Room Number:	1-P1-134		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):		In line with SHTM 03-01
Pressure Relative to Adjoining Space:	0	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air via AHU Battery with Local / BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		10,000 - 100,000 @ bed trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	T0526

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	T0526	Preparation room
Room Number:	1-P1-134	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	T0526

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: T0526 Preparation Room 3 (RHSC)
Room Number: 1-P1-134 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	CAB2565	CABINET; warming lothian; 12 x 1 litre; wall mounted lockable.		1
1		1	CUP2526	CUPBOARD; wall unit; RH door; 600h; lockable; 600mm.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
3		3	MST011	TROLLEY; large, single with handles, 12 sets of runners, 400 facing, buffered, braked, 1800H 600W 650D nominal		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
5		5	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	RAC979	RACK; chrome / stainless steel, 5 wire shelves, mobile, 1739H 1524W, 610D		3
2		2	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
2		2	TRO021	TROLLEY; 4 sets of runners; 850H 600W 600D		3
1		1	TRO923	TROLLEY, medium, stainless steel, buffered, 3 shelves, 870H 920W 620D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	N0106-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	N0106-02	Operating theatre: Intraoperative		
Room Number:	1-P1-155		**Revision Date:**	18/09/2014

Activities:	1) Connection of patient to anaesthetic machine 2) Assembly and connecting of mobile equipment 3) Use of surgical instruments on instrument trolley 4) Surgical procedures performed under local or general anaesthetic 5) Viewing film and/or computer generated images 6) Checking, weighing and recording used swab 7) Displaying operating lists 8) Recording of patient data/notes 9) Transfer of patient from operating table to bed/trolley 10) Computer information accessed 11) Assessment / updating of electronic patient records (EPRs) 12) Maintenance of general anaesthesia 13) Use of mobile image intensifier 14) Use of monitoring/diagnostic or therapeutic equipment
Personnel:	1 x patient 7 x staff
Planning Relationships:	Direct access to preparation room. Direct access to anaesthesia room (when provided). Direct access or adjacent to scrub-up room. Direct access to utility room. Direct access to corridor/exit bay.

Space Data:	**Area (m²):**		**Height (mm):**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	N0106-02

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	N0106-02	Operating theatre: Intraoperative
Room Number:	1-P1-155	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Suppy and Extract
Mechanical Ventilation (Extract ac/hr):		In line with SHTM 03-01
Pressure Relative to Adjoining Space:	0	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Airvia AHU Battery with Local / BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		10,000 - 100,000 @ Bed / Trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	50	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	N0106-02

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	N0106-02	Operating theatre: Intraoperative		
Room Number:	1-P1-155		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	N0106-02

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: N0106-02 Operating Theatre 4 (interoprative)
Room Number: 1-P1-155 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ANA004	ANAESTHETIC MACHINE/WORKSTATION with ventilator, with accessories, mobile, 1580H 565W 695D		3
1		1	BLA902	UNDERBLANKET; Gel 195P		3
2		2	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	CAN010	CANOPY : ultra clean ventilation (UCV) operating theatre, 2000mm clear from floor level to underside, 3200W x3200D, sliding screens.		1
1		1	CHA024	CHAIR, anaesthetist, height adjustable		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DIA004	DIATHERMY UNIT; surgical; monopolar; bipolar; argon compatible; 111H 356W 439D		3
1		1	DIA005	SMOKE EVACUATION SYSTEM; (diathermy) complete with trolley; 860H 487W 643D		3
5		5	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRI2500	DRILL; 7 bar power drill		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	IMG2509	IMAGING; Camera box.		1
2		2	INF001	INFUSION volumetric pump; 356H 178W 178D		3
4		4	LIG071	ILLUMINATED SIGN RADIATION ON, wall mounted		1
1		1	LIG2502	LUMINAIRE; double arm; operating theatre; table with satellite; shadowless; lux 140000 and lux 110000.		1
1		1	LIG2504	Head light source		3
4		4	LIG902	ILLUMINATED SIGN; LASER ON (entrance to theatre).		1
1		1	MON042	MONITOR sedation depth; 169H 175W 100D		3
1		1	MON2501	MONITOR; flat screen; recessed; wall mounted; double PACS theatre specific		5
1		1	MON2513	MONITOR; 42inch, wall mounted		5
1		1	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
20		20	OUT010	SOCKET outlet, switched, 13amp, twin		1
24		24	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
8		8	OUT121	SOCKET outlet; computer data; double.		1
8		8	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT2503	SOCKET; outlet switched 13amp double; ceiling mounted.		1
4		4	OUT453	OUTLET, 4kPa compressed air, medical		1
4		4	OUT454	OUTLET, 7kPa compressed air, medical		1
4		4	OUT461	OUTLET, nitrous oxide, medical		1
8		8	OUT470	OUTLET, oxygen, medical		1
8		8	OUT475	OUTLET, vacuum, medical		1
7		7	OUT480	OUTLET, gas scavenging (AGS), medical		1
15		15	OUT904	OUTLET; socket, AV and control system, typt tbc		1
1		1	PAN053	PANEL operating theatre; to meet the theatre requirements.		1

ADB	Schedule of Components by Room	N0106-02

Project: 11072 RHSC & DCN
Department: P1 Operating Theatres & RHSC Surgical Day Case Unit
Room: N0106-02 Operating Theatre 4 (interoprative)
Room Number: 1-P1-155 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	PEG002	PEGS; equipment; medium; 2; wide spacing; wall mounted.		1
3		3	PEN002	PENDANT; Anaesthetic; medical & power supply unit; vertical movement; ceiling mounted; outlets comprising.		1
1		1	PEN006A	PENDANT SURGICAL; touch screen monitor; medical and power supply unit; tandem; lateral and vertical movement; ceiling mounted; outlets comprising.		1
3		3	PLA002	PLATFORM; step-stand; stackable; portable; 130H 480W 330D		3
1		1	PRI015	PRINTER; label; portable		3
1		1	SCA012	SCALE; swab; includes Mains adaptor		3
2		2	STA101	STAND; lotion bowl; single; stainless steel; (Bowls not included)		3
2		2	STA142	STAND; infusion; twin hook; breaks; mobile		3
2		2	STA2509	STAND; sharps bin, mobile, 30 litre		3
3		3	STO006	STOOL, surgeon/anaesthetist, height adjustable, includes anti-static seat pads		3
2		2	SUC002	SUCTION UNIT; pipeline; high pressure; theatre		3
2		2	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SUR971	Swab bucket		3
2		2	SWC025	SWITCH, light		1
3		3	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
1		1	TAB071	TABLE operating patient, powered with 250mm transverse top, complete with specialty accessories, 715H 600W 2102D		3
2		2	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TRF002	AUTOTRANSFUSION cell separator; mobile; built in air and foam detector; 1620H 270W 585D		3
2		2	TRO021	TROLLEY; 4 sets of runners; 850H 600W 600D		3
4		4	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
2		2	TRO133	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 750W 450D		3
2		2	TRO201	TROLLEY, instruments, stainless steel, buffered, 870H 920W 620D		3
1		1	TRO204	TROLLEY instrument tray MAYO, 650W 450D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAR053	WARMER, blood/fluid, maintains temperature between 36 and 43 deg.C at flow rates up to 500 ml/min, 35H 235W 273D		3
1		1	WAR901	Blanket Warmer		3
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	G0510-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	G0510-02	Lobby: Isolation Room DCN		
Room Number:	2-L2-134		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Dispensing disposable aprons. 3) Dispensing disposable gloves. 4) Disposal of non-clinical waste 5) Donning gown and gloves. 6) Removal and disposal of gown and gloves			
Personnel:	1 x persons			
Planning Relationships:	Direct access to single-bed room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	G0510-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	G0510-02	Lobby: Isolation Room DCN		
Room Number:	2-L2-134		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	69.0	Ventila ion Type: Central Supply
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating type: Warm Air - reheat Battery with Local BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	G0510-02

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	G0510-02	Lobby: Isolation Room DCN		
Room Number:	2-L2-134		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	G0510-02

Project: 11072 RHSC & DCN
Department: L2 DCN Inpatients - 43 Beds
Room: G0510-02 Isolation Bedroom 17 Entrance Lobby
Room Number: 2-L2-134
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	DIS010	DISPENSER; pack; wall mounted; 600H 600W 300D		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
4		4	HOO018	HOOK; coat; single.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	B0308-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B0308-01	Single-bed room: Isolation DCN		
Room Number:	2-L2-135		**Revision Date:**	18/09/2014

Activities:	1) Dressing / undressing in privacy 2) Rest and relaxation 3) Patient may take meals or refreshments in bed, by the bed or in the sitting space 4) Clinical handwashing 5) Patient records reviewed and recorded 6) Storage of clothing and personal belongings 7) Use of mobile hoist (if required) 8) Therapeutic and clinical attention from healthcare staff 9) Patient examinations and assessment 10) Use of piped medical gases, vacuum and associated equipment			
Personnel:	1 x patient 2 x staff 2 x visitors			
Planning Relationships:	En-suite sanitary facilities.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B0308-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B0308-01	Single-bed room: Isolation DCN		
Room Number:	2-L2-135		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 21 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Supply via lobby
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating type: Adjacent space transfer air with BMS Adjustable Sensor Cooling : Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B0308-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B0308-01	Single-bed room: Isolation DCN
Room Number:	2-L2-135	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B0308-01

Project: 11072 RHSC & DCN
Department: L2 DCN Inpatients - 43 Beds
Room: B0308-01 Single Isolation Bedroom 1 (Adult)
Room Number: 2-L2-135
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED013	BED Kings Fund; variable height; two-way tilt; adjustable backrest; bedstripper; on castors		3
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BRA004	BRACKET; holder; suction unit; trunking/rail mounted		2
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA007	CHAIR; easy; with open arms; high back; upholstered, wipeable		3
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM905	IT Tablet		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO019	HOOK, single, small, wall mounted		1
1		1	LIG005	LUMINAIRE, bedhead, dimmable, patient reading and general nursing care/examination		1
1		1	LOC002	LOCKER, bedside, 3 compartment, towel rail at rear, on castors, 902H 485W 485D		3
1		1	MAT004	MATTRESS; Kings Fund bed; standard backrest; 1955L 865W 125D		3
1		1	MIR2500	MIRROR; wall mounted; 1600H 400W unbreakable.		1
1		1	MON900	MONITOR; Low end monitor, general Ward /OPD use		3
1		1	MST007	TROLLEY; lockable; closed; with worktop; approx 900H 660W 500D; 600mm facing		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT121	SOCKET outlet; computer data; double.		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
2		2	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	RAC362	RACK; catheter; vertical; 2 compartments; 420H 160W 65D		2
1		1	RAI130	RAIL, clinical equipment, wall mounted, 600mm		1
1		1	SHE2503	SHELF; 300mm deep; folding; length as drawn.		1
1		1	STA142	STAND; infusion; twin hook; breaks; mobile		3

ADB	Schedule of Components by Room	B0308-01

Project: 11072 RHSC & DCN
Department: L2 DCN Inpatients - 43 Beds
Room: B0308-01 Single Isolation Bedroom 1 (Adult)
Room Number: 2-L2-135
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	STA2504	STAND; Roll stand for monitor		3
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TAB073	TABLE, overbed, cantilevered		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAR900	WARDROBE; lockable; 2700H 750W 500D.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	Q0120

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	Q0120	Activities of daily living: kitchen		
Room Number:	2-M2-009		**Revision Date:**	18/09/2014

Activities:	1) Serving and eating of meals 2) Storage of dry goods 3) Storage of refrigerated provisions 4) Storage of trays, crockery and cutlery 5) Hand-rinsing 6) Patient arrives on foot or in a wheelchair 7) Assessment and training in mobility, self-care and social skills. 8) Preparation of beverages, meals and snacks			
Personnel:	1 x patient 1 x staff 1 x escort			
Planning Relationships:	Adjacent to occupational therapy area/rooms.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	Q0120

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	Q0120	Activities of daily living: kitchen
Room Number:	2-M2-009	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	6.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	Q0120

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	Q0120	Activities of daily living: kitchen
Room Number:	2-M2-009	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing)
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	Q0120

Project: 11072 RHSC & DCN
Department: M2 DCN Therapies
Room: Q0120 ADL Kitchen
Room Number: 2-M2-009
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
2		2	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
2		2	CHA1017	CHAIR; upright; upholstered; height adjustable		3
1		1	CLE009	CLEANER VACUUM; dry suction; tub; with accessories; domestic		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COO004	COOKER; gas; oven; four burner; domestic		2
1		1	COO006	COOKER CONTROL UNIT; 30amp; wall mounted.		1
1		1	COO2500	COOKER; electric; four burner; domestic, variable height		2
1		1	CUP021	CUPBOARD; 1 shelf; lockable; on plinth; 750H 600W 500D.		1
1		1	CUP048	CUPBOARD; 2 shelves; 1 pull out shelf; lockable; on plinth; 800H 600W 500D.		1
1		1	CUP100	CUPBOARD; broom; metal; shelf; lockable; 1800H 600W 450D.		1
1		1	CUP245	CUPBOARD; 1 shelf; lockable; wall mounted; 600H 600W 300D.		1
1		1	CUP263	CUPBOARD; 2 shelves; lockable; wall mounted; 600H 1200W 300D.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRA023	DRAWER UNIT; 3 drawer; 1 shelf pull out with 2 bowl cut-outs; on plinth; 800H 600W 500D.		1
1		1	DRA030	DRAWER UNIT; 4 drawer; on plinth; pull out shelf with 2 bowl cut-outs; 750H 600W 500D.		1
1		1	HEA900	HEAT GUN; Steinel		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	OUT006	SOCKET outlet unswitched 13amp single; wall mounted.		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
1		1	OUT054	CONNECTION UNIT, unswitched, 13 amp, neon indicator		1
2		2	OUT059	CONNECTION UNIT switched 13amp, indicator light		1
1		1	OUT315	OUTLET, drinking water for equipment		1
1		1	OUT435	OUTLET; natural gas connection for equipment.		1
1		1	OVE014	OVEN, microwave, light duty, 1000watt, capacity 26 litres, 295H 295W 410D		3
1		1	PAN900	HEATING PAN; non stick; 28 X 28 X 5		3
1		1	REF920	REFRIGERATOR, with freezer, capacity 117 litres, domestic type, 865H 500W 550D		3
2		2	SHE1000	SHELF; 150mm deep; length as drawn.		1

ADB	Schedule of Components by Room	Q0120

Project: 11072 RHSC & DCN
Department: M2 DCN Therapies
Room: Q0120 ADL Kitchen
Room Number: 2-M2-009
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	SIN105	SINK UNIT; 1 bowl and drainer; stainless steel; variable height; motorised system; 650/910H 1200W 580D		1
5		5	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAB107	TABLE, canteen/kitchen, 710H 900W 750D		3
2		2	TAP359	TAP, pillar, high neck, long lever, pair hot and cold, 1/2 in		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRO401	TROLLEY; walking aid		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
2		2	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
2		2	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
3		3	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT160	WORKTOP variable height; motorised system; consists of: control unit; electric motor; transformer; steering unit; 673/1023H 2000W 600D.		1
1		1	WOR174	WORKTOP; stainless steel; 1 integral sink bowl; 2400W 600D.		1
1		1	WRT002	WORKTOP, non-clinical, 600W 400D		1

ADB	Room Data Sheet	X0105-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0105-02	Distraction Free Treatment room		
Room Number:	2-M2-011		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Assessment / updating of electronic patient records (EPRs) 3) Storage of sterile supplies and consumables on a trolley 4) Use of mobile diagnostic and therapeutic equipment 5) Sterile packs, lotions and drugs prepared for immediate use			
Personnel:	1 x patient 1 x staff			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0105-02

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0105-02	Distraction Free Treatment room
Room Number:	2-M2-011	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	5.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	6.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch / Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0105-02

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0105-02	Distraction Free Treatment room
Room Number:	2-M2-011	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0105-02

Project: 11072 RHSC & DCN
Department: M2 DCN Therapies
Room: X0105-02 Distraction Free Treatment Room
Room Number: 2-M2-011 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BAS102	BASIN; medium; inset; vitreous china; 1 no right hand tap hole; no overflow.		1
1		1	BLI2500	Blind; total blackout boxed; length as indicated. Wipeable.		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	CAB2503	CABINET; filing; 4 drawer; lockable; 1320H 465W 620D		3
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
5		5	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
4		4	COM930	COMPUTER: tablet including cover		3
1		1	CUP011	CUPBOARD, metal, with 4 pull out galvanised shelves, lockable, 1800H 1000W 500D		3
1		1	CUP245	CUPBOARD; 1 shelf; lockable; wall mounted; 600H 600W 300D.		1
2		2	DIS013	DISPENSER, paper towel, wall mounted		2
2		2	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DIS2505	DISPENSER; WATER COOLER, mains supply.		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO020	HOOK, single, large, wall mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
7		7	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT2502	LOOP; induction.		1
1		1	OUT315	OUTLET, drinking water for equipment		1
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	STO004	STOOL, height adjustable, swivel, mobile		3
2		2	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAB007	TABLE, 710H 900W 900D		3
1		1	TAP289	TAP, monobloc, pillar mixer, integral thermostatic, short lever		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TRO905	TROLLEY; Mobile Induction Loop		3
1		1	VIE903	Chat box (Salfillo Corporation)		3
1		1	VIE904	Digital Tape recorder		3

ADB	Schedule of Components by Room	X0105-02

Project: 11072 RHSC & DCN
Department: M2 DCN Therapies
Room: X0105-02 Distraction Free Treatment Room
Room Number: 2-M2-011
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	VIE905	FEES eqt: Fibreoptic endoscopic evaluation of swallowing (Rhinolaryngoscope, chip camera, light source.		3
1		1	VIE906	Lightwriter SL40 (Toby Churchill)		3
2		2	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WAS107	TRAP, bottle, 1.1/4 in, plastic resealing		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	X0318

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0318	Multi Purpose Rehabilitation Room		
Room Number:	2-M2-023		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Administration and clerical duties 3) Provision of information to patients, carers and visitors 4) Clinical administration 5) Patient records reviewed and recorded 6) Use of Telephone 7) Computer information accessed 8) Assessment / updating of electronic patient records (EPRs) 9) Rehabilitation exercises			
Personnel:	10 x patients 2 x staff			
Planning Relationships:	Near to individual treatment room area. Direct access/close to equipment store. Close to associated changing provision.			
Space Data:	**Area (m²):**		**Height (mm):**	3,200
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0318

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0318	Multi Purpose Rehabilitation Room		
Room Number:	2-M2-023		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	5.0	Ventila ion Type: Central Supply and Extrct
Mechanical Ventilation (Extract ac/hr):	6.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0318

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0318	Multi Purpose Rehabilitation Room
Room Number:	2-M2-023	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control.
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0318

Project: 11072 RHSC & DCN
Department: M2 DCN Therapies
Room: X0318 Multi-Purpose Rehabilitation Room
Room Number: 2-M2-023 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BLI2500	Blind; total blackout boxed; length as indicated. Wipeable.		1
1		1	BOA037	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 900H 1200W.		1
1		1	BOA2502	BOARD; display/notice; magnetic; wall mounted; 900H 1200W		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CAM031	CAMERA; CCTV; pan/tilt/zoom.		1
6		6	CHA018	CHAIR; upright; with arms; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM031	COMPUTER: standard with keyboard and screen.		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM899	COMPUTER, secret garden installation		3
1		1	COM925	IT Equipment; use with secret garden installation		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DIS2505	DISPENSER; WATER COOLER, mains supply.		1
1		1	EXE003	EXERCISE BARS; parallel; 3600mm long.		2
1		1	EXE007	EXERCISE BARS; wall; 2400H 920W.		2
1		1	EXE013	EXERCISE STEPS; corner configuration; different heights; 1400H 1230W 1530D		3
1		1	EXE014	EXERCISE BICYCLE; ergometer; 1170 x 530		3
1		1	FRA024	FRAME; suspended; mesh infill; ceiling mounted; 700W x 1900D.		1
1		1	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	INT900	Intermittent Positive Pressure Breathing & stand		3
2		2	LOU903	LOUDSPEAKER; wall mounted.		2
1		1	MIR012	MIRROR; unbreakable/safety glass; mobile; 1600H 500Wl		3
1		1	MIR2504	MIRROR; wall mounted; 1600H 1200W; unbreakable.		1
2		2	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
11		11	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	OUT2502	LOOP; induction.		1
1		1	OUT315	OUTLET, drinking water for equipment		1
2		2	PLI040	PLINTH; Bobath centre; height adjustable (380-910mm) and head section; 910H 1900W 1200D		3
2		2	PLI041	PLINTH; 3 section; variable height 380/1010H 1880W 710D		3
1		1	PRO026	PROJECTOR; multi-media; ceiling mounted		2
1		1	RSU012	DEFIBRILLATOR; Automated External		3
1		1	STO004	STOOL, height adjustable, swivel, mobile		3

ADB	Schedule of Components by Room	X0318

Project: 11072 RHSC & DCN
Department: M2 DCN Therapies
Room: X0318 Multi-Purpose Rehabilitation Room
Room Number: 2-M2-023
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
3		3	STO015	STOOL, wooden, 400H 400W 400D		3
1		1	SUC004	SUCTION UNIT; electric; portable; 350H 320W 340D		3
2		2	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SWC034	SWITCH, dimmer, modulating		1
1		1	TAB003	TABLE, 710H 600W 450D		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
4		4	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRO310	TROLLEY, emergency/resuscitation, complete with defibrillator, 955H 825W 575D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	X0111

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0111	Treatment Area		
Room Number:	2-M3-003		**Revision Date:**	18/09/2014

Activities:	1) Clinical examination and assessment in privacy 2) Clinical hand washing 3) Use of computer by patient for therapeutic purposes 4) Patient records reviewed and recorded 5) Clinical discussions and non invasive procedures at the bedside 6) Use of piped medical gases, vacuum and associated equipment			
Personnel:	4 x patients 2 x staff 4 x escorts			
Planning Relationships:	Near main waiting room. Access to resuscitation facilities.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0111

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0111	Treatment Area
Room Number:	2-M3-003	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		
General Notes:	Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air	

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting
General Notes:	Control: Switch	

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		
General Notes:	Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)	

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	
General Notes:	Maximum cold water discharge temperature (degC): 20	

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0111

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0111	Treatment Area
Room Number:	2-M3-003	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Obscured, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0111

Project: 11072 RHSC & DCN
Department: M3 Programmed Investigations Unit
Room: X0111 Treatment Area
Room Number: 2-M3-003 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
4		4	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
4		4	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
4		4	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
2		2	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
4		4	CHA017	CHAIR; upright; upholstered; stacking		3
3		3	CHA072	CHAIR; treatment; reclining; height adjustable		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
4		4	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
6		6	INF001	INFUSION volumetric pump; 356H 178W 178D		3
4		4	LOC002	LOCKER, bedside, 3 compartment, towel rail at rear, on castors, 902H 485W 485D		3
2		2	MON900	MONITOR; Low end monitor, general Ward /OPD use		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
5		5	OUT010	SOCKET outlet, switched, 13amp, twin		1
8		8	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
8		8	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT215	SOCKET outlet, telephone		1
8		8	OUT471	OUTLET; oxygen medical; trunking mounted.		1
8		8	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PRI015	PRINTER; label; portable		3
5		5	STA142	STAND; infusion; twin hook; breaks; mobile		3
2		2	STA2504	STAND; Roll stand for monitor		3
2		2	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
4		4	SWC033	SWITCH dimmer; 3 position; wall mounted		1
4		4	TAB073	TABLE, overbed, cantilevered		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
4		4	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1

ADB	Schedule of Components by Room	X0111

Project: 11072 RHSC & DCN
Department: M3 Programmed Investigations Unit
Room: X0111 Treatment Area
Room Number: 2-M3-003 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	TRO135	TROLLEY; Gratnell; dressing/instrument; 6 clear trays, stainless steel; buffered; 890H 510W 480D		3
4		4	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003L	WORKTOP; 720 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	X0136

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0136	EMG/Nerve Conduction Room		
Room Number:	2-M4-008		**Revision Date:**	18/09/2014

Activities:	1) Patient examinations and assessment 2) Patient is positioned or repositioned on a treatment couch 3) Holding/storing working supply of clean and sterile materials for immediate use 4) Use of computer workstation(s) 5) Assessment / updating of electronic patient records (EPRs) 6) Use of call systems 7) Clinical hand washing 8) Electroencephalography measurement of brain activity			
Personnel:	1 patient 1 staff 1 escort			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0136

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0136	EMG/Nerve Conduction Room
Room Number:	2-M4-008	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	8.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating type: Warm Air - Reheat Battery with BMS Adjustable Sensor Cooling: Comfort Cooled

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ General working plane 1000 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0136

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0136	EMG/Nerve Conduction Room
Room Number:	2-M4-008	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0136

Project: 11072 RHSC & DCN
Department: M4 DCN Neurophysiology
Room: X0136 EMG/Nerve Conduction Room
Room Number: 2-M4-008 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BLI2500	Blind; total blackout boxed; length as indicated. Wipeable.		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
3		3	CHA018	CHAIR; upright; with arms; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRA057	DRAWER UNIT, 3 drawer, lockable, on castors, desk height 715H 430W 600D		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO022	HOOK; double; wall mounted.		1
2		2	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	MSC082	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
8		8	OUT010	SOCKET outlet, switched, 13amp, twin		1
3		3	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PLI2500	Plinth; patient		3
1		1	REC900	Recorder EMG (EP)		3
1		1	REC909	Visual Stimulator		3
1		1	RES004	REST ARM; height adjustable; mobile; washable cover		3
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
2		2	TRU1002	TRUNKING; vertical; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1

ADB	Schedule of Components by Room	X0136

Project: 11072 RHSC & DCN
Department: M4 DCN Neurophysiology
Room: X0136 EMG/Nerve Conduction Room
Room Number: 2-M4-008
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

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ADB	Room Data Sheet	X0125

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0125	EEG Recording room		
Room Number:	2-M4-019		**Revision Date:**	18/09/2014

Activities:	1) Patient examinations and assessment 2) Patient is positioned or repositioned on a treatment couch 3) Holding/storing working supply of clean and sterile materials for immediate use 4) Use of computer workstation(s) 5) Assessment / updating of electronic patient records (EPRs) 6) Use of call systems 7) Clinical hand washing 8) Electroencephalography measurement of brain activity			
Personnel:	1 patient 2 staff 1 escort			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0125

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0125	EEG Recording room
Room Number:	2-M4-019	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	8.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating type: Warm Air - Reheat Battery with BMS Adjustable Sensor Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ General working plane 1000 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0125

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0125	EEG Recording room
Room Number:	2-M4-019	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0125

Project: 11072 RHSC & DCN
Department: M4 DCN Neurophysiology
Room: X0125 EEG Recording Room
Room Number: 2-M4-019
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED2506	BED; variable height; electric; with cot sides		3
1		1	BLI2500	Blind; total blackout boxed; length as indicated. Wipeable.		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	BRA900	BRACKET; computer; height adjustable; tilt & swivel; wall mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CAM2507	CAMERA; CCTV; pan/tilt/zoom		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
1		1	CHA007	CHAIR; easy; with open arms; high back; upholstered, wipeable		3
3		3	CHA018	CHAIR; upright; with arms; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM900	EEG Recorder portable laptop		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRA057	DRAWER UNIT, 3 drawer, lockable, on castors, desk height 715H 430W 600D		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO022	HOOK; double; wall mounted.		1
1		1	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
2		2	MSC082	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
1		1	MSC2507	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; shelves; 1 door hinged right; wall mounted.		1
1		1	MSC2508	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; shelves; 1 door hinged left; wall mounted.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
8		8	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT052	CONNECTION UNIT, switched, 13 amp		1
1		1	OUT121	SOCKET outlet; computer data; double.		1

ADB	Schedule of Components by Room	X0125

Project: 11072 RHSC & DCN
Department: M4 DCN Neurophysiology
Room: X0125 EEG Recording Room
Room Number: 2-M4-019
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	REC901	Recording System		3
1		1	REC902	Recorder Ambulatory		3
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	TRU1002	TRUNKING; vertical; length as drawn.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

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ADB	Room Data Sheet	M0132-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	M0132-01	Open Plan Office		
Room Number:	2-R1-055		**Revision Date:**	18/09/2014

Activities:	1) Use of computer workstation(s) 2) Use of Telephone 3) Storage of Files and records 4) Secure holding/storing of personal belongings 5) Use of Printer 6) Assessment / updating of electronic patient records (EPRs)			
Personnel:	staff			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	M0132-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	M0132-01	Open Plan Office
Room Number:	2-R1-055	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	M0132-01

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	M0132-01	Open Plan Office		
Room Number:	2-R1-055		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	M0132-01

Project: 11072 RHSC & DCN
Department: R1 Clinical / Management Suite
Room: M0132-01 2nd Floor Open Plan Desks
Room Number: 2-R1-055
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
4		4	BOA027	BOARD; marker/display; whiteboard; magnetic; dry-wipe; with pen holder; wall mounted; 1200H 1800W.		1
18		18	CAB2517	CABINET; filing with 3 drawers 1073 mm high x 1200 mm wide		3
2		2	CAB2520	CABINET; double doors 1912 mm high x 1000 mm wide		3
2		2	CAB2521	CABINET; tambour front 997 mm high x 1000 mm wide		3
9		9	CAB2522	CABINET; unit 3 drawers 1073 mm high x 1000 mm wide		3
9		9	CAB2524	CABINET; filing/storage 2300 mm high x 600 mm deep x 1000 mm wide		3
51		51	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
3		3	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
51		51	COM033	COMPUTER KEYBOARD		3
51		51	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
51		51	DES019	DESK, cantilever, cable management, 1500W 800D		3
51		51	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
28		28	HOO022	HOOK; double; wall mounted.		1
2		2	LOC008	LOCKER clothes; single; 2 compartments; 1800H 300W 550D		3
12		12	LOC019	LOCKER; 6 compartments; 1800H 300W 450D		3
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
102		102	OUT009	SOCKET outlet switched 13 amp twin; floor mounted.		1
102		102	OUT122	SOCKET outlet computer data; floor mounted.		1
34		34	SCR019	SCREEN, dividing, 1500H 1500W		3
1		1	SWC025	SWITCH, light		1
51		51	TEL1000	TELEPHONE; handset.		3

ADB	Room Data Sheet	T0101

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	T0101	Clean Utility: Inpatients RHSC		
Room Number:	3-C1.1-042		**Revision Date:**	18/09/2014

Activities:	1) Preparation of trays and trolleys laid up for surgical/clinical procedures 2) Storage of sterile equipment, consumable supplies and packs 3) Storage of non-sterile medical items, equipment and supplies 4) Storage of sterile fluids 5) Assessment / updating of electronic patient records (EPRs)			
Personnel:	2 x staff			
Planning Relationships:	Access from corridor for delivery of supplies.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	T0101

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	T0101	Clean Utility: Inpatients RHSC
Room Number:	3-C1.1-042	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	6.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	150	@ General working plane 1000 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		Not Applicable
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	T0101

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	T0101	Clean Utility: Inpatients RHSC
Room Number:	3-C1.1-042	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or obscure, solar control, security control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	T0101

Project: 11072 RHSC & DCN
Department: C1.1 Medical Inpatients - 23 Beds
Room: T0101 Clean Utility
Room Number: 3-C1.1-042 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
2		2	BOA2500	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 900H 600W.		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	LIG081	LUMINAIRE fitted with single fluorescent lamp with switch; below drug cupboard; 8watt; 400mm.		1
2		2	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	MSC082	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
4		4	MSC091	CABINET base; 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
4		4	MSC092	CABINET base; 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
4		4	MSC122	CABINET top; 400mm facing; (400x300 inserts); with formed plastic liners; 1 door hinged right; wall mounted.		1
4		4	MSC123	CABINET top; 400mm facing; (400x300 inserts); with formed plastic liners; 1 door hinged left; wall mounted.		1
1		1	MSC127	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; wall mounted.		1
1		1	MSC128	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; wall mounted.		1
1		1	MSC503	PHARMACY CABINET; 600mm facing; with 4 shelves; 1 pull out prep. shelf; controlled drugs cupboard; warning light; 1 door hinged right w/security safe lock; o/a height 1200.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	OUT006	SOCKET outlet unswitched 13amp single; wall mounted.		1
3		3	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT050	OUTLET, controlled drugs cupboard		1
2		2	OUT059	CONNECTION UNIT switched 13amp, indicator light		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	PAN063	PANEL; indicator.		1
1		1	PRI015	PRINTER; label; portable		3
1		1	REF066	REFRIGERATOR, capacity 390 litres, 1855H 645W 595D		3
1		1	SWC025	SWITCH, light		1

ADB	Schedule of Components by Room	T0101

Project: 11072 RHSC & DCN
Department: C1.1 Medical Inpatients - 23 Beds
Room: T0101 Clean Utility
Room Number: 3-C1.1-042
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRO251	TROLLEY; medicine; stainless steel; frame epoxy coated; buffered; 1250H 750W 450D		3
1		1	TRO421	DEVICE; securing; medicine trolley; wall mounted.		1
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

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ADB	Room Data Sheet	E0604-06

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-06	Control / Observation room		
Room Number:	3-C4-007		**Revision Date:**	18/09/2014

Activities:	1) Use of computer workstation(s) 2) Viewing film and/or computer generated images 3) Use of recording equipment 4) Processes and tests are recorded 5) Assessment / updating of electronic patient records (EPRs)			
Personnel:	4 x staff			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	E0604-06

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	E0604-06	Control / Observation room
Room Number:	3-C4-007	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ desk 750 - 850mm AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0604-06

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	E0604-06	Control / Observation room
Room Number:	3-C4-007	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Observation panel, one-way viewing from control room into bedroom.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	E0604-06

Project: 11072 RHSC & DCN
Department: C4 Sleep Lab
Room: E0604-06 Control Room
Room Number: 3-C4-007
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN900	BIN; Recycle waste		3
2		2	BLI2500	Blind; total blackout boxed; length as indicated. Wipeable.		1
2		2	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
2		2	CAB024	CABINET; filing; 2 drawer; 710H 470W 620D		3
2		2	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
3		3	CHA017	CHAIR; upright; upholstered; stacking		3
3		3	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
3		3	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
3		3	CON2502	CONTROL SYSTEM; for sleep; with computer screen		3
3		3	HOO024	HOOK; hat and coat; 1.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
12		12	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
11		11	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	REC030	RECORDER/VIDEO; playback		3
5		5	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
2		2	TEL1000	TELEPHONE; handset.		3
1		1	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
2		2	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
2		2	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	B0705

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B0705	Sleep Room		
Room Number:	3-C4-008		**Revision Date:**	18/09/2014

Activities:	1) Assessment and planning of treatment and/or operation may take place 2) Use of monitoring/diagnostic or therapeutic equipment 3) Rest and relaxation 4) Disposal of non-clinical waste 5) Therapeutic and clinical attention from healthcare staff 6) Clinical hand washing			
Personnel:	1 x patient 1 x staff			
Planning Relationships:	Control Room En-suite Parents Room			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligatureStrategy for anti-ligature provision

ADB	Room Environmental Data	B0705

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room	B0705	Sleep Room
Room Number:	3-C4-008	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Natural & Central Supply Air
Mechanical Ventilation (Extract ac/hr):		via ensuite
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control witch/Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY	
Hot Surface Max. Temp (DegC):	43
Hot Water Max. Temp (DegC):	41

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B0705

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B0705	Sleep Room
Room Number:	3-C4-008	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B0705

Project: 11072 RHSC & DCN
Department: C4 Sleep Lab
Room: B0705 Sleep Room
Room Number: 3-C4-008
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED013	BED Kings Fund; variable height; two-way tilt; adjustable backrest; bedstripper; on castors		3
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BLI2500	Blind; total blackout boxed; length as indicated. Wipeable.		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BRA004	BRACKET; holder; suction unit; trunking/rail mounted		2
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CAM2504	CAMERA; CCTV; pan/tilt/zoom; ceiling mounted.		5
1		1	CHA007	CHAIR; easy; with open arms; high back; upholstered, wipeable		3
1		1	CON2501	CONTROL UNIT; for sleep system.		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO024	HOOK; hat and coat; 1.		1
1		1	LIG005	LUMINAIRE, bedhead, dimmable, patient reading and general nursing care/examination		1
1		1	LOC002	LOCKER, bedside, 3 compartment, towel rail at rear, on castors, 902H 485W 485D		3
1		1	MAT004	MATTRESS; Kings Fund bed; standard backrest; 1955L 865W 125D		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
3		3	OUT010	SOCKET outlet, switched, 13amp, twin		1
5		5	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
3		3	OUT052	CONNECTION UNIT, switched, 13 amp		1
3		3	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT2503	SOCKET; outlet switched 13amp double; ceiling mounted.		1
1		1	OUT2504	SOCKET; outlet data; ceiling mounted.		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
2		2	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	RAC362	RACK; catheter; vertical; 2 compartments; 420H 160W 65D		2
1		1	RAI130	RAIL, clinical equipment, wall mounted, 600mm		1
1		1	SOM2500	SOMNOSCREEN; sleep study system		5
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TAB073	TABLE, overbed, cantilevered		3

ADB	Schedule of Components by Room	B0705

Project: 11072 RHSC & DCN
Department: C4 Sleep Lab
Room: B0705 Sleep Room
Room Number: 3-C4-008
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRO910	TROLLEY; dressing/instrument; stainless steel; buffered; 870H 450W 450D; 1 drawer		3
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAR900	WARDROBE; lockable; 2700H 750W 500D.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Room Data Sheet	X1504

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X1504	Patient Treatment Lounge		
Room Number:	3-D9-016		**Revision Date:**	18/09/2014

Activities:	1) Clinical examination and assessment in privacy 2) Patient may receive scalp cooling (cold cap) treatment, before and during administration of cytotoxic drugs 3) Administration of cytotoxic drugs by injection or intravenous drip 4) Clinical hand washing 5) Recording of patient data/notes 6) Use of computer by patient for therapeutic purposes 7) Patient may take meals or refreshments in bed, by the bed or in the sitting space 8) Patient records reviewed and recorded 9) Clinical discussions and non invasive procedures at the bedside 10) Use of piped medical gases, vacuum and associated equipment
Personnel:	5 x patients 1 x staff 5 x escorts
Planning Relationships:	Near main waiting room. Access to resuscitation facilities.

Space Data:	**Area (m^2):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X1504

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X1504	Patient Treatment Lounge
Room Number:	3-D9-016	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed / Trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X1504

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X1504	Patient Treatment Lounge
Room Number:	3-D9-016	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Obscured, privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X1504

Project: 11072 RHSC & DCN
Department: D9 Medical Day Care Unit - 5 Beds
Room: X1504 Patient Treatment Lounge
Room Number: 3-D9-016 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
4		4	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
4		4	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
8		8	CHA083	CHAIR, stacking, polypropylene, with back and seat pads		3
4		4	CHA091	CHAIR; easy; reclining; 1000H 630W 1880D		3
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
4		4	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
4		4	LIG005	LUMINAIRE, bedhead, dimmable, patient reading and general nursing care/examination		1
4		4	LOC002	LOCKER, bedside, 3 compartment, towel rail at rear, on castors, 902H 485W 485D		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
16		16	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
7		7	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
4		4	OUT471	OUTLET; oxygen medical; trunking mounted.		1
4		4	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PRI015	PRINTER; label; portable		3
4		4	STA142	STAND; infusion; twin hook; breaks; mobile		3
2		2	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
4		4	TAB073	TABLE, overbed, cantilevered		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
4		4	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
2		2	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
4		4	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	H0202-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	H0202-01	Workshop / Tutorial Room		
Room Number:	3-H3-001		**Revision Date:**	18/09/2014

Activities:	1) Use of Multimedia equipment 2) Use of laptop computer(s) 3) Colleagues /visitors received for training/observation purposes			
Personnel:	12-15 x persons Intermittent use			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	H0202-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	H0202-01	Workshop / Tutorial Room
Room Number:	3-H3-001	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):		10 litres a second per person
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - Minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Ceiling Cassette - Chilled Water

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	H0202-01

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	H0202-01	Workshop / Tutorial Room		
Room Number:	3-H3-001		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control Blinds will be required to darken room, full blackout is rarely required.
Internal Glazing:	Observation panel, one-way viewing from control room into tutorial room
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	H0202-01

Project: 11072 RHSC & DCN
Department: H3 SPHERE (Clinical Education Suite)
Room: H0202-01 Workshop / Tutorial Room 3
Room Number: 3-H3-001 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED008	BED; Kings Fund; child; variable height; two-way tilt; adjustable backrest; on castors		3
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BOA2507	BOARD; Interactive smartboard		2
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
3		3	CAM031	CAMERA; CCTV; pan/tilt/zoom.		1
9		9	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM2506	Laptop		3
1		1	COM908	Telemedicine package tandberg 770MXP wall mounted		5
2		2	CUP016	CUPBOARD, metal, 1 shelf, wall mounted, 600H 600W 300D.		1
2		2	CUP2509	CUPBOARD; base unit; LH door; lockable; 600mm.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO024	HOOK; hat and coat; 1.		1
1		1	MON900	MONITOR; Low end monitor, general Ward /OPD use		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT009	SOCKET outlet switched 13 amp twin; floor mounted.		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
4		4	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
3		3	OUT2503	SOCKET; outlet switched 13amp double; ceiling mounted.		1
3		3	OUT2504	SOCKET; outlet data; ceiling mounted.		1
1		1	OUT2509	SOCKET; Telemedicine.		1
2		2	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	SWC025	SWITCH, light		1
1		1	TAB073	TABLE, overbed, cantilevered		3
2		2	TAB122	Table; committee; unit type; 720H 1400W 700D		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
2		2	TRO135	TROLLEY; Gratnell; dressing/instrument; 6 clear trays, stainless steel; buffered; 890H 510W 480D		3
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1

ADB	Schedule of Components by Room	H0202-01

Project: 11072 RHSC & DCN
Department: H3 SPHERE (Clinical Education Suite)
Room: H0202-01
Room Number: 3-H3-001
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	TRU2500	TRUNKING; floor; length as drawn.		1
1		1	TRU2500	TRUNKING; floor; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT124	WORKTOP, cantilevered from wall, 1200W 550D.		1

ADB	Room Design Character	L0102-03

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	L0102-03	Tissue Culture Store		
Room Number:	4-H1-016		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control.
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Room Environmental Data	L0102-03

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	L0102-03	Tissue Culture Store
Room Number:	4-H1-016	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	6.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	6.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - Minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Ceiling Cassette - Chilled Water

LIGHTING		
Service Illumination (Lux):	500	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	60	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Schedule of Components by Room	L0102-03

Project: 11072 RHSC & DCN
Department: H1 Child Life & Health
Room: L0102-03 Tissue Culture Store
Room Number: 4-H1-016
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BOA203	BOARD; combined magnetic display/whiteboard; dry-wipe; with pen holder; wall mounted; 1200H 1500W.		1
2		2	CAB200	CABINET: Class II tissue culture cabinet		1
1		1	CAS020	FIRST AID BOX		2
1		1	CEN004	CENTRIFUGE: Swingout rotor, refrigerated, bench top		3
1		1	COM031	COMPUTER: standard with keyboard and screen.		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
2		2	INC021	INCUBATOR for cell culture (not babies)		3
2		2	LAB928	BENCH, laboratory, 1400W 800D		3
1		1	LSU003	SINK laboratory; 300H 450W 420D; HTM67/S3.		1
1		1	MIC040	MICROSCOPE: Conventional		3
1		1	MIC043	MICROSCOPE: Inverted		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	OUT006	SOCKET outlet unswitched 13amp single; wall mounted.		1
8		8	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
3		3	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
2		2	OUT471	OUTLET; oxygen medical; trunking mounted.		1
3		3	OUT476	OUTLET; vacuum medical; trunking mounted.		1
3		3	OUT491	OUTLET; carbon dioxide; trunking mounted.		1
1		1	REF904	FREEZER 600 X 600 X 850.		3
1		1	SNS753	SINKTOP; single bowl; no tap holes; no overflow; right hand integral ribbed drainer; stainless steel; 1200W 600D. HTM64STA		1
1		1	STF400	CABINET: Under bench cabinet with 1 drawer at top and cabinet with shelf beneath; on castors		3
1		1	SWC025	SWITCH, light		1
1		1	TAP419	TAP; Laboratory Nitrogen		1
2		2	TAP809	TAP, bib, lever, hospital pattern, pair hot and cold, 1/2 in.		1
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
2		2	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	WAS051	WASH; eye; first aid; with mirror; wall mounted; 360H 250W 100D.		1
2		2	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
2		2	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
1		1	WKT1004H	WORKTOP; 920 high 800 deep, laboratory; length as drawn		1

ADB	Room Data Sheet	L0102-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	L0102-01	Molecular Biology Laboratory		
Room Number:	4-H1-018		**Revision Date:**	18/09/2014

Activities:	1) Use of laptop computer(s) 2) Sorting, batching and labelling/numbering specimens and processing request forms 3) Centrifugation of samples/specimens (urine, blood, fluids) 4) Short term storage of specimens 5) Preparation of slides for microscopy 6) Plating specimens for culture. 7) Processes and tests are recorded			
Personnel:	8 x staff 2 visitors			
Planning Relationships:				
Space Data:	**Area (m^2):**		**Height (mm)**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	L0102-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	L0102-01	Molecular Biology Laboratory
Room Number:	4-H1-018	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	6.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	6.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - Minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Ceiling Cassette - Chilled Water

LIGHTING		
Service Illumination (Lux):	500	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	60	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	L0102-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	L0102-01	Molecular Biology Laboratory
Room Number:	4-H1-018	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear. Blackout blinds will be required to darken room.
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Room Data Sheet	L0102-03

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	L0102-03	Tissue Culture Store		
Room Number:	4-H1-016		**Revision Date:**	18/09/2014

Activities:	1) Use of computer workstation(s) 2) Recording of test results 3) Processes and tests are recorded 4) Plating specimens for culture. 5) Preparation of slides for microscopy 6) Short term storage of specimens 7) Centrifugation of samples/specimens (urine, blood, fluids) 8) Sorting, batching and labelling/numbering specimens and processing request forms			
Personnel:	2 x staff			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Schedule of Components by Room	L0102-01

Project: 11072 RHSC & DCN
Department: H1 Child Life & Health
Room: L0102-01 Molecular Biology Laboratory
Room Number: 4-H1-018
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	AUT900	Autoclave		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BIN023	BIN; flammable waste; hinged lid. Complies with HTM83/1983 and BS476PT 7 (1971) for class '0' fire retardancy		3
1		1	BLI2500	Blind; total blackout boxed; length as indicated. Wipeable.		1
1		1	BOA027	BOARD; marker/display; whiteboard; magnetic; dry-wipe; with pen holder; wall mounted; 1200H 1800W.		1
1		1	CAB300	POISONS CABINET: Large, under bench		3
1		1	CAS020	FIRST AID BOX		2
2		2	CEN003	CENTRIFUGE bench mounted; 300H 420W 490D		3
1		1	CEN004	CENTRIFUGE: Swingout rotor, refrigerated, bench top		3
1		1	CEN012	CENTRIFUGE: refrigerated, large, bench top		3
1		1	CEN023	MIKRO CENTRIFUGE		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
3		3	COM031	COMPUTER: standard with keyboard and screen.		3
2		2	CUP031	CUPBOARD; 1 shelf; on plinth; 800H 1200W 500D.		1
6		6	CUP1001	CUPBOARD, mobile, 1 shelf, specialist laboratory		3
1		1	CUP142	CUPBOARD; fume; with extract; bench mounted; 1050H 1000W 750D.		1
2		2	CUP2997	CUPBOARD, flammable store, ducted to CUP142		1
1		1	DIS011	DISPENSER, barrier cream, disposable single cartridge, wall mounted		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
10		10	HOO024	HOOK; hat and coat; 1.		1
1		1	INC020	INCUBATOR: heated, benchtop, with shaker platform		3
1		1	LAB110	STILL; distilled water; with storage tank, wall mounted; 1095H 375W 440D		2
1		1	LAB208	PLATE READER		3
2		2	LAB400	FREEZER; Laboratory, under bench		3
1		1	LAB500	DRYING OVEN; bench top		3
1		1	LAB600	WATER BATH: heated		3
2		2	MIC040	MICROSCOPE: Conventional		3
1		1	MIC041	MICROSCOPE: Multi-header for instruction with camera and computer		3
1		1	MIC042	MICROSCOPE: Time Lapse		3
1		1	NAN010	NANODROP		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
12		12	OUT006	SOCKET outlet unswitched 13amp single; wall mounted.		1
17		17	OUT010	SOCKET outlet, switched, 13amp, twin		1
10		10	OUT052	CONNECTION UNIT, switched, 13 amp		1
9		9	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1

ADB	Schedule of Components by Room	L0102-01

Project: 11072 RHSC & DCN
Department: H1 Child Life & Health
Room: L0102-01 Molecular Biology Laboratory
Room Number: 4-H1-018
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
2		2	OUT315	OUTLET, drinking water for equipment		1
1		1	OUT341	OUTLET, drainage, anti-syphon		1
3		3	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
3		3	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PCR010	PCR MACHINE		3
1		1	RAC500	RACK UNIT; metal; shelves with dividers, shelves to be height adjustable		3
1		1	REF032	FREEZER upright -20 deg.C; Panasonic MDF-U700VX-PE; 2010H 1010W 870D		3
1		1	REF105	ICE MACHINE: under bench, plumbed in		2
1		1	REF200	REFRIGERATOR: upright		3
1		1	RTM010	REAL TIME MACHINE		3
1		1	SHE902	SHELF, with supports from island units, 2no each side		1
2		2	SHE903	SHELF, 2no, with supports		1
2		2	SIG900	SIGN; door; vacant/engaged & names slot		1
2		2	SNS753	SINKTOP; single bowl; no tap holes; no overflow; right hand integral ribbed drainer; stainless steel; 1200W 600D. HTM64STA		1
1		1	SPI300	SPILL KIT		3
1		1	SPI301	RADIATION SPILL KIT		3
7		7	STO023	STOOL; laboratory; complete with footring		3
17		17	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAP022	TAP, laboratory, cold water		1
1		1	TAP023	TAP, laboratory, hot water		1
1		1	TAP419	TAP; Laboratory Nitrogen		1
2		2	TAP809	TAP, bib, lever, hospital pattern, pair hot and cold, 1/2 in.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
3		3	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	WAS021	GLASSWASHER - either under bench or bench top		2
1		1	WAS051	WASH; eye; first aid; with mirror; wall mounted; 360H 250W 100D.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
3		3	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
3		3	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
6		6	WKT1004H	WORKTOP; 920 high 800 deep, laboratory; length as drawn		1
1		1	WKT304	WORKTOP; dished; stainless steel; with right hand sink bowl; cantilevered from wall; 1500W 650D.		1

ADB	Room Data Sheet	L0102-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	L0102-02	Physiology Laboratory		
Room Number:	4-H1-027		**Revision Date:**	18/09/2014

Activities:	1) Use of laptop computer(s) 2) Use of computer workstation(s) 3) Clinical hand washing 4) Processes and tests are recorded 5) Sorting, batching and labelling/numbering specimens and processing request forms 6) Centrifugation of samples/specimens (urine, blood, fluids) 7) Short term storage of specimens 8) Preparation of slides for microscopy 9) Plating specimens for culture. 10) Recording of test results
Personnel:	8 x staff 2 visitors
Planning Relationships:	

Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	L0102-02

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	L0102-02	Physiology Laboratory
Room Number:	4-H1-027	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	6.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	6.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - Minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Coeiling Cassette - Chilled Water

LIGHTING		
Service Illumination (Lux):	500	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	60	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	L0102-02

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	L0102-02	Physiology Laboratory		
Room Number:	4-H1-027		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear. Blackout blinds will be required to darken room.
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	L0102-02

Project: 11072 RHSC & DCN
Department: H1 Child Life & Health
Room: L0102-02 Physiological Laboratory
Room Number: 4-H1-027
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BIN023	BIN; flammable waste; hinged lid. Complies with HTM83/1983 and BS476PT 7 (1971) for class '0' fire retardancy		3
2		2	BLI2500	Blind; total blackout boxed; length as indicated. Wipeable.		1
1		1	BOA027	BOARD; marker/display; whiteboard; magnetic; dry-wipe; with pen holder; wall mounted; 1200H 1800W.		1
1		1	CAB301	POISONS CABINET: Small, wall mounted		2
1		1	CAS020	FIRST AID BOX		2
2		2	CEN003	CENTRIFUGE bench mounted; 300H 420W 490D		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM031	COMPUTER: standard with keyboard and screen.		3
16		16	CUP1001	CUPBOARD, mobile, 1 shelf, specialist laboratory		3
2		2	CUP1003	CUPBOARD, mobile, with 4 drawer, specialist laboratory		3
1		1	CUP142	CUPBOARD; fume; with extract; bench mounted; 1050H 1000W 750D.		1
1		1	DIS011	DISPENSER, barrier cream, disposable single cartridge, wall mounted		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
7		7	HOO024	HOOK; hat and coat; 1.		1
2		2	LAB400	FREEZER; Laboratory, under bench		3
1		1	MIC040	MICROSCOPE: Conventional		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
7		7	OUT006	SOCKET outlet unswitched 13amp single; wall mounted.		1
22		22	OUT010	SOCKET outlet, switched, 13amp, twin		1
7		7	OUT052	CONNECTION UNIT, switched, 13 amp		1
3		3	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT315	OUTLET, drinking water for equipment		1
1		1	OUT341	OUTLET, drainage, anti-syphon		1
3		3	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
3		3	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PCR010	PCR MACHINE		3
1		1	REF032	FREEZER upright -20 deg.C; Panasonic MDF-U700VX-PE; 2010H 1010W 870D		3
1		1	REF105	ICE MACHINE: under bench, plumbed in		2
1		1	SHE902	SHELF, with supports from island units, 2no each side		1
2		2	SHE903	SHELF, 2no, with supports		1
1		1	SIG900	SIGN; door; vacant/engaged & names slot		1
2		2	SNS753	SINKTOP; single bowl; no tap holes; no overflow; right hand integral ribbed drainer; stainless steel; 1200W 600D. HTM64STA		1
1		1	SPI301	RADIATION SPILL KIT		3

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ADB	Schedule of Components by Room	L0102-02

Project: 11072 RHSC & DCN
Department: H1 Child Life & Health
Room: L0102-02 Physiological Laboratory
Room Number: 4-H1-027
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
7		7	STO023	STOOL; laboratory; complete with footring		3
17		17	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAP022	TAP, laboratory, cold water		1
1		1	TAP023	TAP, laboratory, hot water		1
1		1	TAP809	TAP, bib, lever, hospital pattern, pair hot and cold, 1/2 in.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
5		5	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	WAS051	WASH; eye; first aid; with mirror; wall mounted; 360H 250W 100D.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
2		2	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
2		2	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
6		6	WKT1004H	WORKTOP; 920 high 800 deep, laboratory; length as drawn		1

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ADB	Room Data Sheet	X0242-04

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0242-04	Treatment: double-sided couch access (Mental Health)		
Room Number:	G-A1-015		**Revision Date:**	18/09/2014

Activities:	1) Invasive clinical procedures from side of couch 2) Dressing / undressing in privacy 3) Clinical handwashing 4) Assessment / updating of electronic patient records (EPRs) 5) Use of mobile diagnostic and therapeutic equipment			
Personnel:	1 x patient 2 x staff 2 x escorts			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m²):**		**Height (mm):**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0242-04

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0242-04	Treatment: double-sided couch access (Mental Health)
Room Number:	G-A1-015	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0242-04

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0242-04	Treatment: double-sided couch access (Mental Health)
Room Number:	G-A1-015	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or Clear, solar control, privacy control.
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0242-04

Project: 11072 RHSC & DCN
Department: A1 Emergency Department
Room: X0242-04 Treatment Room 11: Dual Access (Mental Health)
Room Number: G-A1-015 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
2		2	ALA001	PUSH BUTTON, security alarm		1
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
3		3	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	MON902	MONITOR; Mid range use in Recovery & HDU.		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
3		3	SEA024	SEAT, tip-up, wall mounted, 400 W 400D		1
1		1	STA2504	STAND; Roll stand for monitor		3
1		1	SWC025	SWITCH, light		1
1		1	TRO282	TROLLEY PATIENT; accident; image top; with tilt and brakes; 540-1000H 740W 2110D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1

ADB	Room Data Sheet	X0242-05

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0242-05	Resuscitation Room: 2 places		
Room Number:	G-A1-028		**Revision Date:**	18/09/2014

Activities:	1) Therapeutic and clinical attention from healthcare staff 2) Patient may require assistance during the activities 3) Clinical hand washing 4) Assessment / updating of electronic patient records (EPRs) 5) Use of computer workstation(s) 6) Use of Telephone 7) Use of call systems 8) Medical and nursing procedures requiring all sides access to patient whilst 1-4 staff using mobile equipment 9) Use of Imaging x-ray equipment			
Personnel:	2 x patients 6 x staff (up to 12) 4 x escort			
Planning Relationships:				
Space Data:	**Area (m^2):**		**Height (mm):**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0242-05

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0242-05	Resuscitation Room: 2 places
Room Number:	G-A1-028	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 21 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	6.0	
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0242-05

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0242-05	Resuscitation Room: 2 places		
Room Number:	G-A1-028		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control, high level
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0242-05

Project: 11072 RHSC & DCN
Department: A1 Emergency Department
Room: X0242-05 Resuscitation Room: 2 places
Room Number: G-A1-028 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
2		2	ANA001	ANAESTHETIC MACHINE/WORKSTATION electrically powered piston ventilator, mobile, 1350H 750W 650D		3
2		2	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
2		2	BIN2503	BIN; sharps disposal		3
4		4	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	CAB950	CONSOLE, X-ray , specialist.		5
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
6		6	CHA017	CHAIR; upright; upholstered; stacking		3
2		2	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
2		2	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	CUP2569	Generator Cabinet.		5
2		2	DIS013	DISPENSER, paper towel, wall mounted		2
2		2	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
2		2	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
4		4	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	INF001	INFUSION volumetric pump; 356H 178W 178D		3
1		1	LIG074	ILLUMINATED SIGN DO NOT ENTER		1
1		1	LIG074	ILLUMINATED SIGN DO NOT ENTER		1
2		2	LIG081	LUMINAIRE fitted with single fluorescent lamp with switch; below drug cupboard; 8watt; 400mm.		1
2		2	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
2		2	MON906	MONITOR; Clinical slave		2
2		2	MSC127	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; wall mounted.		1
2		2	MSC128	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; wall mounted.		1
4		4	MSC981	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; vertical tambour front; on plinth; o/a height 880		1
4		4	MST001	TROLLEY; single open frame; with handle; up to 5 sets of runners; 600mm facing; approx 850H 730W 450D		3
4		4	MST005	TROLLEY; half size open frame; up to 5 sets of runners; 400mm facing; approx 850H 450W 350D		3
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT006	SOCKET outlet unswitched 13amp single; wall mounted.		1
13		13	OUT010	SOCKET outlet, switched, 13amp, twin		1
16		16	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT050	OUTLET, controlled drugs cupboard		1
2		2	OUT059	CONNECTION UNIT switched 13amp, indicator light		1

ADB	Schedule of Components by Room	X0242-05

Project: 11072 RHSC & DCN
Department: A1 Emergency Department
Room: X0242-05 Resuscitation Room: 2 places
Room Number: G-A1-028 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
8		8	OUT121	SOCKET outlet; computer data; double.		1
8		8	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
2		2	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
4		4	OUT453	OUTLET, 4kPa compressed air, medical		1
4		4	OUT461	OUTLET, nitrous oxide, medical		1
8		8	OUT470	OUTLET, oxygen, medical		1
4		4	OUT475	OUTLET, vacuum, medical		1
4		4	OUT480	OUTLET, gas scavenging (AGS), medical		1
4		4	PEN900	PENDANT RESUSCITATION, medical gases and power supply unit, fixed location, ceiling mounted, medical gases and power outlets comprising:		1
2		2	PRI015	PRINTER; label; portable		3
1		1	RAC196	RACK, x-ray lead apron, 5 hangers hinged, wall mounted		2
2		2	REF062	REFRIGERATOR, capacity 82 litres, external temperature gauge, lockable, 660H 500W 510D		3
2		2	RSU010	DEFIBRILLATOR; Manual		3
3		3	SCR066	SCREEN shielding; radiation protection; lead sheets; mobile; 1140H 1070L; lead equivalent 0.8 mm Pb @ 110 keV.		5
2		2	STA142	STAND; infusion; twin hook; breaks; mobile		3
2		2	STA2504	STAND; Roll stand for monitor		3
2		2	STF290	STORAGE UNIT; upper; cupboard; controlled drugs; 1 door; lockable; with inner lockable cupboard and warning light; 550H 600W 300D		1
2		2	STO006	STOOL, surgeon/anaesthetist, height adjustable, includes anti-static seat pads		3
1		1	SWC025	SWITCH, light		1
1		1	SWC062	EMERGENCY STOP switch button, wall mounted		1
4		4	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
2		2	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
2		2	TEL2500	TELEPHONE; handset, wall mounted.		2
2		2	TRO2507	TROLLEY; control; including PC		3
2		2	TRO282	TROLLEY PATIENT; accident; image top; with tilt and brakes; 540-1000H 740W 2110D		3
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAR053	WARMER, blood/fluid, maintains temperature between 36 and 43 deg.C at flow rates up to 500 ml/min, 35H 235W 273D		3
2		2	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
2		2	WAS1000	TRAP; concealed waste; for back outlet basins.		1
2		2	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	XRA010	X-RAY CS; ceiling suspensions; with telescopic tube of column and rotating/tilting arm		5
4		4	XRA015	X-RAY CS RAIL; ceiling suspensions; 6280mm; (Part of XRA010)		5
1		1	XRA040	X-RAY Resus equipment		5

ADB	Room Data Sheet	X0242-06

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0242-06	Resuscitation Room: 2 places		
Room Number:	G-A1-029		**Revision Date:**	18/09/2014

Activities:	1) Therapeutic and clinical attention from healthcare staff 2) Patient may require assistance during the activities 3) Clinical hand washing 4) Assessment / updating of electronic patient records (EPRs) 5) Use of computer workstation(s) 6) Use of Telephone 7) Use of call systems 8) Medical and nursing procedures requiring all sides access to patient whilst 1-4 staff using mobile equipment 9) Use of Imaging x-ray equipment			
Personnel:	2 x patients 6 x staff (up to 12) 4 x escort			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0242-06

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0242-06	Resuscitation Room: 2 places
Room Number:	G-A1-029	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 21 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	6.0	
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0242-06

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0242-06	Resuscitation Room: 2 places
Room Number:	G-A1-029	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control, high level
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0242-06

Project: 11072 RHSC & DCN
Department: A1 Emergency Department
Room: X0242-06 Resuscitation Room: 2 places
Room Number: G-A1-029 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
2		2	ANA001	ANAESTHETIC MACHINE/WORKSTATION electrically powered piston ventilator, mobile, 1350H 750W 650D		3
2		2	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
2		2	BIN2503	BIN; sharps disposal		3
4		4	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	CAB950	CONSOLE, X-ray , specialist.		5
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
6		6	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
2		2	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	CUP2569	Generator Cabinet.		5
2		2	DIS013	DISPENSER, paper towel, wall mounted		2
2		2	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
2		2	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
4		4	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	INF001	INFUSION volumetric pump; 356H 178W 178D		3
2		2	LIG074	ILLUMINATED SIGN DO NOT ENTER		1
2		2	LIG081	LUMINAIRE fitted with single fluorescent lamp with switch; below drug cupboard; 8watt; 400mm.		1
2		2	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
2		2	MON906	MONITOR; Clinical slave		2
2		2	MSC127	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; wall mounted.		1
2		2	MSC128	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; wall mounted.		1
4		4	MSC981	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; vertical tambour front; on plinth; o/a height 880		1
4		4	MST001	TROLLEY; single open frame; with handle; up to 5 sets of runners; 600mm facing; approx 850H 730W 450D		3
4		4	MST005	TROLLEY; half size open frame; up to 5 sets of runners; 400mm facing; approx 850H 450W 350D		3
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT006	SOCKET outlet unswitched 13amp single; wall mounted.		1
13		13	OUT010	SOCKET outlet, switched, 13amp, twin		1
16		16	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT050	OUTLET, controlled drugs cupboard		1
2		2	OUT059	CONNECTION UNIT switched 13amp, indicator light		1
8		8	OUT121	SOCKET outlet; computer data; double.		1

ADB	Schedule of Components by Room	X0242-06

Project: 11072 RHSC & DCN
Department: A1 Emergency Department
Room: X0242-06 Resuscitation Room: 2 places
Room Number: G-A1-029 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
8		8	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
2		2	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
4		4	OUT453	OUTLET, 4kPa compressed air, medical		1
4		4	OUT461	OUTLET, nitrous oxide, medical		1
8		8	OUT470	OUTLET, oxygen, medical		1
4		4	OUT475	OUTLET, vacuum, medical		1
4		4	OUT480	OUTLET, gas scavenging (AGS), medical		1
4		4	PEN900	PENDANT RESUSCITATION, medical gases and power supply unit, fixed location, ceiling mounted, medical gases and power outlets comprising:		1
2		2	PRI015	PRINTER; label; portable		3
1		1	RAC196	RACK, x-ray lead apron, 5 hangers hinged, wall mounted		2
2		2	REF062	REFRIGERATOR, capacity 82 litres, external temperature gauge, lockable, 660H 500W 510D		3
1		1	RSU011	DEFIBRILLATOR; Manual with pacing capability		3
3		3	SCR066	SCREEN shielding; radiation protection; lead sheets; mobile; 1140H 1070L; lead equivalent 0.8 mm Pb @ 110 keV.		5
2		2	STA142	STAND; infusion; twin hook; breaks; mobile		3
2		2	STA2504	STAND; Roll stand for monitor		3
2		2	STF290	STORAGE UNIT; upper; cupboard; controlled drugs; 1 door; lockable; with inner lockable cupboard and warning light; 550H 600W 300D		1
2		2	STO006	STOOL, surgeon/anaesthetist, height adjustable, includes anti-static seat pads		3
1		1	SWC025	SWITCH, light		1
1		1	SWC062	EMERGENCY STOP switch button, wall mounted		1
4		4	SYR004	SYRINGE pump; anaesthetic use; with diprifusor; 115H 400W 180D		3
2		2	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
2		2	TEL2500	TELEPHONE; handset, wall mounted.		2
2		2	TRO2507	TROLLEY; control; including PC		3
2		2	TRO282	TROLLEY PATIENT; accident; image top; with tilt and brakes; 540-1000H 740W 2110D		3
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAR053	WARMER, blood/fluid, maintains temperature between 36 and 43 deg.C at flow rates up to 500 ml/min, 35H 235W 273D		3
2		2	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
2		2	WAS1000	TRAP; concealed waste; for back outlet basins.		1
2		2	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	XRA010	X-RAY CS; ceiling suspensions; with telescopic tube of column and rotating/tilting arm		5
4		4	XRA015	X-RAY CS RAIL; ceiling suspensions; 6280mm; (Part of XRA010)		5
1		1	XRA040	X-RAY Resus equipment		5

ADB	Room Data Sheet	X0242-03

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0242-03	Triage room		
Room Number:	G-A1-035		**Revision Date:**	18/09/2014

Activities:	1) Consultations. 2) Dressing / undressing in privacy 3) Clinical handwashing 4) Patient records reviewed and recorded 5) Computer information accessed 6) Patient examinations and assessment			
Personnel:	1 x patient 2 x staff 2 x escorts			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm)**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0242-03

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0242-03	Triage room		
Room Number:	G-A1-035		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	3.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4- minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0242-03

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0242-03	Triage room		
Room Number:	G-A1-035		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0242-03

Project: 11072 RHSC & DCN
Department: A1 Emergency Department
Room: X0242-03 Triage Room
Room Number: G-A1-035 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BIN2503	BIN; sharps disposal		3
1		1	CAB056	CABINET; stationery; metal; 10 drawer with lock; 600H 280W 410D		3
1		1	CAB2502	CABINET; medicine; wall mounted.		1
1		1	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
4		4	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	DIA2500	DIAGNOSTIC SET; auroscope/opthalmoscope; wall mounted.		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
2		2	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	MON900	MONITOR; Low end monitor, general Ward /OPD use		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
3		3	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	RAI130	RAIL, clinical equipment, wall mounted, 600mm		1
1		1	SCA011	SCALE; baby		3
1		1	SCA2501	SCALE; free standing height column		3
2		2	SUP2500	SUPPORT LEG; for 920 high worktop		1
2		2	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3

ADB	Schedule of Components by Room	X0242-03

Project: 11072 RHSC & DCN
Department: A1 Emergency Department
Room: X0242-03 Triage Room
Room Number: G-A1-035
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRO282	TROLLEY PATIENT; accident; image top; with tilt and brakes; 540-1000H 740W 2110D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	X0242-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0242-02	Treatment: Single sided couch access (ED only)		
Room Number:	G-A1-060		**Revision Date:**	18/09/2014

Activities:	1) Invasive clinical procedures from side of couch 2) Preparation of trays / packs for clinical procedures 3) Clinical handwashing 4) Assessment / updating of electronic patient records (EPRs) 5) Storage of sterile supplies and consumables on a trolley 6) Use of mobile diagnostic and therapeutic equipment 7) Preparation for clinical procedures 8) Sterile supplies and consumables are held 9) Sterile packs, lotions and drugs prepared for immediate use 10) Patient may undress/dress in privacy			
Personnel:	1 x patient 2 x staff 2 x escorts			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0242-02

Project:	11072	RHSC & DCN	
Department:	01	Key Rooms (Financial Close)	
Room:	X0242-02	Treatment: Single sided couch access (ED only)	
Room Number:	G-A1-060	**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		
General Notes:	Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air	

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting
General Notes:	Control: Switch	

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		
General Notes:	Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)	

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	
General Notes:	Maximum cold water discharge temperature (degC): 20	

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0242-02

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0242-02	Treatment: Single sided couch access (ED only)
Room Number:	G-A1-060	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0242-02

Project: 11072 RHSC & DCN
Department: A1 Emergency Department
Room: X0242-02 Treatment Room 3: Single Access
Room Number: G-A1-060
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
2		2	BIN2503	BIN; sharps disposal		3
1		1	BRA003	BRACKET, holder, suction unit, wall mounted		2
1		1	CAB056	CABINET; stationery; metal; 10 drawer with lock; 600H 280W 410D		3
1		1	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
3		3	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	DIA2500	DIAGNOSTIC SET; auroscope/opthalmoscope; wall mounted.		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRA2500	DRAWER UNIT; Plastic;5 drawer; on castors		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO024	HOOK; hat and coat; 1.		1
1		1	LIG015	LUMINAIRE observation/examination; mobile; 1000 lux		3
1		1	MIR024	MIRROR; unbreakable; wall mounted; 800H 300W.		1
1		1	MON900	MONITOR; Low end monitor, general Ward /OPD use		3
2		2	MST001	TROLLEY; single open frame; with handle; up to 5 sets of runners; 600mm facing; approx 850H 730W 450D		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
5		5	OUT010	SOCKET outlet, switched, 13amp, twin		1
3		3	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
3		3	OUT121	SOCKET outlet; computer data; double.		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PRI015	PRINTER; label; portable		3
1		1	STO020	STOOL; anatomic; backrest; armrests; height adjustable		3

ADB	Schedule of Components by Room	X0242-02

Project: 11072 RHSC & DCN
Department: A1 Emergency Department
Room: X0242-02 Treatment Room 3: Single Access
Room Number: G-A1-060
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
2		2	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRA1001	TRACK; curtain; door; length and shape as drawn.		1
1		1	TRO282	TROLLEY PATIENT; accident; image top; with tilt and brakes; 540-1000H 740W 2110D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003L	WORKTOP; 720 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	X0242-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0242-01	Treatment: double sided couch access (ED only)		
Room Number:	G-A2-020		**Revision Date:**	18/09/2014

Activities:	1) Invasive clinical procedures from side of couch 2) Preparation of trays / packs for clinical procedures 3) Clinical handwashing 4) Assessment / updating of electronic patient records (EPRs) 5) Storage of sterile supplies and consumables on a trolley 6) Use of mobile diagnostic and therapeutic equipment 7) Preparation for clinical procedures 8) Sterile supplies and consumables are held 9) Sterile packs, lotions and drugs prepared for immediate use 10) Patient may undress/dress in privacy			
Personnel:	1 x patient 2 x staff 2 x escorts			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m²):**		**Height (mm):**	3,000
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0242-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0242-01	Treatment: double sided couch access (ED only)
Room Number:	G-A2-020	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		
General Notes:	Heating type: Radiant panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air	

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting
General Notes:	Control: Switch	

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		
General Notes:	Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)	

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	
General Notes:	Maximum cold water discharge temperature (degC): 20	

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0242-01

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0242-01	Treatment: double sided couch access (ED only)		
Room Number:	G-A2-020		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0242-01

Project: 11072 RHSC & DCN
Department: A1 Emergency Department
Room: X0242-01 Treatment Room 8: Dual Access
Room Number: G-A1-020
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
2		2	BIN2503	BIN; sharps disposal		3
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
4		4	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	DIA2500	DIAGNOSTIC SET; auroscope/opthalmoscope; wall mounted.		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRA2500	DRAWER UNIT; Plastic;5 drawer; on castors		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	MON902	MONITOR; Mid range use in Recovery & HDU.		3
2		2	MST001	TROLLEY; single open frame; with handle; up to 5 sets of runners; 600mm facing; approx 850H 730W 450D		3
1		1	MST005	TROLLEY; half size open frame; up to 5 sets of runners; 400mm facing; approx 850H 450W 350D		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
6		6	OUT010	SOCKET outlet, switched, 13amp, twin		1
6		6	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
3		3	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	RAI2500	RAIL; clinical equipment; wall mounted; length as drawn.		1
1		1	STO020	STOOL; anatomic; backrest; armrests; height adjustable		3
1		1	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRA1001	TRACK; curtain; door; length and shape as drawn.		1
1		1	TRO2512	TROLLEY; 2 shelves, lectern type top		3
1		1	TRO282	TROLLEY PATIENT; accident; image top; with tilt and brakes; 540-1000H 740W 2110D		3
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Schedule of Components by Room	X0242-01

Project: 11072 RHSC & DCN
Department: A1 Emergency Department
Room: X0242-01 Treatment Room 8: Dual Access
Room Number: G-A1-020
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	X0206

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0206	Plaster Suite		
Room Number:	G-D1-008		**Revision Date:**	18/09/2014

Activities:	1) Application or removal of plaster casts or moulds 2) Disposal of plaster waste and discarded splints 3) Clinical handwashing 4) Assessment / updating of electronic patient records (EPRs) 5) Patient may be ambulant with/without walking aids, in a wheelchair or requiring assistance 6) Use of computer workstation(s) 7) Use of call systems 8) Patient may undress/dress in privacy			
Personnel:	3 x patients 3 x staff 6 x escorts			
Planning Relationships:	Close to a store. (Which store)			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0206

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0206	Plaster Suite
Room Number:	G-D1-008	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	3.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0206

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0206	Plaster Suite
Room Number:	G-D1-008	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0206

Project: 11072 RHSC & DCN
Department: D1 RHSC Main Outpatients
Room: X0206 Plaster Suite (3 bays)
Room Number: G-D1-008
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
3		3	BUC003	BUCKET; plaster; with stand; mobile; 900H 300 dia.		3
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
6		6	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
3		3	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
3		3	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
6		6	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
6		6	HOO022	HOOK; double; wall mounted.		1
3		3	HOO061	HOOK; limb sling; ceiling mounted		2
3		3	LIG963	LUMINAIRE; examination; ceiling; adjustable.		1
1		1	MIR003	MIRROR; wall mounted; 1000H 300W.		1
1		1	MIR2500	MIRROR; wall mounted; 1600H 400W unbreakable.		1
1		1	MSC198	CABINET top; 600mm facing; with 1 shelf; 1 door hinged left; wall mounted.		1
4		4	OUT005	SOCKET outlet, switched, 13amp, single		1
8		8	OUT010	SOCKET outlet, switched, 13amp, twin		1
3		3	OUT052	CONNECTION UNIT, switched, 13 amp		1
4		4	OUT121	SOCKET outlet; computer data; double.		1
4		4	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
3		3	OUT471	OUTLET; oxygen medical; trunking mounted.		1
3		3	OUT476	OUTLET; vacuum medical; trunking mounted.		1
2		2	RAI081	RAIL, grab, horizontal, wall mounted, 900mm		1
3		3	RES003	REST FOOT; height adjustable; washable cover		3
2		2	SAW2500	SAW; plaster		3
1		1	SNS510	SINK plaster; plain top; no tap holes; no upstand; no overflow; left hand drainer; stainless steel; 900H 1200W 600D; HTM64PSH		1
1		1	STF136	STORAGE UNIT; lower; cupboard; 2 door; 1 shelf; lockable; 550H 1000W 450D		1
1		1	STF2506	STORAGE UNIT; lower; cupboard; 2 door; 1 shelf; lockable; on plinth		1
2		2	STF275	STORAGE UNIT; upper; cupboard; 2 door; 1 shelf; lockable; 550H 600W 300D		1
4		4	STF281	STORAGE UNIT; upper; cupboard; 2 door; 1 shelf; lockable; 550H 1000W 300D		1
1		1	STO020	STOOL; anatomic; backrest; armrests; height adjustable		3

ADB	Schedule of Components by Room	X0206

Project: 11072 RHSC & DCN
Department: D1 RHSC Main Outpatients
Room: X0206 Plaster Suite (3 bays)
Room Number: G-D1-008
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	SUP2501	SUPPORT LEG; for 720 high worktop		1
3		3	SUP2502	SUPPORT; over bed monkey bar.		3
4		4	SWC025	SWITCH, light		1
1		1	TAB2199	TABLE; spinal, 1920H 22800W 730D		3
1		1	TAP809	TAP, bib, lever, hospital pattern, pair hot and cold, 1/2 in.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
3		3	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
3		3	TRO133	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 750W 450D		3
2		2	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
3		3	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
1		1	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
3		3	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	X0105-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0105-01	Treatment room: with Prep Area		
Room Number:	G-D1-033		**Revision Date:**	18/09/2014

Activities:	1) Invasive clinical procedures from side of couch 2) Dressing / undressing in privacy 3) Clinical handwashing 4) Assessment / updating of electronic patient records (EPRs) 5) Storage of sterile supplies and consumables on a trolley 6) Use of mobile diagnostic and therapeutic equipment 7) Sterile packs, lotions and drugs prepared for immediate use			
Personnel:	1 x patient 2 x staff 2 x escorts			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0105-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0105-01	Treatment room: with Prep Area
Room Number:	G-D1-033	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0105-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0105-01	Treatment room: with Prep Area
Room Number:	G-D1-033	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0105-01

Project: 11072 RHSC & DCN
Department: D1 RHSC Main Outpatients
Room: X0105-01 Treatment Room (with prep area)
Room Number: G-D1-033 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BRA004	BRACKET; holder; suction unit; trunking/rail mounted		2
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	DIS011	DISPENSER, barrier cream, disposable single cartridge, wall mounted		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO022	HOOK; double; wall mounted.		1
2		2	HOO024	HOOK; hat and coat; 1.		1
1		1	LIG963	LUMINAIRE; examination; ceiling; adjustable.		1
2		2	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	MSC082	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
2		2	MSC127	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; wall mounted.		1
1		1	MSC128	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; wall mounted.		1
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PRI015	PRINTER; label; portable		3
1		1	RAI132	RAIL, clinical equipment, wall mounted, 1200mm		1
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	STO020	STOOL; anatomic; backrest; armrests; height adjustable		3
2		2	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1

ADB	Schedule of Components by Room	X0105-01

Project: 11072 RHSC & DCN
Department: D1 RHSC Main Outpatients
Room: X0105-01 Treatment Room (with prep area)
Room Number: G-D1-033 **Revision Date:** 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRO133	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 750W 450D		3
2		2	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003L	WORKTOP; 720 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	C0224-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0224-01	Consulting/examination: RHSC		
Room Number:	G-D1-039		**Revision Date:**	18/09/2014

Activities:	1) Consultations. 2) Minimally invasive clinical procedures undertaken from one or both sides of the couch. 3) Storage of sterile supplies and consumables on a trolley 4) Assessment / updating of electronic patient records (EPRs) 5) Clinical handwashing 6) Examinations carried out from one or both sides of the couch 7) Patient may undress/dress in privacy			
Personnel:	1 x patient 3 x staff 2 x escorts			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0224-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0224-01	Consulting/examination: RHSC
Room Number:	G-D1-039	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	3.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0224-01

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0224-01	Consulting/examination: RHSC		
Room Number:	G-D1-039		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	C0224-01

Project: 11072 RHSC & DCN
Department: D1 RHSC Main Outpatients
Room: C0224-01 Consult/Examination
Room Number: G-D1-039 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
5		5	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	DIA2500	DIAGNOSTIC SET; auroscope/opthalmoscope; wall mounted.		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO022	HOOK; double; wall mounted.		1
1		1	LIG963	LUMINAIRE; examination; ceiling; adjustable.		1
1		1	MSC197	CABINET top; 600mm facing; with 1 shelf; 1 door hinged right; wall mounted.		1
1		1	MSC2515	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; lockable; shelved; on plinth; o/a height 900.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
1		1	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PRI015	PRINTER; label; portable		3
1		1	RAI130	RAIL, clinical equipment, wall mounted, 600mm		1
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	SIG2501	Sign; door slot Drs name		1
1		1	SPH003	SPHYGMOMANOMETER; rail mounted		3
1		1	STO020	STOOL; anatomic; backrest; armrests; height adjustable		3
2		2	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1

ADB	Schedule of Components by Room	C0224-01

Project: 11072 RHSC & DCN
Department: D1 RHSC Main Outpatients
Room: C0224-01 Consult/Examination
Room Number: G-D1-039
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	VIE900	PEEPHOLE		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	C0217-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0217-01	Consult/exam: multidisciplinary - RHSC		
Room Number:	G-D1-040		**Revision Date:**	18/09/2014

Activities:	1) Consultations. 2) Minimally invasive clinical procedures undertaken from one or both sides of the couch. 3) Storage of sterile supplies and consumables on a trolley 4) Assessment / updating of electronic patient records (EPRs) 5) Clinical handwashing 6) Patient may undress/dress in privacy			
Personnel:	1 x patient 8 x staff 2 x escorts			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm)**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0217-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0217-01	Consult/exam: multidisciplinary - RHSC		
Room Number:	G-D1-040		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	3.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0217-01

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0217-01	Consult/exam: multidisciplinary - RHSC		
Room Number:	G-D1-040		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	C0217-01

Project: 11072 RHSC & DCN
Department: D1 RHSC Main Outpatients
Room: C0217-01 Consult/Multi-Disciplinary
Room Number: G-D1-040 **Revision Date:** 18/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
10		10	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	DIA2500	DIAGNOSTIC SET; auroscope/opthalmoscope; wall mounted.		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
2		2	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
1		1	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO022	HOOK; double; wall mounted.		1
1		1	LIG055	LUMINAIRE variable spotlight beam produce around 40000 lux @ 1m and 60000 lux @ 0.8m. flexible arm; wall/ceiling mounted.		1
1		1	MSC198	CABINET top; 600mm facing; with 1 shelf; 1 door hinged left; wall mounted.		1
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
1		1	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PRI015	PRINTER; label; portable		3
1		1	RAI130	RAIL, clinical equipment, wall mounted, 600mm		1
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	SIG2501	Sign; door slot Drs name		1
1		1	SPH003	SPHYGMOMANOMETER; rail mounted		3
2		2	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAB002	TABLE; 650H 1200W 600D		3
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3

ADB	Schedule of Components by Room	C0217-01

Project: 11072 RHSC & DCN
Department: D1 RHSC Main Outpatients
Room: C0217-01 Consult/Multi-Disciplinary
Room Number: G-D1-040
Revision Date: 18/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
2		2	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	VIE900	PEEPHOLE		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	C0715

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0715	Cardio Pulmonary Exercise Lab		
Room Number:	G-D2-005		**Revision Date:**	18/09/2014

Activities:	1) Electrocardiogram (ECG) exercise stress test 2) Recording of test results 3) Clinical hand washing 4) Patient may undress/dress in privacy 5) Hanging clothing 6) Use of call systems 7) Use of monitoring/diagnostic or therapeutic equipment			
Personnel:	1 x patient 2 x staff 2 x escorts			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0715

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0715	Cardio Pulmonary Exercise Lab		
Room Number:	G-D2-005		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed / Trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0715

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0715	Cardio Pulmonary Exercise Lab
Room Number:	G-D2-005	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	C0715

Project: 11072 RHSC & DCN
Department: D2 Cardiology & Respiratory
Room: C0715 Cardio Pulmonary Exe Lab
Room Number: G-D2-005
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
4		4	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CHA063	CHAIR; height adjustable; with arms; high back; swivel; 5 star base; on castors		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	CUP011	CUPBOARD, metal, with 4 pull out galvanised shelves, lockable, 1800H 1000W 500D		3
1		1	CUP031	CUPBOARD; 1 shelf; on plinth; 800H 1200W 500D.		1
2		2	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	EXE900	EXERCISE SYSTEM; Bicycle		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
3		3	HOO022	HOOK; double; wall mounted.		1
2		2	MST001	TROLLEY; single open frame; with handle; up to 5 sets of runners; 600mm facing; approx 850H 730W 450D		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
5		5	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	SPH003	SPHYGMOMANOMETER; rail mounted		3
1		1	STF2505	STORAGE UNIT; upper cupboard; drugs; 1 door; lockable; 550h 600w 300d		1
1		1	STO004	STOOL, height adjustable, swivel, mobile		3
2		2	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAP809	TAP, bib, lever, hospital pattern, pair hot and cold, 1/2 in.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRO2506	TROLLEY; control; including printer		3
1		1	TRO2507	TROLLEY; control; including PC		3
1		1	TRO2514	TROLLEY; Spirometer		3
1		1	TRO911	TROLLEY; dressing/instrument; stainless steel; buffered; 870H 750W 450D; 1 drawer		3

ADB	Schedule of Components by Room	C0715

Project: 11072 RHSC & DCN
Department: D2 Cardiology & Respiratory
Room: C0715 Cardio Pulmonary Exe Lab
Room Number: G-D2-005
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
2		2	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
1		1	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT300R	WORKTOP; dished; stainless steel; with right hand sink bowl; cantilevered from wall; 1200W 650D; HTM63		1

ADB	Room Data Sheet	C0712

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0712	Treatment room: Echocardiography		
Room Number:	G-D2-006		**Revision Date:**	18/09/2014

Activities:	1) Dressing / undressing in privacy 2) Clinical handwashing 3) Assessment / updating of electronic patient records (EPRs) 4) Storage of sterile supplies and consumables on a trolley 5) Use of mobile diagnostic and therapeutic equipment 6) Echocardiography test			
Personnel:	1 x patient 1 x staff 2 x escorts			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m^2):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0712

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0712	Treatment room: Echocardiography		
Room Number:	G-D2-006		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	8.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air - Reheat Battery with BMS Adjustable Sensor. Cooling: Comfort Cooled

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ General working plane 1000 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0712

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0712	Treatment room: Echocardiography		
Room Number:	G-D2-006		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	C0712

Project: 11072 RHSC & DCN
Department: D2 Cardiology & Respiratory
Room: C0712 Echocardiography Room
Room Number: G-D2-006
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BLI2500	Blind; total blackout boxed; length as indicated. Wipeable.		1
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CHA063	CHAIR; height adjustable; with arms; high back; swivel; 5 star base; on castors		3
5		5	CHA083	CHAIR, stacking, polypropylene, with back and seat pads		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	CRD016	ECHOCARDIOGRAPHY MACHINE		3
2		2	CUP675	CUPBOARD; 1 shelf; on plinth; 850H 600W 500D.		1
1		1	DIS007	DISPENSER, paper towel roll, wall mounted		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT010	SOCKET outlet, switched, 13amp, twin		1
8		8	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
6		6	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	STF135	STORAGE UNIT; lower; cupboard; 2 door; 1 shelf; lockable; 750H 1000W 450D		1
1		1	STO004	STOOL, height adjustable, swivel, mobile		3
2		2	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Schedule of Components by Room	C0712

Project: 11072 RHSC & DCN
Department: D2 Cardiology & Respiratory
Room: C0712 Echocardiography Room
Room Number: G-D2-006
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	C0718-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0718-02	Lung Function Laboratory		
Room Number:	G-D2-013		**Revision Date:**	18/09/2014

Activities:	1) Electrocardiogram (ECG) exercise stress test 2) Recording of test results 3) Clinical hand washing 4) Hanging clothing 5) Use of monitoring/diagnostic or therapeutic equipment			
Personnel:	1 x patient 2 x staff 2 x escorts			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM SZ SL SH 200 001 for room area			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0718-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0718-02	Lung Function Laboratory		
Room Number:	G-D2-013		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed / Trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0718-02

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0718-02	Lung Function Laboratory		
Room Number:	G-D2-013		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	C0718-02

Project: 11072 RHSC & DCN
Department: D2 Cardiology & Respiratory
Room: C0718-02 Lung Function Laboratory
Room Number: G-D2-013
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CAR010	CARREL; gas cylinder; metal frame and uprights; set to floor; cross bars; securing chain; 1300H 900W 500D.		1
3		3	CHA017	CHAIR; upright; upholstered; stacking		3
2		2	CHA063	CHAIR; height adjustable; with arms; high back; swivel; 5 star base; on castors		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	CUP011	CUPBOARD, metal, with 4 pull out galvanised shelves, lockable, 1800H 1000W 500D		3
1		1	CUP2515	CUPBOARD; base unit; 4 drawer; lockable; 600mm.		1
2		2	CUP675	CUPBOARD; 1 shelf; on plinth; 850H 600W 500D.		1
2		2	DIS013	DISPENSER, paper towel, wall mounted		2
2		2	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DRY900	Dryer unit for equipment		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
3		3	HOO022	HOOK; double; wall mounted.		1
1		1	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
2		2	MST001	TROLLEY; single open frame; with handle; up to 5 sets of runners; 600mm facing; approx 850H 730W 450D		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
6		6	OUT010	SOCKET outlet, switched, 13amp, twin		1
5		5	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT049	CONNECTION UNIT, switched, 13amp, flex outlet		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
7		7	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	OXI2500	OXIMETER		3
1		1	PFT2500	Master PFT pro & body box		3
1		1	REF091	REFRIGERATOR; drug; capacity 35 litres; external temperature gauge; lockable; wall mounted; 510H 380W 445D		2
1		1	STF2505	STORAGE UNIT; upper cupboard; drugs; 1 door; lockable; 550h 600w 300d		1

ADB	Schedule of Components by Room	C0718-02

Project: 11072 RHSC & DCN
Department: D2 Cardiology & Respiratory
Room: C0718-02 Lung Function Laboratory
Room Number: G-D2-013
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	STO004	STOOL, height adjustable, swivel, mobile		3
1		1	SUP2500	SUPPORT LEG; for 920 high worktop		1
3		3	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAP809	TAP, bib, lever, hospital pattern, pair hot and cold, 1/2 in.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRO2507	TROLLEY; control; including PC		3
1		1	TRO911	TROLLEY; dressing/instrument; stainless steel; buffered; 870H 750W 450D; 1 drawer		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
1		1	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
2		2	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1003L	WORKTOP; 720 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT2504	WORKTOP; dished; stainless steel; with right hand sink bowl; cantilevered from wall; 1200W 650D; HTM63.		1

ADB	Room Data Sheet	C0718-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0718-01	Excercise Tolerance Test Room		
Room Number:	G-D2-014		**Revision Date:**	18/09/2014

Activities:	1) Electrocardiogram (ECG) exercise stress test 2) Recording of test results 3) Clinical hand washing 4) Hanging clothing 5) Use of monitoring/diagnostic or therapeutic equipment			
Personnel:	1 x patient 1 x staff 2 x escorts			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0718-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0718-01	Excercise Tolerance Test Room		
Room Number:	G-D2-014		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		
General Notes:	Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air	

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting
General Notes:	Control: Switch	

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		
General Notes:	Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)	

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	
General Notes:	Maximum cold water discharge temperature (degC): 20	

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0718-01

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0718-01	Excercise Tolerance Test Room		
Room Number:	G-D2-014		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	C0718-01

Project: 11072 RHSC & DCN
Department: D2 Cardiology & Respiratory
Room: C0718-01 Exercise Tolerance Test Room
Room Number: G-D2-014 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BLI2500	Blind; total blackout boxed; length as indicated. Wipeable.		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BRA901	Bracket; Monitor oxygen/saturation outside rooms		2
4		4	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CHA063	CHAIR; height adjustable; with arms; high back; swivel; 5 star base; on castors		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	CON2500	CONTROL UNIT; for treadmill.		3
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	CUP011	CUPBOARD, metal, with 4 pull out galvanised shelves, lockable, 1800H 1000W 500D		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	EXE016	EXERCISE TREADMILL		3
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO022	HOOK; double; wall mounted.		1
1		1	MON912	MONITOR; Oxygen/Saturation		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
5		5	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	RSU010	DEFIBRILLATOR; Manual		3
1		1	STF120	STORAGE UNIT; lower; cupboard; 1 door; 1 shelf; on castors; 600H 500W 450D		3
2		2	STO004	STOOL, height adjustable, swivel, mobile		3
1		1	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRO310	TROLLEY, emergency/resuscitation, complete with defibrillator, 955H 825W 575D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1

ADB	Schedule of Components by Room	C0718-01

Project: 11072 RHSC & DCN
Department: D2 Cardiology & Respiratory
Room: C0718-01 Exercise Tolerance Test Room
Room Number: G-D2-014
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	C0903-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0903-01	Dental Surgery Standard		
Room Number:	G-D5-008		**Revision Date:**	18/09/2014

Activities:	1) Use of Imaging x-ray equipment 2) Viewing of diagnostic images on monitor 3) Assessment / updating of electronic patient records (EPRs) 4) Preparation of moulds / casts 5) Clinical handwashing			
Personnel:	1 x patient 2 x staff 2 x escorts			
Planning Relationships:	Adjacent to recovery room.			
Space Data:	**Area (m^2):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0903-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0903-01	Dental Surgery Standard
Room Number:	G-D5-008	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):		In line with SHTM 03-01
Pressure Relative to Adjoining Space:	0	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air via Reheat Battery with local BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		
Local Illumination (Lux):		Range from 10000 to 100000 @ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	Not applicable

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0903-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0903-01	Dental Surgery Standard
Room Number:	G-D5-008	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	C0903-01

Project: 11072 RHSC & DCN
Department:
Room: C0903-01 Surgery (standard)
Room Number: G-D5-008 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	AMA900	AMALGAMATOR; dental.		3
1		1	CAB952	CABINETS/WORKTOPS, Dental: Specialist cabinetry as per design layout. Includes WHB, sink, tray system, etc.		5
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
1		1	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CHA031	CHAIR; child; upright; stacking; seat height 380mm		3
1		1	CHA040	CHAIR; dental; with multi-services; fully adjustable; electrically operated; floor mounted		5
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM031	COMPUTER: standard with keyboard and screen.		3
1		1	COM2503	COMPUTER MONITOR, PACS REVIEW STATION; 2 21", high-resolution screens,		3
1		1	DEN010	DENTAL UNIT; with multi-services terminal		5
2		2	DIS013	DISPENSER, paper towel, wall mounted		2
2		2	DIS031	DISPENSER; soap; pump action with 500ml container; sink or worktop mounted		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DIS910	DISPENSER; gloves x 5 sets.		2
2		2	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
1		1	EXT001	EXTRACTION SYSTEM, to remove spilled anaesthetic gasses.		1
1		1	HAN902	DENTAL HANDPIECES/INSTRUMENTS, reprocessed		4
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO024	HOOK; hat and coat; 1.		1
1		1	LIG071	ILLUMINATED SIGN RADIATION ON, wall mounted		1
1		1	LIG905	LIGHT, curing LED rechargable		4
1		1	MIR901	MIRROR, hand		4
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
10		10	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT059	CONNECTION UNIT switched 13amp, indicator light		1
6		6	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT2502	LOOP; induction.		1
4		4	OUT315	OUTLET, drinking water for equipment		1
4		4	OUT341	OUTLET, drainage, anti-syphon		1
1		1	OUT406	OUTLET dental compressed air 5.5kPA; wall mounted.		1
1		1	OUT453	OUTLET, 4kPa compressed air, medical		1
1		1	OUT461	OUTLET, nitrous oxide, medical		1
2		2	OUT470	OUTLET, oxygen, medical		1
1		1	OUT475	OUTLET, vacuum, medical		1
1		1	OUT480	OUTLET, gas scavenging (AGS), medical		1
1		1	PLA900	PHOSPHOR PLATES, for CR reader		4
1		1	RAC440	RACK; leaflet; wall mounted; 915H 250W 105D.		1
1		1	RAN901	RA MACHINE; c/w patient circuit.		3
1		1	SCA081	SCALE column; weighing person; electronic; and telescopic column for height measure		3

ADB	Schedule of Components by Room	C0903-01

Project: 11072 RHSC & DCN
Department:
Room: C0903-01 Surgery (standard)
Room Number: G-D5-008 **Revision Date:** 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
2		2	STO024	STOOL, dental, with back support, mobile		3
1		1	SWC025	SWITCH, light		1
1		1	TAB2500	TABLE; trapezoidal; Childs;600H 1200W 600D		3
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TRO133	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 750W 450D		3
1		1	TRO136	TROLLEY; dressing; MAYO; 900H 1050W 600D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	XRA902	X-RAY; unit; intra oral wall mounted.		5

ADB	Room Data Sheet	J0132-03

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	J0132-03	Multi Functional Activity Zone		
Room Number:	G-E1-001		**Revision Date:**	18/09/2014

Activities:	1) Patients, relatives and escorts wait to be seen 2) Displaying information 3) Displaying notices 4) Holding / storing toys, books and games			
Personnel:	40 x patients 80 x escorts			
Planning Relationships:	Close to, with clear view of, entrance and waiting area.			
Space Data:	**Area (m²):**		**Height (mm):**	
	Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To uit urrounding area/de ign			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	J0132-03

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	J0132-03	Multi Functional Activity Zone
Room Number:	G-E1-001	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - Minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		55:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	J0132-03

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	J0132-03	Multi Functional Activity Zone
Room Number:	G-E1-001	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	N/A, open to circulation.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	J0132-03

Project: 11072 RHSC & DCN
Department: E1 Pod
Room: J0132-03 Multi-Functional Activity Zone
Room Number: G-E1-001
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	OUT009	SOCKET outlet switched 13 amp twin; floor mounted.		1
1		1	TOY002	Range of soft play equipment		3
1		1	TOY003	Range of technology based activity equipment		2

ADB	Room Data Sheet	J0132-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	J0132-01	Reception: 2 person		
Room Number:	G-E1-002		**Revision Date:**	18/09/2014

Activities:	1) Reception and registration of patients 2) Maintenance of appointments and attendance register 3) Use of computer workstation(s) 4) Dealing with enquiries 5) Use of Telephone 6) Control of access 7) Displaying of notices, information and/or messages
Personnel:	4 x patient 2 x staff 8 x escorts
Planning Relationships:	Close to, with clear view of, entrance and waiting area. Close to self-registration point when provided. Close to clinical or work area(s). Easy access to records store when paper records are still used. Access to a "safe haven" area.
Space Data:	**Area (m^2):** | **Height (mm):** Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To suit surrounding area/design.

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	J0132-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	J0132-01	Reception: 2 person		
Room Number:	G-E1-002		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - Minimum
Humidity (%RH):		
General Notes:	Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air	

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting
General Notes:	Control: Switch	

NOISE		
Privacy Factor Required (dB):		Not Applicable
Mechanical Services (NR):	35	
Intrusive Noise (NR Leq):		
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		
General Notes:	Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)	

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		
General Notes:		

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	J0132-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	J0132-01	Reception: 2 person
Room Number:	G-E1-002	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	N/A, open to circulation.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	J0132-01

Project: 11072 RHSC & DCN
Department: E1 Pod
Room: J0132-01 Reception (2 person)
Room Number: G-E1-002
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BIN2504	BIN; confidential waste		3
2		2	CAB056	CABINET; stationery; metal; 10 drawer with lock; 600H 280W 410D		3
1		1	CAS020	FIRST AID BOX		2
2		2	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COP008	COPIER; photocopier; collator; floor standing; 800H 1500W 650D		3
1		1	COU1001	COUNTER; reception; DDA compliant; with below counter storage; as per detailed design.		1
2		2	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
5		5	OUT010	SOCKET outlet, switched, 13amp, twin		1
5		5	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT2502	LOOP; induction.		1
1		1	PRI900	Printer; high spec		3
2		2	STF233	STORAGE UNIT; tall; cupboard; 2 door; adjustable shelves; lockable; 1600H 600W 600D		1
1		1	SWC025	SWITCH, light		1
2		2	TEL1000	TELEPHONE; handset.		3

ADB	Room Data Sheet	J0132-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	J0132-02	Sub Wait With Nurse Base		
Room Number:	G-E1-003		**Revision Date:**	18/09/2014

Activities:	1) Reception and registration of patients 2) Maintenance of appointments and attendance register 3) Use of computer workstation(s) 4) Dealing with enquiries 5) Use of Telephone 6) Control of access 7) Displaying of notices, information and/or messages 8) Patients, relatives and escorts wait to be seen			
Personnel:	8 x patients 16 x escorts			
Planning Relationships:	Close to, with clear view of, entrance and waiting area. Close to clinical or work area(s).			
Space Data:	**Area (m²):**		**Height (mm):**	
	Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To suit surrounding area/design.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	J0132-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	J0132-02	Sub Wait With Nurse Base		
Room Number:	G-E1-003		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	5.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	5.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - Minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	J0132-02

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	J0132-02	Sub Wait With Nurse Base		
Room Number:	G-E1-003		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	N/A, open to circulation.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	J0132-02

Project: 11072 RHSC & DCN
Department: E1 Pod
Room: J0132-02 Sub Waiting Area(incl sup play)
Room Number: G-E1-003 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
2		2	BIN900	BIN; Recycle waste		3
2		2	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BOA037	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 900H 1200W.		1
1		1	BOA2501	BOARD; combined magnetic display/whiteboard; dry-wipe; with pen holder; wall mounted; 900H 600W		1
1		1	CAM031	CAMERA; CCTV; pan/tilt/zoom.		1
2		2	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
10		10	CHA007	CHAIR; easy; with open arms; high back; upholstered, wipeable		3
10		10	CHA031	CHAIR; child; upright; stacking; seat height 380mm		3
5		5	CHA069	UNIT CHAIR with links; 3 seater; with arms; upholstered		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU1000	COUNTER; staff/nurse base; as per detailed design.		1
1		1	DIS2505	DISPENSER; WATER COOLER, mains supply.		1
1		1	DRA056	DRAWER UNIT, 2 drawer, lockable, on castors, 600H 410W 600D		3
1		1	MON910	MONITOR; Solus screen		2
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
2		2	OUT009	SOCKET outlet switched 13 amp twin; floor mounted.		1
8		8	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT315	OUTLET, drinking water for equipment		1
1		1	OUT901	SOCKET; outlet solus screen.		1
1		1	RAC440	RACK; leaflet; wall mounted; 915H 250W 105D.		1
4		4	TAB056	TABLE; occasional; round; 415H 610mm dia.		3
1		1	TAB057	TABLE; trapezoidal; 710H 1200W 600D		3
1		1	TEL1000	TELEPHONE; handset.		3

ADB	Room Data Sheet	J1255

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	J1255	Main Waiting: RHSC		
Room Number:	G-E1-011		**Revision Date:**	18/09/2014

Activities:	1) Patients, relatives and escorts wait to be seen 2) Displaying information			
Personnel:	3 x patients 5 x escorts			
Planning Relationships:	Adjacent to reception area. Close to clinical or work area. Close to WC facilities.			
Space Data:	**Area (m²):**		**Height (mm):**	
	Refer to HLM-SZ-SL-SH-200-001 for room areas. Ceiling height: To suit surrounding area/design.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	J1255

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	J1255	Main Waiting: RHSC
Room Number:	G-E1-011	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	5.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	5.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	J1255

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	J1255	Main Waiting: RHSC
Room Number:	G-E1-011	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	N/A, open to circulation.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	J1255

Project: 11072 RHSC & DCN
Department: E1 Pod
Room: J1255 Main Waiting Area
Room Number: G-E1-011
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BOA2501	BOARD; combined magnetic display/whiteboard; dry-wipe; with pen holder; wall mounted; 900H 600W		1
1		1	CAM031	CAMERA; CCTV; pan/tilt/zoom.		1
6		6	CHA067	UNIT CHAIR; 1 seater; with arms; upholstered		3
2		2	CHA068	UNIT CHAIR with links; 2 seater; with arms; upholstered		3
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	DIS2505	DISPENSER; WATER COOLER, mains supply.		1
1		1	MON910	MONITOR; Solus screen		2
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	OUT009	SOCKET outlet switched 13 amp twin; floor mounted.		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT315	OUTLET, drinking water for equipment		1
1		1	OUT901	SOCKET; outlet solus screen.		1
1		1	TAB056	TABLE; occasional; round; 415H 610mm dia.		3

ADB	Room Data Sheet	H1107

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	H1107	Group room		
Room Number:	G-F1-020		**Revision Date:**	18/09/2014

Activities:	1) Relaxation activities 2) Assessment and planning of treatment and/or operation may take place 3) Use of Multimedia equipment 4) Use of laptop computer(s)			
Personnel:	12 patients 2 x staff			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	H1107

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	H1107	Group room		
Room Number:	G-F1-020		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):		10 litres a second per person
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Ceiling Cassette - Chilled water

LIGHTING		
Service Illumination (Lux):	300	@ Desk 750 - 850 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise:
Intrusive Noise (NR Leq):		SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	H1107

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	H1107	Group room
Room Number:	G-F1-020	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control, privacy control. Blindsmay be required to darken room.
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	H1107

Project: 11072 RHSC & DCN
Department: F1 Child & Adolescent Mental Health Services - 12 Beds
Room: H1107 Group Room
Room Number: G-F1-020 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
4		4	BOA017	BOARD; display/notice; magnetic; wall mounted; 1200H 1200W.		1
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CAM031	CAMERA; CCTV; pan/tilt/zoom.		1
6		6	CHA017	CHAIR; upright; upholstered; stacking		3
7		7	CHA031	CHAIR; child; upright; stacking; seat height 380mm		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT052	CONNECTION UNIT, switched, 13 amp		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	PRO026	PROJECTOR; multi-media; ceiling mounted		2
1		1	SCR043	SCREEN; projection; ceiling mounted; 1800H 1800W.		1
1		1	STF231	STORAGE UNIT; tall; cupboard; 2 door; adjustable shelves; lockable; 1600H 600W 300D		1
1		1	SWC025	SWITCH, light		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TRA108	TRACK; curtain; one sided; 3300mm length.		1
1		1	TVM2500	TV / monitor flat screen with DVD player		3

ADB	Room Data Sheet	X0613

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0613	Therapy room		
Room Number:	G-F1-034		**Revision Date:**	18/09/2014

Activities:	1) Clinical handwashing 2) Administration and clerical duties 3) Provision of information to patients, carers and visitors 4) Patient records reviewed and recorded 5) Computer information accessed 6) Rehabilitation exercises			
Personnel:	4 x patients 2 x staff			
Planning Relationships:	Near to individual treatment room area. (Are these included in HBN 11 SoA) Direct access/close to equipment store. Close to any associated changing/shower provision.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0613

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0613	Therapy room
Room Number:	G-F1-034	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	3.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0613

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	X0613	Therapy room
Room Number:	G-F1-034	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, high level.
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0613

Project: 11072 RHSC & DCN
Department: F1 Child & Adolescent Mental Health Services - 12 Beds
Room: X0613 Therapy / Play Therapy Room
Room Number: G-F1-034 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BOA017	BOARD; display/notice; magnetic; wall mounted; 1200H 1200W.		1
2		2	CHA005	CHAIR; easy; low back; upholstered		3
4		4	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM2506	Laptop		3
1		1	CUP1000	CUPBOARD; opens up for display		3
1		1	DIS007	DISPENSER, paper towel roll, wall mounted		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	SIN093	SINK; Belfast style; stainless steel; 38mm waste; combined outlet and overflow; 205H 455W 380D		1
1		1	SWC025	SWITCH, light		1
1		1	TAB2502	TABLE; 1200W 600D adjustable height		3
1		1	TAP289	TAP, monobloc, pillar mixer, integral thermostatic, short lever		1
1		1	TAP809	TAP, bib, lever, hospital pattern, pair hot and cold, 1/2 in.		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TRA061	TRAY sand for children's games; 180H 810W 570D on stand 600mm height		3
1		1	TRO906	TROLLEY; 6 coloured plastic drawers, mobile.		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
1		1	WAS107	TRAP, bottle, 1.1/4 in, plastic resealing		1
1		1	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1

ADB	Room Data Sheet	D0608-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	D0608-02	Dining / Recreation (Day Prog)		
Room Number:	G-F1-036		**Revision Date:**	18/09/2014

Activities:	1) Reading 2) Serving and eating of meals			
Personnel:	24 x patients 4 x staff 2 x visitors			
Planning Relationships:	External view/outlook.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	D0608-02

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	D0608-02	Dining / Recreation (Day Prog)
Room Number:	G-F1-036	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	6.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ Floor
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	D0608-02

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	D0608-02	Dining / Recreation (Day Prog)
Room Number:	G-F1-036	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	D0608-02

Project: 11072 RHSC & DCN
Department: F1 Child & Adolescent Mental Health Services - 12 Beds
Room: D0608-02 Dining Room (Inpatients & Day Prog)
Room Number: G-F1-036 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BIN900	BIN; Recycle waste		3
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
26		26	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	CUP031	CUPBOARD; 1 shelf; on plinth; 800H 1200W 500D.		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	STF136	STORAGE UNIT; lower; cupboard; 2 door; 1 shelf; lockable; 550H 1000W 450D		1
1		1	SWC025	SWITCH, light		1
1		1	TAB011	TABLE; 725H 1220W 750D		3
5		5	TAB107	TABLE, canteen/kitchen, 710H 900W 750D		3
1		1	TAP1002	TAP; bib; anti-ligature; HTM64 compliant.		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
2		2	TRO064	TROLLEY; clearing; 1050H 1200W 600D		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003L	WORKTOP; 720 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	Q0121

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	Q0121	Therapeutic kitchen		
Room Number:	G-F1-037		**Revision Date:**	18/09/2014

Activities:	1) Serving and eating of meals 2) Secure Storage of food 3) Storage of dry goods 4) Storage of refrigerated provisions 5) Storage of trays, crockery and cutlery 6) Hand-rinsing 7) Assessment and training in mobility, self-care and social skills. 8) Preparation of beverages, meals and snacks			
Personnel:	6 x patients 2 x staff			
Planning Relationships:	Adjacent to occupational therapy area/rooms.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	Q0121

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	Q0121	Therapeutic kitchen
Room Number:	G-F1-037	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central General Extract
Mechanical Ventilation (Extract ac/hr):	6.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Adjacent Space Transfer Air. Cooling: Ceiling Cassette - Chilled Water

LIGHTING		
Service Illumination (Lux):	500	@ general working plane 1000 AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	40	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		50:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY	
Hot Surface Max. Temp (DegC):	43
Hot Water Max. Temp (DegC):	41

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	Q0121

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	Q0121	Therapeutic kitchen
Room Number:	G-F1-037	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	Q0121

Project: 11072 RHSC & DCN
Department: F1 Child & Adolescent Mental Health Services - 12 Beds
Room: Q0121 Therapeutic Kitchen
Room Number: G-F1-037 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
4		4	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CHA2503	CHAIR; high; infant feeding		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COO004	COOKER; gas; oven; four burner; domestic		2
1		1	COO006	COOKER CONTROL UNIT; 30amp; wall mounted.		1
1		1	COO2500	COOKER; electric; four burner; domestic, variable height		2
3		3	CUP021	CUPBOARD; 1 shelf; lockable; on plinth; 750H 600W 500D.		1
1		1	CUP048	CUPBOARD; 2 shelves; 1 pull out shelf; lockable; on plinth; 800H 600W 500D.		1
2		2	CUP2515	CUPBOARD; base unit; 4 drawer; lockable; 600mm.		1
2		2	CUP263	CUPBOARD; 2 shelves; lockable; wall mounted; 600H 1200W 300D.		1
1		1	DIS007	DISPENSER, paper towel roll, wall mounted		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	KET001	Kettle, electric		3
2		2	OUT005	SOCKET outlet, switched, 13amp, single		1
5		5	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT052	CONNECTION UNIT, switched, 13 amp		1
1		1	OUT059	CONNECTION UNIT switched 13amp, indicator light		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT435	OUTLET; natural gas connection for equipment.		1
1		1	OVE013	OVEN, microwave, heavy duty, 1600watt, capacity 26 litre, 370H 465W 560D		3
1		1	REF920	REFRIGERATOR, with freezer, capacity 117 litres, domestic type, 865H 500W 550D		3
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	SNS1003R	SINKTOP; inset; single bowl and drainer; stainless steel; right hand drainer.		1
1		1	SWC025	SWITCH, light		1
1		1	TAP1002	TAP; bib; anti-ligature; HTM64 compliant.		1
2		2	TAP809	TAP, bib, lever, hospital pattern, pair hot and cold, 1/2 in.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL2500	TELEPHONE; handset, wall mounted.		2
1		1	TOA2501	TOASTER; automatic; electric; 4 slices		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
3		3	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
2		2	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1

ADB	Schedule of Components by Room	Q0121

Project: 11072 RHSC & DCN
Department: F1 Child & Adolescent Mental Health Services - 12 Beds
Room: Q0121 Therapeutic Kitchen
Room Number: G-F1-037 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	WAS2500	DISHWASHER; under bench; high temperature; 2 drawer		2
6		6	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1011	WORKTOP; dished; stainless steel; with central double bowl and double drainer; cantilevered from wall; 1800W 650D; HTM63.		1
2		2	WKT160	WORKTOP variable height; motorised system; consists of: control unit; electric motor; transformer; steering unit; 673/1023H 2000W 600D.		1

ADB	Room Data Sheet	B0510-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	B0510-01	Single-bed room (CAMHS)		
Room Number:	G-F1-073		**Revision Date:**	18/09/2014

Activities:	1) Dressing / undressing in privacy 2) Rest and relaxation 3) Use of entertainment services system 4) Patient may receive visitors 5) Storage of clothing and personal belongings			
Personnel:	1 x patient. 2 x staff			
Planning Relationships:	En-suite sanitary facilities.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	B0510-01

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room	B0510-01	Single-bed room (CAMHS)
Room Number:	G-F1-073	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18-25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Natural & Central Supply Air
Mechanical Ventilation (Extract ac/hr):		via ensuite
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	100	
Service Illumination Night (Lux):	5.0	
Local Illumination (Lux):	300.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control witch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	30	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime / 35:nightime (LAeq,1hr) and 45 nightime (LAmax,f).
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	B0510-01

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	B0510-01	Single-bed room (CAMHS)
Room Number:	G-F1-073	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	B0510-01

Project: 11072 RHSC & DCN
Department: F1 Child & Adolescent Mental Health Services - 12 Beds
Room: B0510-01 Single Bedroom 4 (CAMHS)
Room Number: G-F1-073 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BED004	BED, divan style, fixed height, with legs, on lockable castors, 1950L 900W		3
1		1	BED1000	BEDSIDE UNIT; 1 drawer, 1 cupboard with 1 shelf; 540H 450W 450D		3
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	CAL047	PUSH BUTTON staff emergency call; reset and integral/adjacent indicator lamp; trunking mounted.		1
1		1	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	HOL1000	HOLDER; bin; plastic lined; freestanding.		3
1		1	LIG903	LUMINAIRE; reading; adjustable arm; 100 watt		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
2		2	SWC025	SWITCH, light		1
1		1	TAB003	TABLE, 710H 600W 450D		3
1		1	TVM001	TELEVISION monitor, colour, flat panel, small, wall mounted		2
1		1	WAR2500	WARDROBE; fitted; anti-ligature; with sliding doors; size as drawn.		1

ADB	Room Data Sheet	V1610

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	V1610	Shower room: en-suite: anti ligature		
Room Number:	G-F1-074		**Revision Date:**	18/09/2014

Activities:	1) Use of shower (with assistance if required) 2) Use of toilet (with assistance if required) 3) Dressing / undressing in privacy 4) Hanging clothes and towels 5) Use of shower chair 6) Use of call systems			
Personnel:	1 x patient 2 x staff Intermittent use			
Planning Relationships:	En-suite to single-bed room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,400
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	V1610

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	V1610	Shower room: en-suite: anti ligature
Room Number:	G-F1-074	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 20 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):		Ventila ion Type: Central Dirty Extract
Mechanical Ventilation (Extract ac/hr):	10.0	
Pressure Relative to Adjoining Space:	Negative	
Filtration (%DSE and % Arrestance):	/	None
Humidity (%RH):		

General Notes: Heating: Adjacent Space Transfer Air. Cooling: None

LIGHTING		
Service Illumination (Lux):	200	@ Floor
Service Illumination Night (Lux):		Not applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Presence Detection

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	45	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		45:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	N	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	V1610

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	V1610	Shower room: en-suite: anti ligature
Room Number:	G-F1-074	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	N/A
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	V1610

Project: 11072 RHSC & DCN
Department: F1 Child & Adolescent Mental Health Services - 12 Beds
Room: V1610 En-suite wheelchair-accessible WC, Shower & wash Bedroom 4
Room Number: G-F1-074 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BIN2501	BIN; sanitary disposal		3
1		1	CAL043	PUSH BUTTON patient/staff call with socket for extension pear push; trunking mounted.		1
1		1	CIS005	CISTERN, concealed, low level, reversible, 7.5 litres, 300H 500W 150D		1
1		1	CLE924	Toilet Brush and Holder		3
1		1	DIS015	DISPENSER, toilet paper, dispense individual sheets, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	HOL1000	HOLDER; bin; plastic lined; freestanding.		3
1		1	LIG063	LUMINAIRE, single fluorescent lamp, wall, 8 watt, 300 mm		1
1		1	MIR023	MIRROR; unbreakable; wall mounted; 650H 300W		1
1		1	OUT025	SOCKET outlet, shaver		1
1		1	RAI2504	RAIL; towel; anti-ligature; single stainless steel; 15mm dia. 450mm.		1
1		1	RAI266	RAIL for shower curtain; 1800mm.		1
1		1	SHO002	SHOWER; slip resistant floor with drainage outlet; 900W 900D		1
1		1	SHO1000	SHOWER; anti-ligature; sensor operated with time regulated water flow.		1
1		1	TAP1002	TAP; bib; anti-ligature; HTM64 compliant.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS107	TRAP, bottle, 1.1/4 in, plastic resealing		1
1		1	WCH1000	WC/toilet pan with seat, 700 mm projection, hospital pattern, rimless pan, vitreous china.		1

ADB	Room Data Sheet	C0217

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0217	Consult/exam: multidisciplinary - DCN		
Room Number:	G-M1-012		**Revision Date:**	18/09/2014

Activities:	1) Consultations. 2) Minimally invasive clinical procedures undertaken from one or both sides of the couch. 3) Storage of sterile supplies and consumables on a trolley 4) Assessment / updating of electronic patient records (EPRs) 5) Clinical handwashing 6) Patient may undress/dress in privacy			
Personnel:	1 x patient 6 x staff 1 x escort			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm)**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0217

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0217	Consult/exam: multidisciplinary - DCN
Room Number:	G-M1-012	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	3.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0217

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0217	Consult/exam: multidisciplinary - DCN
Room Number:	G-M1-012	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	C0217

Project: 11072 RHSC & DCN
Department: M1 DCN Outpatients
Room: C0217 Consult/Multi-Disciplinary
Room Number: G-M1-012 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BIN2503	BIN; sharps disposal		3
1		1	BOA037	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 900H 1200W.		1
1		1	BRA004	BRACKET; holder; suction unit; trunking/rail mounted		2
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
10		10	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM035	COMPUTER PRINTER; line; small		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	DIA2500	DIAGNOSTIC SET; auroscope/opthalmoscope; wall mounted.		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
2		2	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO022	HOOK; double; wall mounted.		1
1		1	LIG015	LUMINAIRE observation/examination; mobile; 1000 lux		3
1		1	LIG046	SLIT LAMP; with accessories and height adjustable stand		3
1		1	MSC197	CABINET top; 600mm facing; with 1 shelf; 1 door hinged right; wall mounted.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT052	CONNECTION UNIT, switched, 13 amp		1
3		3	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PRI015	PRINTER; label; portable		3
1		1	RAI130	RAIL, clinical equipment, wall mounted, 600mm		1
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	SIG2501	Sign; door slot Drs name		1
1		1	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1

ADB	Schedule of Components by Room	C0217

Project: 11072 RHSC & DCN
Department: M1 DCN Outpatients
Room: C0217 Consult/Multi-Disciplinary
Room Number: G-M1-012 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	TRO135	TROLLEY; Gratnell; dressing/instrument; 6 clear trays, stainless steel; buffered; 890H 510W 480D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	VIE900	PEEPHOLE		1
1		1	VIE901	Visual Acuity Measuring Eqt; optotype chart; wall mounted		2
1		1	VIE902	Visual Field Analyser; 680Hx760Wx500D		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	X0105

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0105	Treatment room		
Room Number:	G-M1-014		**Revision Date:**	18/09/2014

Activities:	1) Invasive clinical procedures from side of couch 2) Dressing / undressing in privacy 3) Clinical handwashing 4) Assessment / updating of electronic patient records (EPRs) 5) Storage of sterile supplies and consumables on a trolley 6) Use of mobile diagnostic and therapeutic equipment 7) Sterile packs, lotions and drugs prepared for immediate use			
Personnel:	1 x patient 1 x staff			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m²):**		**Height (mm)**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	X0105

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0105	Treatment room		
Room Number:	G-M1-014		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central Supply Air
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		
General Notes:	Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air	

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting
General Notes:	Control: Switch	

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		
General Notes:	Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)	

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	
General Notes:	Maximum cold water discharge temperature (degC): 20	

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	X0105

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	X0105	Treatment room		
Room Number:	G-M1-014		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A or Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	X0105

Project: 11072 RHSC & DCN
Department: M1 DCN Outpatients
Room: X0105 Treatment Room
Room Number: G-M1-014 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BIN2503	BIN; sharps disposal		3
1		1	BRA004	BRACKET; holder; suction unit; trunking/rail mounted		2
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	DIA2500	DIAGNOSTIC SET; auroscope/opthalmoscope; wall mounted.		2
1		1	DIS011	DISPENSER, barrier cream, disposable single cartridge, wall mounted		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	HOI006	HOIST PATIENT; electric; 24V; track ceiling mounted (Length of the track to suit the individual needs).		1
3		3	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO022	HOOK; double; wall mounted.		1
1		1	HOO024	HOOK; hat and coat; 1.		1
1		1	HOO024	HOOK; hat and coat; 1.		1
1		1	LIG963	LUMINAIRE; examination; ceiling; adjustable.		1
1		1	MIR010	MIRROR; wall mounted; 800H 300W.		1
1		1	MON900	MONITOR; Low end monitor, general Ward /OPD use		3
2		2	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
2		2	MSC082	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
2		2	MSC083	CABINET base; 600mm facing; (600x400 inserts); with 6 telescopic runners; 1 door hinged right; on plinth; o/a height 900.		1
2		2	MSC127	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; wall mounted.		1
1		1	MSC128	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; wall mounted.		1
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
3		3	OUT010	SOCKET outlet, switched, 13amp, twin		1
5		5	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
3		3	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1

ADB	Schedule of Components by Room	X0105

Project: 11072 RHSC & DCN
Department: M1 DCN Outpatients
Room: X0105 Treatment Room
Room Number: G-M1-014 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PEG2500	HOOK; Pat Slide.		1
1		1	PRI015	PRINTER; label; portable		3
1		1	RAI130	RAIL, clinical equipment, wall mounted, 600mm		1
1		1	RAI132	RAIL, clinical equipment, wall mounted, 1200mm		1
1		1	RSU012	DEFIBRILLATOR; Automated External		3
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	SLI2500	PATSLIDE		3
1		1	SUC004	SUCTION UNIT; electric; portable; 350H 320W 340D		3
1		1	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRO133	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 750W 450D		3
1		1	TRO135	TROLLEY; Gratnell; dressing/instrument; 6 clear trays, stainless steel; buffered; 890H 510W 480D		3
1		1	TRO310	TROLLEY, emergency/resuscitation, complete with defibrillator, 955H 825W 575D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	VIE900	PEEPHOLE		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
2		2	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	C0224

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0224	Consulting/examination: DCN		
Room Number:	G-M1-018		**Revision Date:**	18/09/2014

Activities:	1) Consultations. 2) Minimally invasive clinical procedures undertaken from one or both sides of the couch. 3) Storage of sterile supplies and consumables on a trolley 4) Assessment / updating of electronic patient records (EPRs) 5) Clinical handwashing 6) Patient may undress/dress in privacy			
Personnel:	1 x patient 2 x staff 2 x escorts			
Planning Relationships:				
Space Data:	**Area (m²):**		**Height (mm)**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	C0224

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	C0224	Consulting/examination: DCN		
Room Number:	G-M1-018		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	3.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	C0224

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	C0224	Consulting/examination: DCN
Room Number:	G-M1-018	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	Clear, solar control (East, South, West facing), privacy control
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	C0224

Project: 11072 RHSC & DCN
Department: M1 DCN Outpatients
Room: C0224 Consult/Examination
Room Number: G-M1-018 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BED2502	BED HEAD BUFFER; bed and wall protection; vertical; wall mounted.		1
1		1	BIN2503	BIN; sharps disposal		3
1		1	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM035	COMPUTER PRINTER; line; small		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	DIA2500	DIAGNOSTIC SET; auroscope/opthalmoscope; wall mounted.		2
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO022	HOOK; double; wall mounted.		1
1		1	LIG963	LUMINAIRE; examination; ceiling; adjustable.		1
1		1	MIR010	MIRROR; wall mounted; 800H 300W.		1
1		1	MSC197	CABINET top; 600mm facing; with 1 shelf; 1 door hinged right; wall mounted.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
1		1	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	PRI015	PRINTER; label; portable		3
1		1	RAI130	RAIL, clinical equipment, wall mounted, 600mm		1
1		1	SIG2500	SIGN; vacant/engaged; wall mounted.		1
1		1	SIG2501	Sign; door slot Drs name		1
1		1	SPH003	SPHYGMOMANOMETER; rail mounted		3
2		2	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRO135	TROLLEY; Gratnell; dressing/instrument; 6 clear trays, stainless steel; buffered; 890H 510W 480D		3
2		2	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1

ADB	Schedule of Components by Room	C0224

Project: 11072 RHSC & DCN
Department: M1 DCN Outpatients
Room: C0224 Consult/Examination
Room Number: G-M1-018
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	VIE900	PEEPHOLE		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003L	WORKTOP; 720 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	E0128

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0128	Imaging Room: General X-ray		
Room Number:	G-Q1-004		**Revision Date:**	18/09/2014

Activities:	1) Patient is positioned or repositioned for examination 2) Use of radiation protection equipment 3) Imaging x-ray examination of patient 4) Use of oxygen and vacuum services for resuscitation 5) Storage of Positioning aids e.g. wedges pillows and other immobilisation devices 6) Clinical handwashing			
Personnel:	1 x patient 1 x staff 1 x escort			
Planning Relationships:	Adjacent to viewing/reporting area. Direct access from changing cubicles - optional.			
Space Data:	**Area (m²):**		**Height (mm):**	3,100
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	E0128

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0128	Imaging Room: General X-ray		
Room Number:	G-Q1-004		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	8.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air - Reheat Battery with BMS Adjustable Sensor. Cooling: Comfort Cooled

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ General working plane 1000 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0128

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0128	Imaging Room: General X-ray		
Room Number:	G-Q1-004		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings Floor Recess required
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	E0128

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0128 General X-Ray Room 1
Room Number: G-Q1-004 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BIN2508	BIN; storage;toy box		3
1		1	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	CAB050	CABINET; x-ray cassette storage; mobile; 550H 700W 500D		3
3		3	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CHA902	CHAIR; Scoliosis		3
1		1	CHR900	IMAGING CHAIR; Chest Paediatric		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
4		4	LIG074	ILLUMINATED SIGN DO NOT ENTER		1
1		1	MSC091	CABINET base; 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	MSC092	CABINET base; 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
1		1	MSC096	CABINET base; 400mm facing; (400x600 inserts); with 3 telescopic runners; 1 door hinged left; on plinth; o/a height 900.		1
1		1	OUT002	OUTLET, cable 13amp		1
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
12		12	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT059	CONNECTION UNIT switched 13amp, indicator light		1
4		4	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT208	SOCKET outlet television aerial; single; ceiling mounted.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	PEG2500	HOOK; Pat Slide.		1
1		1	PLA002	PLATFORM; step-stand; stackable; portable; 130H 480W 330D		3
1		1	PRO026	PROJECTOR; multi-media; ceiling mounted		2

ADB	Schedule of Components by Room	E0128

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0128 General X-Ray Room 1
Room Number: G-Q1-004
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
2		2	RAC197	RACK; x-ray lead apron; 6 swivel arms; mobile		3
1		1	SCR061	SCREEN shielding; radiation proof; 2mm lead; solid/glass; 2000H 2100L; angle		5
3		3	SLI2500	PATSLIDE		3
1		1	STA2502	STAND; scoliosis cassettes		3
1		1	STF2500	STORAGE UNIT; tall; cupboard; 2 door; adjustable shelves; lockable; 1800H 600W 300D		2
3		3	SWC025	SWITCH, light		1
2		2	SWC062	EMERGENCY STOP switch button, wall mounted		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
2		2	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	XRA010	X-RAY CS; ceiling suspensions; with telescopic tube of column and rotating/tilting arm		5
1		1	XRA011	X-RAY CS CONTROL DESK UNIT; freestanding;		5
1		1	XRA012	X-RAY CS STAND for control unit;		5
1		1	XRA013	X-RAY CS GENERATOR CABINET;		5
2		2	XRA018	X-RAY CS RAIL; ceiling suspensions; 2455mm (3655 w/optional extension rail)		5
1		1	XRA021	X-RAY TABLE PATIENT; floating top; motorised variable height horizontal bucky; 800H 2180W 700D		5
1		1	XRA030	X-RAY CHEST stand; universal; includes Bucky mechanism		5

ADB	Room Data Sheet	E0115

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0115	Ultrasound Treatment Room		
Room Number:	G-Q1-010		**Revision Date:**	18/09/2014

Activities:	1) Assessment / updating of electronic patient records (EPRs) 2) Storage of sterile supplies and consumables on a trolley 3) Use of monitoring/diagnostic or therapeutic equipment 4) Use of computer workstation(s) 5) Patient is positioned or repositioned on examination/treatment couch or in a chair 6) Patient may have an ultrasound scan 7) Clinical hand washing			
Personnel:	1 x patient 2 x staff 2 x escorts			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	E0115

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0115	Ultrasound Treatment Room		
Room Number:	G-Q1-010		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	8.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air - Reheat Battery with BMS Adjustable Sensor. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ General working plane 1000 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0115

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0115	Ultrasound Treatment Room		
Room Number:	G-Q1-010		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0115

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0115 Ultrasound Room
Room Number: G-Q1-010 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BIN2504	BIN; confidential waste		3
1		1	BIN2508	BIN; storage;toy box		3
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
2		2	CHR903	CHAIR; Saddle Operator		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2503	COMPUTER MONITOR, PACS REVIEW STATION; 2 21", high-resolution screens,		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
2		2	CUP378	CUPBOARD/DRAWER UNIT; 1 drawer; 1 shelf; on castors; 660H 480W 390D		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO022	HOOK; double; wall mounted.		1
1		1	LIG005	LUMINAIRE, bedhead, dimmable, patient reading and general nursing care/examination		1
1		1	LIG910	Task lamp: Anglepoise type.		3
1		1	MSC128	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; wall mounted.		1
1		1	MSC2530	CABINET base; 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 780.		1
1		1	MSC2531	CABINET base; 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 780.		1
1		1	MSC2532	CABINET base; 400mm facing; (400x600 inserts); with 3 telescopic runners; 1 door hinged left; on plinth; o/a height 780.		1
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
7		7	OUT010	SOCKET outlet, switched, 13amp, twin		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
4		4	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1

ADB	Schedule of Components by Room	E0115

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0115 Ultrasound Room
Room Number: G-Q1-010
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	OUT215	SOCKET outlet, telephone		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT463	OUTLET; nitrous oxide; medical, trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	OUT481	OUTLET; gas scavenging (AGS); medical, trunking mounted.		1
1		1	PRO026	PROJECTOR; multi-media; ceiling mounted		2
1		1	SWC025	SWITCH, light		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRA141	TRACK; curtain; door; one sided; 1500mm doorset.		1
1		1	TRO131	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 450W 450D		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	ULT017	ULTRASOUND computed sonography; 128 channels; multi purpose; mobile; 1295H 635W 920D		3
1		1	WAR051	WARMER, ultrasound couplant gel, 200H 100W 150D		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	E0716

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0716	Imaging Room: Gamma Camera		
Room Number:	G-Q1-039		**Revision Date:**	18/09/2014

Activities:	1) Patient is positioned or repositioned for examination 2) Use of radiation protection equipment 3) Imaging x-ray examination of patient 4) Use of oxygen and vacuum services for resuscitation 5) Storage of small items of equipment 6) Storage of Positioning aids e.g. wedges pillows and other immobilisation devices 7) Clinical handwashing			
Personnel:	1 x patient 2 x staff 2 x escort			
Planning Relationships:	Adjacent to viewing/reporting area. Direct access from changing cubicles - optional.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

Radiation protection requirements are subject to RPA advice upon selection of equipment.

The "radiation in use" warning lamp should be installed at eye level outside the entrance(s) to the room.

ADB	Room Environmental Data	E0716

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0716	Imaging Room: Gamma Camera		
Room Number:	G-Q1-039		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	8.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air - Reheat Battery with BMS Adjustable Sensor. Cooling: Comfort Cooled

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ General working plane 1000 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0716

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0716	Imaging Room: Gamma Camera		
Room Number:	G-Q1-039		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings Floor Recess required
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Viewing panel from control room, radiation protection.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0716

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0716 Gamma Camera 1
Room Number: G-Q1-039
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ANA004	ANAESTHETIC MACHINE/WORKSTATION with ventilator, with accessories, mobile, 1580H 565W 695D		3
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BIN025	BIN, disposal, standard, pedal, epoxy coated steel, radioisotope symbol, 17 litres 6mm lead, 640H 240W 360D		3
1		1	BIN2508	BIN; storage;toy box		3
2		2	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
2		2	BRA015	BRACKET, flat panel monitor, height adjustable, wall mounted		2
1		1	CAM031	CAMERA; CCTV; pan/tilt/zoom.		1
2		2	CHA083	CHAIR, stacking, polypropylene, with back and seat pads		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	CUP2569	Generator Cabinet.		5
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
2		2	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
3		3	HOO024	HOOK; hat and coat; 1.		1
1		1	IMG072	IMAGER GAMMA CAMERA; digital; multi detector/PET; with monitor		5
1		1	IMG073	TABLE PATIENT - SPECT; gamma camera; variable height; 970/730H 2060W 720D; Part of gamma camera)		5
4		4	IMG076	IMAGER CART exchange collimator; gamma camera; 1270H 670W 910D; (Part of IMG070 and IMG072		5
1		1	IMG077	CONSOLE UNIT and COMPUTER for gamma camera/PET; 1180H 1040W 900D; (Included in IMG070; IMG071; IMG072 and IMG091)		5
2		2	LIG074	ILLUMINATED SIGN DO NOT ENTER		1
1		1	LIG1001	LUMINAIRE variable spotlight beam produce around 40000 lux @ 1m and 60000 lux @ 0.8m. flexible arm; wall/ceiling mounted.		1
1		1	MON011	MONITOR; electrocardiograph (ECG); 12-lead		3
1		1	MON904	MONITOR; High end multi-functionality for ITU/Theatre/High Acuity		3
1		1	MON919	MONITOR; Portable contamination detection		5
1		1	MON920	MONITOR; electrocardiograph (ECG); 3 lead		3
1		1	MSC091	CABINET base; 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	MSC092	CABINET base; 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1

ADB	Schedule of Components by Room	E0716

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0716 Gamma Camera 1
Room Number: G-Q1-039
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	MSC096	CABINET base; 400mm facing; (400x600 inserts); with 3 telescopic runners; 1 door hinged left; on plinth; o/a height 900.		1
1		1	MSC127	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; wall mounted.		1
1		1	MST001	TROLLEY; single open frame; with handle; up to 5 sets of runners; 600mm facing; approx 850H 730W 450D		3
1		1	MST005	TROLLEY; half size open frame; up to 5 sets of runners; 400mm facing; approx 850H 450W 350D		3
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
5		5	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT079	OUTLET isolator, equipment manufacturer's specification		1
5		5	OUT121	SOCKET outlet; computer data; double.		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT208	SOCKET outlet television aerial; single; ceiling mounted.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT463	OUTLET; nitrous oxide; medical, trunking mounted.		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
2		2	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	OUT481	OUTLET; gas scavenging (AGS); medical, trunking mounted.		1
1		1	PEG2500	HOOK; Pat Slide.		1
1		1	PRO026	PROJECTOR; multi-media; ceiling mounted		2
1		1	RAC194	RACK; x-ray lead apron; 3 hangers; wall mounted		2
1		1	SCR2501	SCREEN; Mobile		3
3		3	SLI2500	PATSLIDE		3
1		1	SWC025	SWITCH, light		1
1		1	SWC062	EMERGENCY STOP switch button, wall mounted		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	E0604-04

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-04	Control room: Gamma Camera		
Room Number:	G-Q1-042		**Revision Date:**	18/09/2014

Activities:	1) Use of computer workstation(s) 2) Viewing of X-ray films 3) Displaying notices 4) Maintenance and storage of EBME equipment records and reports 5) Viewing diagnostic images on VDT 6) Use of Imaging x-ray equipment			
Personnel:	2 x staff Access to visitors, researchers			
Planning Relationships:	Direct access to/from CT & MRI room. Access may be required to medical conference room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligatureStrategy for anti-ligature provision

ADB	Room Environmental Data	E0604-04

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-04	Control room: Gamma Camera		
Room Number:	G-Q1-042		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4- minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Conmfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ desk 750 - 850mm AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):		
Hot Water Max. Temp (DegC):		

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0604-04

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-04	Control room: Gamma Camera		
Room Number:	G-Q1-042		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to Gamma Camera Room to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Viewing panel to CT/MRI room, radiation protection.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0604-04

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0604-04 Gamma Camera Control Area
Room Number: G-Q1-042
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN2504	BIN; confidential waste		3
2		2	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
2		2	CAB066	CABINET; roller shutter; screen-hung/wall mounted; 430H 800W 430D.		1
6		6	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
2		2	COM033	COMPUTER KEYBOARD		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	IMG2500	Gamma camera control console		5
2		2	IMG2511	Single monitor processing station		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
11		11	OUT010	SOCKET outlet, switched, 13amp, twin		1
11		11	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	OUT215	SOCKET outlet, telephone		1
2		2	PAN2500	PANEL; syringe injector controller.		5
2		2	REC030	RECORDER/VIDEO; playback		3
7		7	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
2		2	SWC062	EMERGENCY STOP switch button, wall mounted		1
1		1	TEL1000	TELEPHONE; handset.		3
3		3	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WKT1003L	WORKTOP; 720 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
2		2	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	E0601

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0601	CT Room DCN		
Room Number:	G-Q1-059		**Revision Date:**	18/09/2014

Activities:	1) Patient may arrive on foot in a wheelchair or on a trolley 2) Patient undergoes examination with diagnostic x-rays to localise tumour and verify proposed treatment method. 3) Storage of Positioning aids e.g. wedges pillows and other immobilisation devices 4) Clinical hand washing 5) Use of computer workstation(s) 6) Contrast media, I.V. injections and other sterile procedures may be prepared 7) Use of radiation protection equipment 8) Radiation measurement will be used 9) Parking, storage of patients' trolley(s)			
Personnel:	1 x Patient 4 x Staff			
Planning Relationships:	Direct access to/from control room. Close to sub-waiting area. Adjacent to changing facilities (direct access optional).			
Space Data:	**Area (m²):**		**Height (mm):**	3,100
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

Radiation protection requirements are subject to RPA advice upon selection of equipment.

The "radiation in use" warning lamp should be installed at eye level outside the entrance(s) to the room.

ADB	Room Environmental Data	E0601

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0601	CT Room DCN		
Room Number:	G-Q1-059		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	8.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air - Reheat Battery with BMS Adjustable Sensor. Cooling: Comfort Cooled

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ General working plane 1000 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0601

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0601	CT Room DCN		
Room Number:	G-Q1-059		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Viewing panel from control room, radiation protection.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0601

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0601 CT Room
Room Number: G-Q1-059
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	BIN2509	BIN; sharps disposal; 7 litre; rail mounted		3
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	CAB034	CABINET warming, contrast media, stainless steel, wall mounted		2
1		1	CAM031	CAMERA; CCTV; pan/tilt/zoom.		1
1		1	CHA317	CHAIR, upright, upholstered, stacking, wipeable		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
3		3	CUP2510	CUPBOARD; base unit; LH door; ; 600mm.		1
1		1	CUP2569	Generator Cabinet.		5
2		2	CUP2998	CUPBOARD, base unit, 1 door, 1 shelf 600W 300D 880H		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS024	DISPENSER, soap, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
2		2	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
3		3	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO020	HOOK, single, large, wall mounted		1
1		1	IMG066	TABLE PATIENT - CT imager; floating top; (Part of IMG2502)		5
1		1	IMG2502	IMAGER; COMPUTER TOMOGRAPHY (CT) ; 128 slice unit		5
1		1	IMG901	SAM HALL TURNER		3
1		1	INS002	INSUFFLATOR; automatic delivery 30L/min; 145H X 300W X 320D		3
1		1	KIC001	KICKABOUT; bowl stand; stainless steel; 360mm dia.		3
2		2	LIG074	ILLUMINATED SIGN DO NOT ENTER		1
1		1	MON906	MONITOR; Clinical slave		2
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
4		4	OUT010	SOCKET outlet, switched, 13amp, twin		1
9		9	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
3		3	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT207	SOCKET outlet aerial television, closed circuit (CCTV), wall mounted		1
1		1	OUT453	OUTLET, 4kPa compressed air, medical		1
1		1	OUT461	OUTLET, nitrous oxide, medical		1
1		1	OUT470	OUTLET, oxygen, medical		1
2		2	OUT475	OUTLET, vacuum, medical		1
1		1	OUT480	OUTLET, gas scavenging (AGS), medical		1
1		1	PEG2500	HOOK; Pat Slide.		1
1		1	PEN2504	PENDANT; Anaesthetic; medical & power supply unit; vertical movement; ceiling mounted; outlets comprising: MRI compatible.		1
1		1	RAC197	RACK; x-ray lead apron; 6 swivel arms; mobile		3
2		2	SLI2500	PATSLIDE		3
2		2	STA142	STAND; infusion; twin hook; breaks; mobile		3
2		2	STF275	STORAGE UNIT; upper; cupboard; 2 door; 1 shelf; lockable; 550H 600W 300D		1

ADB	Schedule of Components by Room	E0601

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0601 CT Room
Room Number: G-Q1-059
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	SWC025	SWITCH, light		1
1		1	SWC062	EMERGENCY STOP switch button, wall mounted		1
1		1	SYR2502	SYRINGE INJECTOR; automatic; hi pressure injection; contrast media; ceiling mounted		5
1		1	TAP892	TAP, bib, 2x8 mm thermostatic mixer, automatic action, sensor operated, non-touch		1
1		1	TRO133	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 750W 450D		3
1		1	TRO401	TROLLEY; walking aid		3
1		1	TRO601	TROUGH scrub-up; hospital pattern; stainless steel; single; 75mm upstand; 800W 450D. HTM64SUH1.		1
1		1	TRO907	TROLLEY;Caretray.		3
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
1		1	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WRT003	WORKTOP, 1200W 400D		1

ADB	Room Data Sheet	E0604-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-02	Control room: CT DCN		
Room Number:	G-Q1-071		**Revision Date:**	18/09/2014

Activities:	1) Use of computer workstation(s) 2) Viewing of X-ray films 3) Displaying notices 4) Maintenance and storage of EBME equipment records and reports 5) Viewing diagnostic images on VDT 6) Use of Imaging x-ray equipment			
Personnel:	5 x staff Access to visitors, researchers			
Planning Relationships:	Direct access to/from CT room. Access may be required to medical conference room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	E0604-02

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-02	Control room: CT DCN		
Room Number:	G-Q1-071		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply & Extract
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - Minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ desk 750 - 850mm AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0604-02

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-02	Control room: CT DCN		
Room Number:	G-Q1-071		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to CT to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Viewing panel to CT room, lead glass screen.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0604-02

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0604-02 Control Room - CT
Room Number: G-Q1-071
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN2504	BIN; confidential waste		3
2		2	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
2		2	BOA2502	BOARD; display/notice; magnetic; wall mounted; 900H 1200W		1
1		1	BRA015	BRACKET, flat panel monitor, height adjustable, wall mounted		2
1		1	CAB056	CABINET; stationery; metal; 10 drawer with lock; 600H 280W 410D		3
4		4	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
1		1	COM039	COMPUTER, CPU, vertical, specific to radiation therapy software		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	COM910	MONITOR; double CT monitor		5
1		1	COM911	CONTROL CONSOLE; for CT Injector & hard drive		5
1		1	CUP332	CUPBOARD; key; 30 hooks; lockable; wall mounted; 305H 230W 70D.		1
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	IMG2512	CONTROL CONSOLE; for CT		5
1		1	LIG074	ILLUMINATED SIGN DO NOT ENTER		1
1		1	LOC019	LOCKER; 6 compartments; 1800H 300W 450D		3
1		1	MON2504	MONITOR and CONTROL for CCTV; complete with flat screen monitor; keyboard; digital recorder (computer) and power supply		5
1		1	MON2519	CT MULTI MODALITY WORKSTATION		5
1		1	MON921	MONITOR; chiller temperature display		5
1		1	OUT002	OUTLET, cable 13amp		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
11		11	OUT010	SOCKET outlet, switched, 13amp, twin		1
11		11	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
2		2	OUT215	SOCKET outlet, telephone		1
1		1	PRI015	PRINTER; label; portable		3
2		2	STF120	STORAGE UNIT; lower; cupboard; 1 door; 1 shelf; on castors; 600H 500W 450D		3
9		9	SUP2501	SUPPORT LEG; for 720 high worktop		1
2		2	SWC025	SWITCH, light		1
1		1	SWC062	EMERGENCY STOP switch button, wall mounted		1
2		2	TEL1000	TELEPHONE; handset.		3
4		4	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
4		4	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	E0113

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0113	Doppler Ultrasound		
Room Number:	G-Q1-081		**Revision Date:**	18/09/2014

Activities:	1) Assessment / updating of electronic patient records (EPRs) 2) Use of monitoring/diagnostic or therapeutic equipment 3) Use of computer workstation(s) 4) Patient is positioned or repositioned on examination/treatment couch or in a chair 5) Patient may have an ultrasound scan 6) Clinical hand washing 7) Hanging clothing			
Personnel:	1 x patient 2 x staff 1 x escort			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	E0113

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0113	Doppler Ultrasound		
Room Number:	G-Q1-081		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	8.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air - Reheat Battery with BMS Adjustable Sensor. Cooling: Comfort Cooled

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ General working plane 1000 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0113

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0113	Doppler Ultrasound		
Room Number:	G-Q1-081		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0113

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0113 Doppler Ultrasound
Room Number: G-Q1-081
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	BIN2504	BIN; confidential waste		3
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	BOA2502	BOARD; display/notice; magnetic; wall mounted; 900H 1200W		1
1		1	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CHR903	CHAIR; Saddle Operator		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
2		2	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2503	COMPUTER MONITOR, PACS REVIEW STATION; 2 21", high-resolution screens,		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	COU2506	COUCH; examination/treatment; (3 section); electric; variable height; retractable wheels; with paper roll holder.		3
1		1	CUP378	CUPBOARD/DRAWER UNIT; 1 drawer; 1 shelf; on castors; 660H 480W 390D		3
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
2		2	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	HOO022	HOOK; double; wall mounted.		1
3		3	LIG003	LUMINAIRE, reading, adjustable arm, 100 watt		1
1		1	LIG963	LUMINAIRE; examination; ceiling; adjustable.		1
1		1	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	MSC082	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
1		1	MSC127	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; wall mounted.		1
1		1	MSC128	CABINET top; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; wall mounted.		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
9		9	OUT010	SOCKET outlet, switched, 13amp, twin		1
7		7	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
2		2	STO023	STOOL; laboratory; complete with footring		3

ADB	Schedule of Components by Room	E0113

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0113 Doppler Ultrasound
Room Number: G-Q1-081
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
3		3	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
1		1	TRO907	TROLLEY;Caretray.		3
3		3	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	ULT901	SONOSITE MICROMAX		3
1		1	ULT902	SCAN MED MULTIDOP		3
1		1	ULT903	SIEMENS ANTARES		3
1		1	ULT904	TROLLEY: U/S machine (micromax & multidop) to sit on.		3
1		1	WAR051	WARMER, ultrasound couplant gel, 200H 100W 150D		3
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003L	WORKTOP; 720 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	E0715

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0715	Injection Room: DCN MRI		
Room Number:	G-Q1-108		**Revision Date:**	18/09/2014

Activities:	1) Assessment / updating of electronic patient records (EPRs) 2) Storage of sterile supplies and consumables on a trolley 3) Use of monitoring/diagnostic or therapeutic equipment 4) Use of computer workstation(s) 5) Patient is positioned or repositioned on examination/treatment couch or in a chair 6) Clinical hand washing 7) Contrast media, I.V. injections and other sterile procedures may be prepared			
Personnel:	1 x patient 2 x staff			
Planning Relationships:	Close to a clean utility room. Close to a dirty utility room.			
Space Data:	**Area (m^2):**		**Height (mm)**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	E0715

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	E0715	Injection Room: DCN MRI
Room Number:	G-Q1-108	**Revision Date:** 18/09/2014

AIR	**Requirements**	**Notes**
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	10.0	Ventila ion Type: Central SupplyAir
Mechanical Ventilation (Extract ac/hr):		
Pressure Relative to Adjoining Space:	Positive	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	500	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0715

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	E0715	Injection Room: DCN MRI
Room Number:	G-Q1-108	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings
Floor:	Refer to HLM 330 erie of drawing
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A

Notes:

ADB	Schedule of Components by Room	E0715

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0715 Injection Room
Room Number: G-Q1-108
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
2		2	CHA905	CHAIR; Venepuncture reclining		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
1		1	COM033	COMPUTER KEYBOARD		3
1		1	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
2		2	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOL020	HOLDER, sharps box, up to 7 litre capacity, rail/trolley hang or wall mounted, 170H 125W 100D		3
2		2	HOO024	HOOK; hat and coat; 1.		1
2		2	LIG055	LUMINAIRE variable spotlight beam produce around 40000 lux @ 1m and 60000 lux @ 0.8m. flexible arm; wall/ceiling mounted.		1
2		2	MST001	TROLLEY; single open frame; with handle; up to 5 sets of runners; 600mm facing; approx 850H 730W 450D		3
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
7		7	OUT010	SOCKET outlet, switched, 13amp, twin		1
2		2	OUT059	CONNECTION UNIT switched 13amp, indicator light		1
2		2	OUT131	SOCKET outlet double data/voice; wall/trunking mounted.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
2		2	OUT471	OUTLET; oxygen medical; trunking mounted.		1
2		2	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	SCA081	SCALE column; weighing person; electronic; and telescopic column for height measure		3
2		2	STF135	STORAGE UNIT; lower; cupboard; 2 door; 1 shelf; lockable; 750H 1000W 450D		1
2		2	STF281	STORAGE UNIT; upper; cupboard; 2 door; 1 shelf; lockable; 550H 1000W 300D		1
2		2	STO2502	INJECTION STOOL: MR compatible		3
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
1		1	TRA1003	TRACK; curtain; bed/trolley; length and shape as drawn.		1
2		2	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	E0604-03

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-03	Control room: MRI DCN		
Room Number:	G-Q1-111		**Revision Date:**	18/09/2014

Activities:	1) Use of computer workstation(s) 2) Viewing of X-ray films 3) Displaying notices 4) Maintenance and storage of EBME equipment records and reports 5) Viewing diagnostic images on VDT 6) Use of Imaging x-ray equipment			
Personnel:	7 x staff Access to visitors, researchers			
Planning Relationships:	Direct access to/from MRI room. Access may be required to medical conference room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	E0604-03

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	E0604-03	Control room: MRI DCN
Room Number:	G-Q1-111	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ desk 750 - 850mm AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0604-03

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-03	Control room: MRI DCN		
Room Number:	G-Q1-111		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to MRI to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Viewing panel to MRI room, radiation protection.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0604-03

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0604-03 Control Room - MRI
Room Number: G-Q1-111 **Revision Date:** 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN2504	BIN; confidential waste		3
2		2	BOA022	BOARD; display/notice; magnetic; wall mounted; 900H 600W.		1
1		1	BOA034	BOARD; marker; whiteboard; dry-wipe; with pen holder; wall mounted; 600H 900W.		1
1		1	BRA015	BRACKET, flat panel monitor, height adjustable, wall mounted		2
2		2	BUT2500	Quench button.		5
5		5	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
3		3	COM033	COMPUTER KEYBOARD		3
1		1	COM041	COMPUTER PRINTER; SCANNER; PHOTOCOPIER; FAX; A4; 235H 485W 390D		3
3		3	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
2		2	COM913	Hard drive for MRI scanner		5
2		2	CUP2531	CUPBOARD; wall unit; 2 door; lockable; 600mm.		1
1		1	CUP2540	CUPBOARD; key; 30 hooks; lockable; wall mounted; right hand; 305H 230W 70D.		1
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	IMG112	CONTROL CONSOLE; for MRI		5
2		2	IMG2507	Wave Guide.		5
8		8	LOC1012	LOCKER; MR compatible, wall mounted; 340H 300W 300D		1
2		2	MON017	MONITOR and CONTROL for CCTV; complete with flat screen monitor; keyboard; digital recorder (computer) and power supply.		1
2		2	MON901	MONITOR; double MRI monitor		5
1		1	MON906	MONITOR; Clinical slave		2
2		2	MON921	MONITOR; chiller temperature display		5
2		2	MON922	MONITOR; oxygen monitoring		5
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
20		20	OUT010	SOCKET outlet, switched, 13amp, twin		1
12		12	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
2		2	OUT215	SOCKET outlet, telephone		1
2		2	OUT2500	OUTLET; connection for IPOD.		1
2		2	PAN2500	PANEL; syringe injector controller.		5
1		1	PRI015	PRINTER; label; portable		3
3		3	SHE1002	SHELF; 300mm deep; length as drawn.		1
2		2	STF151	STORAGE UNIT; lower; 2 drawer; on castors; 600H 500W 450D		3
10		10	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
2		2	SWC062	EMERGENCY STOP switch button, wall mounted		1
2		2	TEL1000	TELEPHONE; handset.		3

ADB	Schedule of Components by Room	E0604-03

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0604-03 Control Room - MRI
Room Number: G-Q1-111
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
3		3	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
3		3	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	E0801

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0801	Imaging room: MRI DCN		
Room Number:	G-Q1-123		**Revision Date:**	18/09/2014

Activities:	1) Patient is positioned or repositioned for examination 2) Use of radiation protection equipment 3) Imaging x-ray examination of patient 4) Use of oxygen and vacuum services for resuscitation 5) Storage of small items of equipment 6) Storage of Positioning aids e.g. wedges pillows and other immobilisation devices 7) Clinical handwashing			
Personnel:	1 x patient 3 x staff			
Planning Relationships:	Adjacent to viewing/reporting area. Direct access from changing cubicles - optional.			
Space Data:	**Area (m²):**		**Height (mm)**	3,100
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	E0801

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0801	Imaging room: MRI DCN		
Room Number:	G-Q1-123		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	8.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air - Reheat Battery with BMS Adjustable Sensor. Cooling: Comfort Cooled

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ General working plane 1000 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0801

Project	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	E0801	Imaging room: MRI DCN
Room Number:	G-Q1-123	**Revision Date:** 18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings Floor Recess required Radiation protection to be agreed with NHSL RPO
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Viewing panel from control room, radiation protection.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0801

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0801 MRI Room 1
Room Number: G-Q1-123
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ANA007	ANAESTHETIC MACHINE/WORKSTATION; MRI compatible; electrically powered piston ventilator; mobile; 1350H 750W 650D		3
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	BUT2500	Quench button.		5
1		1	CAM2505	CAMERA CCTV; pan/tilt/zoom; MRI compatible.		5
2		2	CHA023	CHAIR; upright; wood		3
2		2	CUP2570	CUPBOARD UNIT; non-ferrous; open; 9 adjustable shelf; on plinth; 1000H 500W 2700D.		1
1		1	DET2500	Ferromagnetic detector		1
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	IMG081	IMAGER; MAGNETIC RESONANCE IMAGING (MRI); closed bore; 1.5 Tesla unit		5
2		2	IMG086	TABLE PATIENT - MRI imager; floating top; (Part of IMG081)		5
1		1	IMG2501	Coil Holder.		5
2		2	IMG2507	Wave Guide.		5
1		1	LAD2502	FOOT STEPS: MR compatible		3
1		1	OUT010	SOCKET outlet, switched, 13amp, twin		1
3		3	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT056	CONNECTION UNIT, unswitched, 13 amp		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT463	OUTLET; nitrous oxide; medical, trunking mounted.		1
2		2	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	OUT481	OUTLET; gas scavenging (AGS); medical, trunking mounted.		1
1		1	PEG2500	HOOK; Pat Slide.		1
2		2	SLI2500	PATSLIDE		3
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	SWC062	EMERGENCY STOP switch button, wall mounted		1
1		1	SYR005	SYRINGE INJECTOR; MRI compatible; automatic; hi pressure injection; media contrast		5
2		2	TRO901	TROLLEY; Coil cupd		3
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	TVM2503	TV / monitor flat screen with DVD player, MRI compatible		3

ADB	Room Data Sheet	E0801-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0801-01	Imaging Room: MRI RHSC		
Room Number:	G-Q1-134		**Revision Date:**	18/09/2014

Activities:	1) Patient is positioned or repositioned for examination 2) Use of radiation protection equipment 3) Imaging x-ray examination of patient 4) Use of oxygen and vacuum services for resuscitation 5) Storage of small items of equipment 6) Storage of Positioning aids e.g. wedges pillows and other immobilisation devices 7) Clinical handwashing			
Personnel:	1 x patient 2 x staff 2 x escort			
Planning Relationships:	Adjacent to viewing/reporting area. Direct access from changing cubicles - optional.			
Space Data:	**Area (m²):**		**Height (mm):**	3,100
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	E0801-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0801-01	Imaging Room: MRI RHSC		
Room Number:	G-Q1-134		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	8.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air - Reheat Battery with BMS Adjustable Sensor. Cooling: Comfort Cooled

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ General working plane 1000 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch / Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0801-01

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0801-01	Imaging Room: MRI RHSC		
Room Number:	G-Q1-134		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings Floor Recess required Radiation protection to be agreed with NHSL RPO
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Viewing panel from control room, radiation protection.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0801-01

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0801-01 MRI Room
Room Number: G-Q1-134
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ANA007	ANAESTHETIC MACHINE/WORKSTATION; MRI compatible; electrically powered piston ventilator; mobile; 1350H 750W 650D		3
1		1	BRA013	BRACKET; TV; height adjustable; wall mounted.		1
1		1	BUT2500	Quench button.		5
1		1	CAM2505	CAMERA CCTV; pan/tilt/zoom; MRI compatible.		5
2		2	CHA023	CHAIR; upright; wood		3
2		2	CUP2570	CUPBOARD UNIT; non-ferrous; open; 9 adjustable shelf; on plinth; 1000H 500W 2700D.		1
1		1	DET2500	Ferromagnetic detector		1
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	IMG081	IMAGER; MAGNETIC RESONANCE IMAGING (MRI); closed bore; 1.5 Tesla unit		5
1		1	IMG086	TABLE PATIENT - MRI imager; floating top; (Part of IMG081)		5
1		1	IMG2501	Coil Holder.		5
2		2	IMG2507	Wave Guide.		5
1		1	LAD2502	FOOT STEPS: MR compatible		3
1		1	MON051	MONITOR; patient; MR compatible; vital signs; multi-parameter; includes pulse oximeter		3
1		1	OUT010	SOCKET outlet, switched, 13amp, twin		1
3		3	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
2		2	OUT056	CONNECTION UNIT, unswitched, 13 amp		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT463	OUTLET; nitrous oxide; medical, trunking mounted.		1
2		2	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	OUT481	OUTLET; gas scavenging (AGS); medical, trunking mounted.		1
1		1	PEG2500	HOOK; Pat Slide.		1
1		1	RAC2500	RACK; magazine; double sided; mobile; MRI compatible		3
3		3	SLI2500	PATSLIDE		3
1		1	SWC031	SWITCH; light; dimmer to M&E design.		1
2		2	SWC062	EMERGENCY STOP switch button, wall mounted		1
1		1	SYR005	SYRINGE INJECTOR; MRI compatible; automatic; hi pressure injection; media contrast		5
1		1	TRO139	TROLLEY; dressing/instrument; MRI compatible; 870H 450W 450D		3
2		2	TRO901	TROLLEY; Coil cupd		3
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	TVM2503	TV / monitor flat screen with DVD player, MRI compatible		3
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	E0604-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-01	Control room: CT/MRI RHSC		
Room Number:	G-Q1-135		**Revision Date:**	18/09/2014

Activities:	1) Use of computer workstation(s) 2) Viewing of X-ray films 3) Displaying notices 4) Maintenance and storage of EBME equipment records and reports 5) Viewing diagnostic images on VDT 6) Use of Imaging x-ray equipment			
Personnel:	1 x patient 8 x Staff 2 x escorts Access to visitors, researchers			
Planning Relationships:	Direct access to/from CT & MRI room. Access may be required to medical conference room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

ADB	Room Environmental Data	E0604-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-01	Control room: CT/MRI RHSC		
Room Number:	G-Q1-135		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	4.0	Ventila ion Type: Central Supply & Extract
Mechanical Ventilation (Extract ac/hr):	4.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	@ desk 750 - 850mm AFFL
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):		None
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):		

General Notes:

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0604-01

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0604-01	Control room: CT/MRI RHSC		
Room Number:	G-Q1-135		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to CT/MRI to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Viewing panel to CT/MRI room, radiation protection.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0604-01

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0604-01 Control Room - CT/MRI
Room Number: G-Q1-135
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	BIN2504	BIN; confidential waste		3
2		2	BOA2504	BOARD; marker; whiteboard; dry-wipe; with pen holder;magnetic; wall mounted; 600H 900W.		1
2		2	BUT2500	Quench button.		5
2		2	CAB024	CABINET; filing; 2 drawer; 710H 470W 620D		3
6		6	CHA002	CHAIR; height adjustable; medium back; swivel; 5 star base; on castors		3
2		2	CHA017	CHAIR; upright; upholstered; stacking		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
3		3	COM033	COMPUTER KEYBOARD		3
1		1	COM038	COMPUTER PRINTER, laser, A4, 250H 380W 385D		3
3		3	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2503	COMPUTER MONITOR, PACS REVIEW STATION; 2 21", high-resolution screens,		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	CUP332	CUPBOARD; key; 30 hooks; lockable; wall mounted; 305H 230W 70D.		1
4		4	CUP378	CUPBOARD/DRAWER UNIT; 1 drawer; 1 shelf; on castors; 660H 480W 390D		3
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
1		1	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
1		1	IMG112	CONTROL CONSOLE; for MRI		5
1		1	IMG2501	Coil Holder.		5
1		1	IMG2507	Wave Guide.		5
1		1	IMG2512	CONTROL CONSOLE; for CT		5
1		1	LIG074	ILLUMINATED SIGN DO NOT ENTER		1
1		1	LOC2503	LOCKER; wall mounted; RH; 340H 300W 300D.		1
2		2	MON017	MONITOR and CONTROL for CCTV; complete with flat screen monitor; keyboard; digital recorder (computer) and power supply.		1
2		2	MON2515	Injection control monitor		5
1		1	MON901	MONITOR; double MRI monitor		5
1		1	MON906	MONITOR; Clinical slave		2
1		1	OUT002	OUTLET, cable 13amp		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
20		20	OUT010	SOCKET outlet, switched, 13amp, twin		1
11		11	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
3		3	OUT215	SOCKET outlet, telephone		1
2		2	OUT2500	OUTLET; connection for IPOD.		1
2		2	PAN2500	PANEL; syringe injector controller.		5
2		2	PRI015	PRINTER; label; portable		3
2		2	SHE1002	SHELF; 300mm deep; length as drawn.		1
9		9	SUP2501	SUPPORT LEG; for 720 high worktop		1
1		1	SWC025	SWITCH, light		1
2		2	SWC062	EMERGENCY STOP switch button, wall mounted		1
3		3	TEL1000	TELEPHONE; handset.		3
1		1	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1

ADB	Schedule of Components by Room	E0604-01

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0604-01 Control Room - CT/MRI
Room Number: G-Q1-135
Revision Date: 09/09/2014

Quantity			Code	Description	Alt. Code	Grp
New	Trans	Total				
1		1	UPS003	Uninterrupted power supply (UPS).		1
3		3	WKT1006L	WORKTOP; 720 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	E0601-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0601-01	CT Room RHSC		
Room Number:	G-Q1-136		**Revision Date:**	18/09/2014

Activities:	1) Patient may arrive on foot in a wheelchair or on a trolley 2) Patient undergoes examination with diagnostic x-rays to localise tumour and verify proposed treatment method. 3) Storage of Positioning aids e.g. wedges pillows and other immobilisation devices 4) Clinical hand washing 5) Use of computer workstation(s) 6) Contrast media, I.V. injections and other sterile procedures may be prepared 7) Use of radiation protection equipment 8) Radiation measurement will be used 9) Parking, storage of patients' trolley(s)
Personnel:	1 x patient 5 x Staff 2 x escorts
Planning Relationships:	Direct access to/from control room. Close to sub-waiting area. Adjacent to changing facilities (direct access optional).

Space Data:	**Area (m²):**		**Height (mm):**	3,100
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

Radiation protection requirements are subject to RPA advice upon selection of equipment.

The "radiation in use" warning lamp should be installed at eye level outside the entrance(s) to the room.

ADB	Room Environmental Data	E0601-01

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0601-01	CT Room RHSC		
Room Number:	G-Q1-136		**Revision Date:**	18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 25
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	8.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	8.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	F7 - minimum
Humidity (%RH):		

General Notes: Heating Type: Warm Air - Reheat Battery with BMS Adjustable Sensor. Cooling: Comfort Cooled

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ General working plane 1000 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch/ Dimmer

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0601-01

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0601-01	CT Room RHSC		
Room Number:	G-Q1-136		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Viewing panel from control room, radiation protection.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0601-01

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0601-01 CT Room
Room Number: G-Q1-136
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ANA007	ANAESTHETIC MACHINE/WORKSTATION; MRI compatible; electrically powered piston ventilator; mobile; 1350H 750W 650D		3
1		1	BIN2509	BIN; sharps disposal; 7 litre; rail mounted		3
1		1	CAB034	CABINET warming, contrast media, stainless steel, wall mounted		2
1		1	CAM031	CAMERA; CCTV; pan/tilt/zoom.		1
2		2	CHA317	CHAIR, upright, upholstered, stacking, wipeable		3
1		1	CLO003	CLOCK synchronous with second sweep hand, wall mounted		1
2		2	CUP048	CUPBOARD; 2 shelves; 1 pull out shelf; lockable; on plinth; 800H 600W 500D.		1
1		1	CUP2538	CUPBOARD; base unit; 4 drawer; lockable; 500W 860H 500D.		1
1		1	CUP2569	Generator Cabinet.		5
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2500	DISPENSER; danicentre; combined glove/apron.		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
3		3	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
2		2	HOO020	HOOK, single, large, wall mounted		1
1		1	IMG066	TABLE PATIENT - CT imager; floating top; (Part of IMG2502)		5
1		1	IMG2502	IMAGER; COMPUTER TOMOGRAPHY (CT) ; 128 slice unit		5
1		1	IMG901	SAM HALL TURNER		3
1		1	IMG902	CONTRAST OVEN		3
2		2	LIG074	ILLUMINATED SIGN DO NOT ENTER		1
1		1	LIG081	LUMINAIRE fitted with single fluorescent lamp with switch; below drug cupboard; 8watt; 400mm.		1
1		1	MON902	MONITOR; Mid range use in Recovery & HDU.		3
1		1	MON906	MONITOR; Clinical slave		2
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
5		5	OUT010	SOCKET outlet, switched, 13amp, twin		1
4		4	OUT012	SOCKET outlet switched 13amp twin; trunking/pendant mounted.		1
1		1	OUT050	OUTLET, controlled drugs cupboard		1
1		1	OUT052	CONNECTION UNIT, switched, 13 amp		1
1		1	OUT059	CONNECTION UNIT switched 13amp, indicator light		1
1		1	OUT079	OUTLET isolator, equipment manufacturer's specification		1
2		2	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT206	SOCKET outlet television aerial; single; wall mounted.		1
1		1	OUT207	SOCKET outlet aerial television, closed circuit (CCTV), wall mounted		1
1		1	OUT452	OUTLET; 4 kPa compressed air medical; trunking mounted.		1
1		1	OUT463	OUTLET; nitrous oxide; medical, trunking mounted.		1
2		2	OUT471	OUTLET; oxygen medical; trunking mounted.		1
1		1	OUT476	OUTLET; vacuum medical; trunking mounted.		1
1		1	OUT481	OUTLET; gas scavenging (AGS); medical, trunking mounted.		1

ADB	Schedule of Components by Room	E0601-01

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0601-01 CT Room
Room Number: G-Q1-136
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	PEG2500	HOOK; Pat Slide.		1
1		1	RAC197	RACK; x-ray lead apron; 6 swivel arms; mobile		3
3		3	SLI2500	PATSLIDE		3
1		1	STF286	STORAGE UNIT; upper; cupboard; medicine; 2 door; lockable; 550H 600W 300D		1
1		1	STF290	STORAGE UNIT; upper; cupboard; controlled drugs; 1 door; lockable; with inner lockable cupboard and warning light; 550H 600W 300D		1
3		3	SWC031	SWITCH; light; dimmer to M&E design.		1
1		1	SWC062	EMERGENCY STOP switch button, wall mounted		1
1		1	SYR2502	SYRINGE INJECTOR; automatic; hi pressure injection; contrast media; ceiling mounted		5
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TRO133	TROLLEY, dressing/instrument, stainless steel, buffered, 870H 750W 450D		3
1		1	TRO135	TROLLEY; Gratnell; dressing/instrument; 6 clear trays, stainless steel; buffered; 890H 510W 480D		3
1		1	TRO601	TROUGH scrub-up; hospital pattern; stainless steel; single; 75mm upstand; 800W 450D. HTM64SUH1.		1
1		1	TRU1001	MEDICAL SERVICE TRUNKING; horizontal; length as drawn.		1
1		1	UPS003	Uninterrupted power supply (UPS).		1
1		1	WAS102	WASTE, unslotted flush-grated, metal, 1.1/2 in		1
1		1	WAS108	TRAP, bottle, 1.1/2 in, plastic resealing		1
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1

ADB	Room Data Sheet	E0135

Project:	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0135	Dental room		
Room Number:	G-Q1-141		**Revision Date:**	18/09/2014

Activities:	1) Use of Imaging x-ray equipment 2) Viewing of diagnostic images on monitor 3) Assessment / updating of electronic patient records (EPRs) 4) Clinical handwashing			
Personnel:	1 x patient 1 x staff 1 x escort			
Planning Relationships:	Adjacent to recovery room.			
Space Data:	**Area (m²):**		**Height (mm):**	2,700
	Refer to HLM-SZ-SL-SH-200-001 for room areas.			

Notes:

Refer to ME 571 series of drawings for access control (PCP 4.17)

Refer to HLM-SZ-00-PL-331-001 Anti-ligature Strategy for anti-ligature provision

Radiation protection requirements are subject to RPA advice upon selection of equipment.

The "radiation in use" warning lamp should be installed at eye level outside the entrance(s) to the room.

ADB	Room Environmental Data	E0135

Project:	11072	RHSC & DCN
Department:	01	Key Rooms (Financial Close)
Room:	E0135	Dental room
Room Number:	G-Q1-141	**Revision Date:** 18/09/2014

AIR	Requirements	Notes
Winter Temperature (DegC):		Permissible space temperature range (dry bulb) (degC) : 18 - 28
Summer Temperature (DegC):		
Mechanical Ventilation (Supply ac/hr):	3.0	Ventila ion Type: Central Supply and Extract
Mechanical Ventilation (Extract ac/hr):	3.0	
Pressure Relative to Adjoining Space:	Balanced	
Filtration (%DSE and % Arrestance):	/	G4 - minimum
Humidity (%RH):		

General Notes: Heating Type: Radiant Panels with TRV Remote Head Adj. Cooling: Comfort Cooled Fresh Air

LIGHTING		
Service Illumination (Lux):	300	
Service Illumination Night (Lux):		Not Applicable
Local Illumination (Lux):	1,000.0	@ Bed/trolley 1450 AFFL
Colour Rendering Required:	Y	Colour rendering characteristics (Ra):80
Standby Lighting Grade:	A	Lighting of the level and quality equal or nearly equal to that provided by normal lighting

General Notes: Control: Switch

NOISE		
Privacy Factor Required (dB):		
Mechanical Services (NR):	35	Intrusive Noise: SHTM 08-01 noise intrusion from external noise sources is not given in NR values but instead in LAeq,1hr and LAmax,f.
Intrusive Noise (NR Leq):		40:daytime (LAeq,1hr)
***Acceptable Sound Level [L10dB(A)]:**		
***Speech Privacy Required:**	Y	
***Quality Which Cannot Be Tolerated:**		
(* alternative format)		

General Notes: Refer to HLM 252 series of drawings for partition types and Acoustic Report (PCP 4.13)

SAFETY		
Hot Surface Max. Temp (DegC):	43	
Hot Water Max. Temp (DegC):	41	

General Notes: Maximum cold water discharge temperature (degC): 20

FIRE

Enclosure:

Automatic Detection:

Refer to HLM 572 series of drawings and Fire Strategy Report (PCP 4.12)

ADB	Room Design Character	E0135

Project	11072	RHSC & DCN		
Department:	01	Key Rooms (Financial Close)		
Room:	E0135	Dental room		
Room Number:	G-Q1-141		**Revision Date:**	18/09/2014

Walls:	Refer to HLM 330 series of drawings Radiation protection to be agreed with NHSL RPO
Floor:	Refer to HLM 330 series of drawings
Ceiling:	Refer to HLM 332 series of drawings
Doorsets:	Refer to HLM 322 series of drawings for location / type.
Windows:	N/A
Internal Glazing:	Refer to HLM 322 series for door and screen types.
Hatch:	N/A
Notes:	

ADB	Schedule of Components by Room	E0135

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0135 Dental Room
Room Number: G-Q1-141
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	ALA001	PUSH BUTTON, security alarm		1
1		1	BAS101	BASIN, medium, hospital pattern, vitreous china, no tap holes, no overflow, intefral back outlet, 500W 400D		1
1		1	CHA901	CHAIR; X-Ray Dental		5
1		1	CHR903	CHAIR; Saddle Operator		3
3		3	COM033	COMPUTER KEYBOARD		3
3		3	COM1000	COMPUTER MONITOR; TFT; Sunray digital flat panel display; desk top		3
1		1	COM2509	INTERCOM two way communication system; wall mounted (flush).		1
1		1	DIS013	DISPENSER, paper towel, wall mounted		2
1		1	DIS030	DISPENSER, soap, disposable single cartridge, lever action, wall mounted		2
1		1	DIS2503	DISPENSER; alcohol gel; disposable single cartridge; wall mounted.		2
2		2	HOL005	HOLDER; bin; medium; capacity 70 litres; freestanding.		3
3		3	HOO020	HOOK, single, large, wall mounted		1
1		1	IMG2506	READER; CR dental		3
1		1	LIG074	ILLUMINATED SIGN DO NOT ENTER		1
1		1	MSC081	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	MSC082	CABINET base; 600mm facing; (600x400 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
1		1	MSC091	CABINET base; 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged right; on plinth; o/a height 900.		1
1		1	MSC092	CABINET base; 400mm facing; (400x600 inserts); with formed plastic liners; 1 door hinged left; on plinth; o/a height 900.		1
1		1	OUT004	OUTLET cable, fused, 13 amp, ceiling mounted		1
1		1	OUT005	SOCKET outlet, switched, 13amp, single		1
9		9	OUT010	SOCKET outlet, switched, 13amp, twin		1
7		7	OUT121	SOCKET outlet; computer data; double.		1
1		1	OUT208	SOCKET outlet television aerial; single; ceiling mounted.		1
1		1	OUT210	SOCKET outlet two-way communication system (intercom), wall mounted		1
1		1	OUT215	SOCKET outlet, telephone		1
1		1	PRO026	PROJECTOR; multi-media; ceiling mounted		2
1		1	RAC194	RACK; x-ray lead apron; 3 hangers; wall mounted		2
1		1	SCR060	SCREEN shielding; radiation proof; 1mm lead; solid/glass; 2000H 2100L; angle		5
1		1	SUP2500	SUPPORT LEG; for 920 high worktop		1
1		1	SWC025	SWITCH, light		1
1		1	SWC062	EMERGENCY STOP switch button, wall mounted		1
1		1	TAP894	TAP bib; hospital pattern; integral thermostatic mixer; HTM64		1
1		1	TEL1000	TELEPHONE; handset.		3
2		2	TRU1000	TRUNKING; Power and Data trunking; length as drawn.		1
1		1	WAS100	WASTE, unslotted flush-grated, metal, 1.1/4 in		1
1		1	WAS1000	TRAP; concealed waste; for back outlet basins.		1

ADB	Schedule of Components by Room	E0135

Project: 11072 RHSC & DCN
Department: Q1 Radiology
Room: E0135 Dental Room
Room Number: G-Q1-141
Revision Date: 09/09/2014

Quantity					Alt. Code	Grp
New	Trans	Total	Code	Description		
1		1	WKT1003H	WORKTOP; 920 high 600 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	WKT1006H	WORKTOP; 920 high 800 deep 40mm thick; with 50mm upstand; length as drawn.		1
1		1	XRA003	X-RAY UNIT TUBE; dental; fixed		5
1		1	XRA004	X-RAY GENERATOR for dental tube; wall mounted		5
1		1	XRA005	X-RAY UNIT DENTAL PANORAMIC (OPG); height adjustable; floor mounted		5
1		1	XRA006	X-RAY IMAGING CEPHALOSTAT ATTACHMENT; dental; (Part of XRA005)		5

From: Mr Ken Hall - Multiplex Construction Europe [redacted] on behalf of Mr Ken Hall - Multiplex Construction Europe
Sent: 18 April 2018 09:30
To: Mr Stewart McKechnie - Wallace Whittle; Mr Kamil Kolodziejczyk - Mott MacDonald Ltd (Head Office UK); Mr Ronnie Henderson - NHS Lothian; Mr Douglas Anderson - Mott MacDonald Ltd (Head Office UK)
Cc: Mr Colin Grindlay - Multiplex Construction Europe; Mr Andrew McColl - Multiplex Construction Europe
Subject: Re: 12.04.18 4 Bed Workshop Summary

Hi Ronnie

4ACH is the brief - supply and extract. The rev 05 schedule is the previous schedule tabled from last year. If you use this schedule at this stage purely as identifying the room numbers for the 14 rooms so that TUV SUD are updating/changing the design to the correct 14 rooms.

The schedule will be reissued to Rev 06 capturing the revised design intent as part of the RDD process pack being pulled together following the site survey to assess feasibility of what was tabled last Thursday.

Regards

Ken

From: R Henderson
Sent: 18/04/2018 9:10:44 AM BST (GMT +01:00)
To: Douglas Anderson, Kamil Kolodziejczyk, Ken Hall, Stewart McKechnie
Cc: Colin Grindlay, Andrew McColl
Mail Number: NHSL-GC-002953
Subject: Re: 12.04.18 4 Bed Workshop Summary

Hi Ken,

I note the attched schedule rev 05 still refers to Air Change rates between 2.7 & 3.5, we are seeking design for 4 Air Changes to all 14 rooms. Can you confirm that this is the brief to WW

Regards

Ronnie

From: K Hall
Sent: 17/04/2018 2:52:00 PM BST (GMT +01:00)
To: Douglas Anderson, Kamil Kolodziejczyk, Ronnie Henderson, Stewart McKechnie
Cc: Colin Grindlay, Andrew McColl
Mail Number: MPX-MM-000503
Subject: 12.04.18 4 Bed Workshop Summary

Confirmation of Key Points discussed.

Attendees: as attached.
Marked Up Drawings Tabled: as attached.
Agenda: as below - (MPX-GC-026334)
Date and Time: 12.04.18 @ 13.00Hrs

1.0 SM noted concerns on agreement from the previous workshop No1 that the objective of workshop No2 was to obtain agreement in principle on the draft drawings being tabled to allow progress to continue on 4 bed design. This was due to NHSL held up at another meeting, and no delegated authority at the workshop.

Action. Concerns resolved as Ronnie Henderson joined the workshop at 13.30.

A. 4 BED Agenda Item

2.0 14 Rooms in question tabled based on the previous Rev 05 schedule. Rooms cross referenced drawings against the schedule. See attached schedule and drawings over viewed.

3.0 Room "M" type. NHSL noted environmental matrix notes supply and extract. Drawing tabled and site inspection has no changes to the extract.

Action: TUV SUD to confirm design intent to comply with the environmental matrix.

4.0 Area I + J. NHSL requested actual air change rates be confirmed given the increase in one extract system rather than perhaps introducing it across the 3 systems in the locale.

Action: Increase in air change rate(s) to be identified due to noise concerns.

5.0 Physical sizes of all increased duct sizes to be verified at site to confirm any spatial constraints.

Post meeting note: Surveys confirmed to proceed 18.04.18. Findings to be shared with NHSL.

6.0 NHSL confirmed agreement in principal to the strategy tabled, and to proceed to the next stage of site survey based on drawings tabled. Thereafter RDD pack to be submitted for speedy approval.

7.0 Spare capacity. TUV SUD tabled the initial draft assessment:

Supply: No impact as being maintained at 4ACH as per the Environmental Matrix.

Extract: AHU-04-06: extract up by 23%.
Extract: AHU-04-07: extract up by 10%.
Extract: AHU-04-08: extract up by 15%.
Extract: AHU-02-23: extract up by 36%.
Extract: AHU-04-04: extract up by 6%.

TUV SUD noted dialogue with Supplier of AHU being undertaken.

Action: Spare capacity impact analysis document to be issued after site checks carried out on spatial review to identify impact on current spare capacity to allow NHSL to consider if the design can proceed on this basis.

B. Spare Capacity Document

NHSL noted receipt of spare capacity document. Comments on the document to be tabled at next workshop.

8.0 NHSL noted the document issued per department had the comments removed that were in the original spare capacity document issued. Specifically for example the fans in relation to 10% spare capacity comment. NHSL reiterated clarity if the fans had 25% spare capacity, this was confirmed by TUV SUD.

Action: TUV SUD to confirm statement made at the meeting, ventilation 25% design spare capacity on the fans.

C. Schneider Agreement

9.0 TUV SUD statement distributed at the meeting,

Action: NHSL to feedback at next workshop.

D AOB

10.0 NHSL requested Thursday meetings continue, perhaps alternated mechanical and electrical depending on topics to be resolved.

11.0 TUV SUD queried if generator load profile document had been returned by NHSL / MPX.

MPX confirmed after meeting TUV SUD were issued the document on 10.04.18.

Action: TUV SUD to confirm feedback on NHSL comments received.

12.0 NHSL noted query regarding earth cable and fire rated cabling. To be discussed and agreed at next workshop. NHSL requested formal confirmation to the points raised within original calculations feedback.

Action: TUV SUD to respond to Aconex MPX-GC-026161 dated 29.03.18.

Next meeting: Thursday 19.04.18, agenda to be issued prior to meeting.

From: K Hall
Sent: 11/04/2018 3:36:34 PM BST (GMT +01:00)
To: Douglas Anderson, Ronnie Henderson, Stewart McKechnie
Cc: Colin Grindlay, Andrew McColl
Mail Number: MPX-GC-026334
Subject: 12.04.18 Thursday M+E Workshop 13.00Hrs

Confirmation of agenda items to discuss tomorrow, 13.00Hrs, MPX Conference Room.

1.0 Tabling of 4 Bed Design - 14 Rooms

2.0 Feedback on Spare Capacity Review - Specific Departments

Clinical Management Suite

Family Hotel

Shelled rooms

Out patients

Child life and Health

Clinical Research Facility

Multidisciplinary offices in wards

Sphere

Class rooms

Health records

3.0 Update on Schneider Agreement - Electrical Distribution 90/70 degree debate v's BS 7671 Derating

MULTIPLEX

Record of Meeting Attendance			
Project Reference		Rev	

Location	RHSC & DCN Site Office		
Date of Meeting	24th February 2017	Time	09.30

Topic	Bedroom Ventilation Update Meeting

Attendance List

No:	Name	Job Title	Company	Signature
1	KEN HALL	M+E MGR	MULTIPLEX	[redacted]
2	JANICE MACKENZIE	CLINICAL DIRECTOR	NHSL	[redacted]
3	Dorothy Hanley	COMMISSIONING	NHSC	[redacted]
4	BRIAN CAREY	PROJECT DIRECTOR	NHSL	
5	Hayley Rouse	Project Administrator	IHSL	
6	Colin Grindlay	M+E MANAGER	MPX	[redacted]
7	Kamil Kolodziejczyk	TA	MM	[redacted]
8	Ronnie Henderson	COMMISSIONING MANAGER	NHSL	[redacted]
9	Steve Wh	Director	TUV - W	
10	BRIAN RUTHERFORD	SENIOR ENGINEER	TUV - WW	[redacted]
11				
12				
13				
14				
15				
16				

A46676816

MARKED UP AT MEETING 24/02/17

General Ward – Ventilation Amendment Proposal to achieve Room Balance

Wallace Whittle

Proposed Solution To Rooms Identified As Being Of Concern

Room Reference Location	Ventilation Layout Drawing Number	Room Number	Room Description	Proposed Solution	Severity of Works			Ductwork Fabricated
					Local	Medium	Major	Yes/No
A	WW-Z4-00-PL-524-001I	G-A2-054 ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 2.7ac/hr, increase dirty extract for en-suite and WC from 10ac/hr to 17ac/hr, branch ductwork and grilles to be increased in size. This will achieve a balanced room pressure. Branch ducts have long runs across the width of the floor plate to get back to the main duct.		✓		Yes
B	WW-Z4-00-PL-524-001I	G-A2-046 ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 2.7ac/hr, increase dirty extract for en-suite and WC from 10ac/hr to 17ac/hr, branch ductwork and grilles to be increased in size. This will achieve a balanced room pressure. Branch ducts have long runs across the width of the floor plate to get back to the main duct.		✓		Yes
C	WW-Z4-00-PL-524-002G	G-A2-028 ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 2.7ac/hr, increase dirty extract for en-suite and WC from 10ac/hr to 17ac/hr, branch ductwork and grilles to be increased in size. This will achieve a balanced room pressure. Branch ducts have long runs back to the main duct within the corridor.		✓		Yes
D	WW-Z4-01-PL-524-001H	1-B1-063 ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 3ac/hr, introduce a general extract ductwork branch and grille and connect into the duct main branch. This will achieve a balanced room pressure. The branch duct will require to be increased in size and has a long run back to the main.		✓		Yes
E	WW-Z4-01-PL-524-001H	1-B1-031 ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 3ac/hr, introduce a general extract ductwork branch and grille and connect into the duct branch. This will achieve a balanced room pressure. The branch duct will require to be increased in size and has a long run back to the main.		✓		Yes
F	WW-Z4-01-PL-524-001H	1-B1-009 ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 3ac/hr, increase the main branch size and introduce a general extract duct branch and grille within the room. This will achieve a balanced room pressure. The branch duct will require to be increased in size and has a long run back to the main.		✓		Yes
G	WW-Z3-03-PL-524-001F	3-C1.3-011 ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 3ac/hr, increase dirty extract for en-suite from 10ac/hr to 17ac/hr, branch ductwork and grille to be increased in size. Wet room to increase to 17ac/hr with new ductwork and grille being introduced and connect into the duct main. This will achieve a negative room pressure. En-suite ductwork has a long run to get back to the main, additional wet room branch is local.	✓			Yes
~~H~~	WW-Z3-03-PL-524-001F	3-C1.3-013 ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 3ac/hr, increase dirty extract for en-suite from 10ac/hr to 17ac/hr, branch ductwork and grille to be increased in size. Wet room to increase to 17ac/hr with new ductwork branch and grille being introduced and connect into the duct main. This will achieve a negative room pressure. En-suite ductwork has a long run to get back to the main, additional wet room branch is local.	✓			Yes

Issue	Date	By	Checked
1	08.02.17	SR	SMcK
2	14.02.17	SR	SMcK
3	22.02.17	SR	SMcK

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Wallace Whittle

General Ward – Ventilation Amendment Proposal to Achieve Room Balance

Room Reference Location	Ventilation Layout Drawing Number	Room Number	Room Description	Proposed Solution	Severity of Works			Ductwork Fabricated
					Local	Medium	Major	Yes/No
I	WW-Z4-03-PL-524-001F	3-C1.2-026	Multi Bed (4)	Reduce supply ventilation down to 3ac/hr, increase dirty extract for en-suite from 10ac/hr to 17ac/hr, branch ductwork and grille to be increased in size. Wet room to increase to 17ac/hr with new ductwork branch and grille being introduced and connect into the duct main. This will achieve a balanced room pressure. En-suite ductwork has a long run to get back to the main, additional wet room branch is local. The main ductwork will also require to be increased in size.			✓	Yes
J	WW-Z4-03-PL-524-001F	3-C1.2-023	Multi Bed (4)	Reduce supply ventilation down to 3ac/hr, increase dirty extract for en-suite from 10ac/hr to 17ac/hr, branch ductwork and grille to be increased in size. Wet room to increase to 17ac/hr with new ductwork branch and grille being introduced and connect into the duct main. This will achieve a balanced room pressure. En-suite ductwork has a long run to get back to the main, additional wet room branch is local. The main ductwork will also require to be increased in size.			✓	Yes
K	WW-Z4-03-PL-524-002F	3-C1.1-018	Multi Bed (4)	Reduce supply ventilation down to 2.7ac/hr, increase dirty extract for en-suite and WC from 10ac/hr to 17ac/hr, branch ductwork and grilles to be increased in size. This will achieve a balanced room pressure. The branch ducts will require to be increased in size and have a long run back to the main. The main ductwork will also require to be increased in size.			✓	Yes
L	WW-Z4-03-PL-524-002F	3-C1.1-046	Multi Bed (4)	Reduce supply ventilation down to 2.7ac/hr, increase dirty extract for en-suite and WC from 10ac/hr to 17ac/hr, branch ductwork and grilles to be increased in size. This will achieve a balanced room pressure. The branch duct will require to be increased in size and have a long run back to the main. The main ductwork will also require to be increased in size.			✓	Yes
M	WW-Z4-01-PL-524-001H	1-B1-065	Multi Cot (3)	Reduce supply ventilation down to 3ac/hr, introduce a general extract ductwork branch and grille and connect into the duct main branch. This will achieve a balanced room pressure. The branch duct will require to be increased in size and has a long run back to the main.		✓		Yes
T	WW-Z4-03-PL-524-002F	3-D9-022	Multi Bed (3)	Reduce supply ventilation down to 3ac/hr, increase dirty extract for en-suite from 10ac/hr to 17ac/hr, branch ductwork and grille to be increased in size. Introduce a new general extract branch and grille into the room and connect into the duct main. This will achieve a balanced room pressure. En-suite ductwork is local to the main. The general extract main ductwork is at the end of the system and will have to be extended as well as being increased in size in order to accommodate the additional volume requirements.			✓	Yes

Issue	Date	By	Checked
1	08.02.17	BR	SMcK
2	14.02.17	BR	SMcK
3	22.02.17	BR	SMcK

Wallace Whittle

General Ward – Ventilation Amendment Proposal to Achieve Room Balance

Addendum - Review of Rooms Identified as Non Critical

Room Reference Location	Ventilation Layout Drawing Number	Room Number	Room Name	Proposed Solution	Severity of Works			Ductwork Fabricated
					Local	Medium	Major	Yes/No
N	WW-Z4-01-PL-524-002F	1-L1-100 NOT ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 3ac/hr, increase dirty extract for en-suite from 10ac/hr to 17ac/hr, branch ductwork and grille to be increased in size. Introduce a new general extract branch and grille into the room and connect into the duct main. This will achieve a balanced room pressure. En-suite ductwork has a long run across the width of the floor plate to get back to the main. The general extract main ductwork is local to the room, however the main will require to be increased in size in order to accommodate the additional volume requirements.			✓	Yes
O	WW-Z4-01-PL-524-002F	1-L1-097 NOT ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 3ac/hr, increase dirty extract for en-suite from 10ac/hr to 17ac/hr, branch ductwork and grille to be increased in size. Introduce a new general extract branch and grille into the room and connect into the duct main. This will achieve a balanced room pressure. En-suite ductwork has a long run across the width of the floor plate to get back to the main. The general extract main ductwork is local to the room, however the main will require to be increased in size in order to accommodate the additional volume requirements.			✓	Yes
P	WW-Z3-03-PL-524-001F	3-C1.8-027 NOT ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 2.7 ac/hr, increase dirty extract for en-suite and WC from 10ac/hr to 17ac/hr, branch ductwork and grilles to be increased in size. This will achieve a balanced room pressure. Branch ducts have long runs back to the main duct which is in the corridor. The main ductwork will also require to be increased in size.			✓	Yes
Q	WW-Z3-03-PL-524-001F	3-C1.8-016 NOT ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 2.7 ac/hr, increase dirty extract for en-suite and WC from 10ac/hr to 17ac/hr, branch ductwork and grilles to be increased in size. This will achieve a balanced room pressure. Branch ducts have long runs back to the main duct which is in the corridor. The main ductwork will also require to be increased in size.			✓	Yes
R	WW-Z3-03-PL-524-002G	3-C1.4-084 NOT ESSENTIAL	Multi Bed (4)	Reduce supply ventilation down to 3ac/hr, increase dirty extract for en-suite from 10ac/hr to 17ac/hr, branch ductwork and grille to be increased in size. Introduce a new general extract branch and grille into the room and connect into the duct main. This will achieve a balanced room pressure. The general extract main ductwork is local to the room, however the main will require to be increased in size in order to accommodate the additional volume requirements. The dirty extract main will also need increased in size.			✓	Yes
S	WW-Z3-03-PL-524-002G	3-C1.4-061 NOT ESSENTIAL	Multi Bed (6)	Reduce supply ventilation down to 3ac/hr, increase dirty extract for en-suite from 10ac/hr to 17ac/hr, branch ductwork and grille to be increased in size. Introduce a new general extract branch and grille into the room and connect into the duct main. This will achieve a balanced room pressure. The general extract main ductwork is local to the room, however the main will require to be increased in size in order to accommodate the additional volume requirements. The dirty extract main will also need increased in size.			✓	Yes

Issue	Date	By	Checked
1	08.02.17	BR	SMcK
2	14.02.17	BR	SMcK
3	22.02.17	BR	SMcK

(1) LOTHIAN HEALTH BOARD

(2) IHS LOTHIAN LIMITED

SETTLEMENT AGREEMENT AND SUPPLEMENTAL AGREEMENT RELATING TO THE PROJECT AGREEMENT FOR THE PROVISION OF RHSC AND DCN AT LITTLE FRANCE

Pinsent Masons

CONTENTS

THIS SA1 is made the 22 February 2019

BETWEEN:

(1) **LOTHIAN HEALTH BOARD**, a health board constituted in Scotland under the National Health Service (Constitution of Health Boards) (Scotland) Order 1974 (S.I. 1974/267) as amended by the National Health Service (Constitution of Health Boards) (Scotland) Amendment Order 2003 (S.S.I. 2003/217) pursuant to Section 2 of the National Health Service (Scotland) Act 1990 and having its principal address at Waverley Gate, 2-4 Waterloo Place, Edinburgh, EH1 3EG (hereinafter referred to as the **"Board"**); and

(2) **IHS LOTHIAN LIMITED** (registered under number SC493676) whose registered office is 13 Queen's Road, Aberdeen, AB15 4YL (**"Project Co"**).

WHEREAS

A. A Project Agreement was entered into between the Board and Project Co dated 12th and 13th February 2015 setting out the terms and conditions of a project for the design, build, finance and maintenance of a project to re-provide services from the Royal Hospital for Sick Children, Child and Adolescent Mental Health Department and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France as amended by the Amendment Agreement between the Board and Project Co dated 19th December 2018.

B. The Board and Project Co entered into settlement discussions regarding various matters relating to the Project and the terms of this SA1 reflect the outcome of those settlement discussions.

C. Project Co has requested in terms of a Project Co Change that certain amendments to the Project Agreement are made to provide for the amendment to the rights of access and use of areas of land for the construction, installation, maintenance, repair and renewal of the CCTV Works and CCTV Infrastructure. The Board has requested in terms of a Board Change that certain amendments to the Project Agreement are made to accommodate a revised table of Gross Service Units.

D. The Parties understand that the Independent Certifier has completed the tests on completion in respect of the Works (other than the Post Completion Works and Outstanding Works) and, subject to: (i) the terms of the Project Agreement as supplemented by this SA1); and (ii) the conditions set out in the Independent Tester's letter to Project Co dated 7 February 2019; is ready to issue a Certificate of Practical Completion on or about the SA1 Effective Date.

THE PARTIES AGREE AS FOLLOWS:-

1. **DEFINITIONS**

1.1 This SA1 is supplemental to and amends the Project Agreement, and from the SA1 Effective Date, the Project Agreement shall be read and construed as supplemented by the provisions of this SA1. Save where expressly stated to the contrary herein, where words and expressions appear in capitalised terms in this SA1, such words and expressions shall have the same meaning as is given to such words and expressions under the Project Agreement. In the event of any inconsistency existing between the provisions of this SA1 and any provision of the Project Agreement, the provision of this SA1 shall (in such case) prevail.

1.2 Reference to a document being in the Agreed Form is a reference to the form of the relevant document (or where appropriate, the form of relevant document on USB memory stick) agreed between the parties and for the purpose of identification initialled by each of them or on their behalf.

1.3 In this SA1 the following words and expressions shall have the following meanings:

"Agreed Resolution"	means the technical solution required to resolve the Dispute (other than the Post Completion Disputed Works) and the obligations on each Party to meet (or procure the meeting of) that agreed technical solution all as detailed in the column entitled "Description of Agreed Resolution" in Part 1 of the Schedule (Technical Schedule);
"Concrete Specification"	means the dispute between the Parties regarding whether the concrete used during the Works for waterproofing as set out in the RBG-SZ-XX-SP-260-001 concrete specification is compliant with Section 5.1 (Schedule of Life Expectancies) of the Board's Construction Requirements or IHSL-ARC-041 (4.32 Schedule of Derogations);
"Construction Contract Supplemental Agreement"	means the amendment to the Construction Contract dated the same date as this SA1 between Project Co and the Contractor which as at the SA1 Effective Date is in the Agreed Form;
"**CCTV Infrastructure**"	means the infrastructure resulting from the CCTV Works;
"**CCTV Infrastructure Sites**"	means the Sites of the CCTV Infrastructure shown indicatively as a "Po" on drawing number ME-EW-XX-PL-571-001 version E, which forms part of the CCTV Works Proposal or such other sites as are otherwise agreed between the Parties;
"CCTV Works"	means the design (including preparation of all Design Data), construction, testing, commissioning and completion of the CCTV Infrastructure and thereafter maintaining, repairing and renewing the CCTV Infrastructure at the CCTV Infrastructure Sites in the Yellow Area, as described in the CCTV Works Proposal;
"**CCTV Works Proposal**"	means the information for the design and construction of the CCTV Works detailed in Part B of Part 3 of the Schedule (CCTV Works Proposal) as amended from time to time in accordance with the Project Agreement;
"De-watering"	means the temporary deepwell de-watering exercise undertaken on behalf of Project Co between April 2015 and April 2016 for the purposes of excavating the basement because the designed basement levels were below the groundwater table, including the design, installation, operation and removal and demobilisation of the de-watering system as referred to in, inter alia, Aconex Reference BMCE-TRANSMIT-004045, Document Reference BMCE-XX-XX-DC-014 Rev 00;
"Dispute"	means: (i) all claims, disagreements and disputes between the Parties arising out of or in connection with the matters which are set out in the column entitled "Dispute" in Part 1 of the Schedule (Technical Schedule); and/ or (ii) the Post Completion Disputed Works;
"Drainage Works"	means the drainage works as described in Parts A and B of Part 5 of the Schedule (Post Completion Works);

"Drainage Completion Criteria"	means the drainage completion criteria as set out in Part C of Part 5 of the Schedule (Post Completion Works);
"Energy Centre Lighting Calcs"	means the dispute between the parties regarding compliance with LG2 in relation to Zone 5 Energy Centre Lighting Calculation as set out in Document Number: ME-XX-XX-DC-400-104 Rev 4;
"Failed Instalment"	has the meaning given in Clause 4.1 (Payment);
"Future Claim"	means (other than the Released Claims), as the context requires, any actions, claims, liabilities, rights, demands and set-offs, counterclaims whether in this jurisdiction or any other, including but not limited to claims arising from rights acquired from third parties, whether currently known to the parties or not and whether in law or equity, that it, its parent, subsidiaries, assigns, successors, transferees, novatees, representatives, principals, agents, contractors, subcontractors of any tier, officers, employees or directors, or any of them ever had, may have or hereafter can, shall or may have against the other Party or any other of its present and former parent, subsidiaries, assigns, successors, transferees, novatees, representatives, principals, agents, contractors, subcontractors of any tier, officers, employees or directors, arising after 21st February 2019: (a) available to either party arising out of or in any way connected with any act, omission, breach, default, negligence or failure to comply with the Project Agreement (as revised pursuant to this SA1), as measured (where appropriate) against the technical solution set out in: (i) the Agreed Resolution; (ii) the Post Completion Works Agreed Resolution; and/or (iii) the Outstanding Works Completion Criteria (b) available to the Board arising out of or connected with the Board's whole rights, remedies and pleas pursuant to the Project Agreement (as revised pursuant to this SA1) including rectification of Defects, rectification of Snagging Matters, rights of inspection, rights to issue Warning Notices, the rights and remedies set out in the Payment Mechanism and any other rights and remedies available to the Board set out in the Project Agreement (as revised pursuant to this SA1), all as measured (where appropriate) against the technical solution set out in: (i) the Agreed Resolution; (ii) the Post Completion Works Agreed Resolution; and/ or (iii) the Outstanding Works Completion Criteria;

(c) available to the Board, arising out of or in any way connected with any act, omission, breach, default, negligence or failure by Project Co to comply with the Project Agreement (as revised pursuant to this SA1) including for the avoidance of any doubt:

(i) all rights remedies and pleas available to the Board in connection with rectification of Defects and rectification of Snagging Matters; and

(ii) all rights, remedies and pleas available to the Board in connection with the following items of works: the Concrete Specification, De-Watering, Geotechnical Reports and Submains Schedule; excepting that (without prejudice to the Board's rights to claim that the design and/ or construction of the Concrete Specification, De-Watering, Geotechnical Reports and Submains Schedule are non-compliant with the relevant provisions of the Project Agreement) the Board's rights to make a "Future Claim" shall exclude any right to claim that Project Co failed to comply with the process for review of the RDD Status C Submitted Items and, in particular, that Project Co should not have acted upon the RDD Status C Submitted Items pursuant to Schedule Part 8, Paragraph 4.3 of the Project Agreement, and/ or claim that the RDD Status C Submitted Items ought to have been re-submitted to the Board's Representative in accordance with Schedule Part 8, Paragraph 4.4 of the Project Agreement;

(d) except where excluded pursuant to this SA1 (including pursuant to limb (f) of Released Claims), available to Project Co pursuant to Clause 29 of the Project Agreement (Delay Events) and/ or Clause 30 of the Project Agreement (Relief Events);

"Geotechnical Reports" means the geotechnical interpretative report Aconex Reference MPX-TRANSMIT-010922, Document Reference RBG-SZ-XX-DC-100-001 Rev 1 and geotechnical design report Aconex Reference MPX-TRANSMIT-010922, Document Reference RBG-SZ-XX-DC-100-002 Rev 1 both dated 17 May 2016 and produced by Robert Bird Group;

"Heater Battery Completion Criteria" means the heater battery completion criteria as described in Part C of Part 5 of the Schedule (Post Completion Works);

"Heater Battery Works" means the heater battery works as described in Parts A and B of Part 5 of the Schedule (Post Completion Works);

"Independent Tester Varied Services Letter" means the letter signed by Project Co's Representative and the Board's Representative jointly instructing the Independent Tester to provide the Varied Services issued pursuant to Clause 3.4 of this SA1 in the form contained in Part 9 of the Schedule (Independent Tester Varied Services Letter);

"Joint Completion Programme" means the joint completion programme set out in Part 4 of the Schedule (Joint Completion Programme) in the Agreed Form as amended from time to time;

"Milestone 1"	has the meaning given to it in Part 7 of the Schedule (Payment and Milestones);
"Milestone 2"	means completion of the Drainage Works in accordance with the Drainage Completion Criteria;
"Milestone 2 Completion Date"	means the actual date Project Co met Milestone 2 as certified by the Independent Tester;
"Milestone 2 Target Completion Date"	means 24 May 2019;
"Milestone 3"	means completion of the Void Detection Works in accordance with the Void Detection Completion Criteria;
"Milestone 3 Completion Date"	means the actual date Project Co met Milestone 3 as certified by the Independent Tester;
"Milestone 3 Target Completion Date"	means 13 June 2019;
"Milestone 4"	means completion of the Heater Battery Works in accordance with the Heater Battery Completion Criteria;
"Milestone 4 Completion Date"	means the actual date Project Co met Milestone 4 as certified by the Independent Tester;
"Milestone 4 Target Completion Date"	means 27 May 2019;
"Outstanding Works"	means the works set out in Part 6 of the Schedule (Outstanding Works) which the Parties have agreed will be completed after the Actual Completion Date, including the Outstanding Works Exclusions;
"Outstanding Works Completion Criteria"	means the Outstanding Works completion criteria as set out in Part B of Part 6 of the Schedule (Outstanding Works);
"Outstanding Works Exclusions"	means the Outstanding Works which are noted as "Outstanding Works Exclusions (post 27 May 19)" in Part A of Part of the Schedule 6 (Outstanding Works)
"Outstanding Works Target Completion Date	means: (i) in relation to the Outstanding Works (other than the Outstanding Works Exclusions), 27 May 2019; and (ii) in relation to the Outstanding Works Exclusions, the relevant dates set out in Part A of Part 6 of the Schedule (Outstanding Works);
"Party"	means a party to this SA1;
"Post Completion Disputed Works"	means all claims, disagreements and disputes between the Parties arising out of or in connection with the matters which are set out in the column entitled "Post Completion Disputed Works" in Part A of Part 5 of the Schedule (Post Completion Works);
"Post Completion Works"	means the Drainage Works, Void Detection Works and Heater Battery Works all as described in Parts A and B of Part 5 of the Schedule (Post Completion Works) in the Agreed Form;

"Post Completion Works Agreed Resolution"	means the technical solution required to resolve the Dispute in respect of the Post Completion Disputed Works and the obligations on each Party to meet (or procure the meeting of) that agreed technical solution to meet the Post Completion Works Completion Criteria all as detailed in the column entitled "Description of Post Completion Works Agreed Resolution" in Part A of Part 5 of the Schedule (Post Completion Works);
"Post Completion Works Completion Criteria"	means the Drainage Completion Criteria, the Void Detection Completion Criteria and the Heater Battery Completion Criteria as set out in Part C of Part 5 of the Schedule (Post Completion Works);
"Post Completion Works Longstop Date"	means 26th July 2019 or such later date as may be specified by the Board's Representative pursuant to Clause 29 (Delay Events) of the Project Agreement or such other date as may be agreed by the Parties;
"RDD Status C Submitted Items"	means the documentation submitted by Project Co for review under Schedule Part 8 (Review Procedure) of the Project Agreement which has been endorsed Level C by the Board in relation to: (i) De-Watering; (ii) Geotechnical Reports; (iii) the Concrete Specification; (iv) the Submains Schedule; and (v) Energy Centre Lighting Calcs;
"Released Claims"	subject to Clause 3.9, any actions, claims, liabilities, rights, demands and set-offs, counterclaims whether in this jurisdiction or any other, including but not limited to claims arising from rights acquired from third parties, whether known to the Parties or not and whether in law or equity, that it, its parent, subsidiaries, assigns, successors, transferees, novatees, representatives, principals, agents, contractors, subcontractors of any tier, officers, employees or directors, or any of them ever had, may have or hereafter can, shall or may have against the other Party or any other of its present and former parent, subsidiaries, assigns, transferees, representatives, principals, agents, contractors, officers or directors arising out of or connected with: (a) the Dispute; (b) the underlying facts relating to the Dispute; (c) any act, omission, breach, default, negligence or failure to comply with the Project Agreement (as revised pursuant to this SA1) in relation to the Dispute; (d) the Agreed Resolution (save that nothing in this provision is intended to release Project Co's obligation to carry out and complete the technical solution required in order to achieve the Agreed Resolution);

(e) the Post Completion Works Agreed Resolution (save that nothing in this provision is intended to release Project Co's obligation to carry out and complete the technical solution required in order to achieve the Post Completion Works Agreed Resolution);

(f) subject to Clauses 3.9.5, 3.9.6 and 3.9.7, any relief available to Project Co pursuant to Clause 29 of the Project Agreement (Delay Events) and/ or Clause 30 of the Project Agreement (Relief Events) arising prior to the SA1 Effective Date including (without limitation) all notifications issued pursuant to Clause 29.4 of the Project Agreement (Delay Events) by Project Co prior to 21 February 2019;

"SA1"	means this supplemental agreement to the Project Agreement including the Schedule;
"SA1 Effective Date"	has the meaning given to Clause 2.1;
"Schedule"	means the schedule (in 10 parts) annexed to this SA1;
"Settlement Sum"	has the meaning given in Clause 4.1 (Payment);
"Submains Schedule"	means the dispute between the Parties relative to whether the low voltage cable design and supporting calculations fully comply with BS7671;
"Void Detection Completion Criteria"	means the void detection completion criteria as set out in Part C of Part 5 of the Schedule (Post Completion Works);
"Void Detection Works"	means the void detection works as described in Parts A and B of Part 5 of the Schedule (Post Completion Works).

2. COMMENCEMENT AND DURATION

2.1 This SA1 and the rights and obligations of the Parties shall commence on the date of effectiveness as provided for in Clause 15 (Counterparts and Delivery) ("**SA1 Effective Date**") and, without prejudice to Clause 47.6 (Continuing Obligations) of the Project Agreement, shall terminate automatically on the expiry of the Project Term or earlier termination of the Project Agreement, as applicable.

DELIVERY OF DOCUMENTS

2.2 On or prior to the execution of this SA1, the Board shall deliver to ProjectCo the following documents (unless the requirement to deliver any such document is waived by ProjectCo by written notice to the Board):

2.2.1 A certified copy of the resolution of the Board approving the amendments to the Project Agreement and authorising a named person to execute this SA1 and documents to be delivered by it pursuant thereto;

2.2.2 A certificate of the relevant officer of the Board setting out the names and specimen signatures of the person or persons named in the resolution of the Board referred to in Clause 2.2.1 above;

2.2.3 An externally financed development agreement certificate under the National Health Service (Private Finance) Act 1997;

2.2.4 A counterpart of the supplemental agreement to the Funders' Direct Agreement signed by the Board.

2.3 On or prior to the execution of this SA1, ProjectCo shall deliver to the Board the following documents (unless the requirement to deliver any such document is waived by the Board by written notice to ProjectCo):

2.3.1 Extracts of the minutes of the meeting of the board of directors (certified as true and accurate by the company secretory, director or authorised signatory) of Project Co at which resolutions were passed approving the amendments to the Project Agreement, the Ancillary Documents and the Initial Funding Documents and approving the execution, delivery and performance of this SA1 and the Construction Contract Supplemental Agreement by Project Co and in each case authorising a named person or persons to execute and deliver each such document and any other documents to be delivered by it pursuant to it;

2.3.2 A certificate, certified by the company secretary, director or authorised signatory of Project Co, setting out the names and specimen signatures of the person or persons named in the relevant certified extract;

2.3.3 Extracts from the minutes of the meeting of the board of directors (certified as true and accurate by the Secretary, Director or authorised signatory) of the Contractor at which resolutions were passed approving the execution, delivery and performance of the Construction Contract Supplemental Agreement and authorising a named person or persons to execute and deliver such document and any other documents to be delivered by it pursuant to it;

[redacted] 2.3.4 Copies of consents from Project Co's shareholders including Hold Co and Top Co (certified as true and accurate by the company secretory, director or authorised signatory to Project Co) approving the execution, delivery and performance of each relevant document to which such entity is expressed to be a party;

2.3.5 Counterparts of the supplemental agreement to the Funders' Direct Agreement signed by the Security Trustee and Project Co.

2.4 Following signature of this SA1, Project Co shall provide the Board with copies of the following documentation:

2.4.1 certified true copy of consent from the Senior Funders to the amendments to the Project Agreement, the Construction Contract and the Initial Funding Documents;

2.4.2 certified true copy of the Construction Contract Supplemental Agreement.

2.4.3 executed side letter to the Performance Guarantee entered into in relation to the Construction Contract Supplemental Agreement.

3. SETTLEMENT AND RELEASE

3.1 In respect of the Agreed Resolution:

3.1.1 subject to:

(a) Clause 29 (Delay Events) of the Project Agreement and Clause 30 (Relief Events) of the Project Agreement;

(b) any future amendment of this SA1 (which shall be agreed by both Parties in writing); and/or

(c) Clause 3.9.4 (Settlement and Release);

Project Co shall design, construct, test, commission and complete the Works (other than the Post Completion Works and Outstanding Works) and Facilities in accordance with the Project Agreement as amended by the Agreed Resolution so as to satisfy the Completion Criteria as amended by the Agreed Resolution and all other terms of the Project Agreement (as revised pursuant to this SA1) and this SA1;

3.1.2 without prejudice to Project Co's rights in respect of Future Claims, Clause 3.9.5, Clause 3.9.6, Clause 3.9.7 and/ or Clause 4 (Payment), Project Co waives any and all actions, claims, liabilities, rights, demands, set-offs and counterclaims to additional payment (including without limitation any adjustment to the Annual Service Payment and/or a Monthly Service Payment and/ or Capital Expenditure) and/ or any extension of time to the Completion Date arising out of or in any way connected with the Agreed Resolution; and

3.1.3 the Board shall comply with any obligations it has pursuant to Part 1 of the Schedule (Technical Schedule).

3.2 The Board and Project Co agree that the Agreed Resolution:

3.2.1 resolves the Dispute (with the exception of the Post Completion Disputed Works) between the Board and Project Co;

3.2.2 shall be used by the Independent Tester for the purposes of interpreting the relevant aspects of the Completion Criteria as amended by the Agreed Resolution for those parts of the Works (other than the Outstanding Works and the Post Completion Works) detailed in Part 1 of the Schedule (Technical Schedule) which are the subject of the Dispute (other than the Post Completion Disputed Works), and, for the avoidance of doubt, the provisions of Clause 17 (Pre-Completion Commissioning and Completion) of the Project Agreement apply (subject to Clause 3.5) mutatis mutandis to the Works as amended by the Agreed Resolution (other than the Outstanding Works and the Post Completion Works) for the purposes of the Independent Tester issuing the Certificate of Practical Completion for the Works as amended by the Agreed Resolution (other than the Outstanding Works and the Post Completion Works);

3.2.3 shall not dilute:

(a) Project Co's obligation to continue to comply with all relevant obligations relative to the Project Operations pursuant to the Project Agreement (as revised pursuant to this SA1), including for the avoidance of doubt Clause 12.3 (Design responsibility) of the Project Agreement, Snagging Matters, Defects, obligations under Schedule Part 31 of the Project Agreement and/or any other obligations of Project Co relative to the Project Operations in respect of the Project Agreement (as revised pursuant to this SA1); and/or

(b) the Board's rights pursuant to the Project Agreement (as revised pursuant to this SA1), including for the avoidance of doubt rights of inspection, rights to issue Warning Notices, rights and remedies of the Board pursuant to the Payment Mechanism and/or any other rights and remedies of the Board relative to the Project Operations in respect of the Project Agreement (as revised pursuant to this SA1); and/or

(c) the Completion Criteria for those parts of the Works which are not the subject of the Dispute and which are not part of the Post Completion Works or Outstanding Works; and/or

(d) the Parties rights and/or obligations in respect of the Outstanding Works and the Post Completion Works;

3.2.4 for the avoidance of doubt, is a variation to the Works as varied, amended or supplemented in accordance with this SA1 (save that such variation shall not entitle

Project Co to any additional payment and / or extension of time other than to the extent set out in this SA1).

3.2A Notwithstanding the RDD Status C Submitted Items, the Parties shall procure that the Independent Tester shall issue a Certificate of Practical Completion for the Works in accordance with Clause 3.3.1. Except as amended in this SA1, all other rights and obligations in relation to the Concrete Specification, De-Watering, Geotechnical Reports and Submains Schedule are wholly reserved.

3.3 Pursuant to paragraph 3.1 (Varied Services) of the Independent Tester Contract, Project Co undertakes and agrees to instruct Project Co's Representative and the Board undertakes and agrees to instruct the Board's Representative, to jointly instruct the Independent Tester to procure that the Independent Tester shall provide the following Varied Services:

3.3.1 issue the Certificate of Practical Completion pursuant to Clause 17.12 (Completion Certificate) of the Project Agreement (as revised pursuant to this SA1) when he is satisfied that the Facilities and the Retained Estate Handback Infrastructure are complete in accordance with the Completion Criteria as amended pursuant to this SA1 and the other relevant provisions of the Project Agreement (as revised pursuant to this SA1) notwithstanding:

(a) any requirement to procure the completion of: (i) the Outstanding Works in accordance with Clause 6.14; (ii) the Post Completion Works in accordance with Clause 6.11; and/ or (iii) the RDD Status C Submitted Items;

(b) the dispute between the Parties regarding the Concrete Specification, De-Watering, Geotechnical Reports, Submains Schedule and the Energy Centre Lighting Calcs; and

(c) that there are Snagging Matters;

3.3.2 certify the relevant works comprising Milestone 2, Milestone 3 and/ or Milestone 4 as the case may be as complete when the Independent Tester is satisfied that the works comprising Milestone 2, Milestone 3 and/ or Milestone 4 as the case may be are complete in accordance with the relevant Post Completion Works Completion Criteria and all other provisions of the Project Agreement (as amended by SA1) notwithstanding:

(a) any requirement to procure the completion of: (a) the other Post Completion Works (to the extent not yet complete); (b) the Outstanding Works (to the extent not yet complete); and/or (c) the RDD Status C Submitted Items;

(b) the dispute between the Parties regarding the Concrete Specification, De-Watering, Geotechnical Reports, Submains Schedule, the Energy Centre Lighting Calcs any other disputes which arise after the SA1 Effective Date or any Future Claims;

(c) that there are Snagging Matters;

(d) that there are any defects in the Works not forming part of the applicable Post Completion Works;

3.3.3 issue certificates to the Board and Project Co confirming achievement of Milestone 2, Milestone 3 and Milestone 4;

3.3.4 certify the relevant works comprising the Outstanding Works as complete when the Independent Tester is satisfied that the Outstanding Works are complete in accordance with the Outstanding Works Completion Criteria and all other relevant provisions of the Project Agreement (as amended by SA1) notwithstanding:

(a) any requirement to procure the completion of: (a) the Post Completion Works (to the extent not yet complete); (b) the Outstanding Works Exclusions; and/or (c) the RDD Status C Submitted Items;

(b) the dispute between the Parties regarding the Concrete Specification, De-Watering, Geotechnical Reports and Submains Schedule, any other disputes which arise after the SA1 Effective Date or any Future Claims;

(c) that there are Snagging Matters;

(d) that there are any defects in the Works not forming part of the applicable Outstanding Works;

3.3.5 perform the other Independent Tester Services as detailed in the Independent Tester Varied Services Letter in Part 9 of the Schedule (Independent Tester Varied Services Letter).

3.4 Project Co undertakes and agrees to instruct Project Co's Representative and the Board undertakes and agrees to instruct the Board's Representative to sign and issue the Independent Tester Varied Services Letter to the Independent Tester on the SA1 Effective Date.

3.5 The Parties agree that the Independent Tester Varied Services Letter shall be deemed to be sufficient notification to the Independent Tester pursuant to Clause 17.5 (Pre-Completion Commissioning and Completion) of the Project Agreement of the date when Project Co believes (acting reasonably) that the Works as amended by the Agreed Resolution (other than the Post Completion Works and Outstanding Works) shall be complete.

3.6 The fee for the Varied Services which, for the avoidance of doubt, shall apply from the Actual Completion Date, shall be shared equally between the Board and Project Co.

3.7 The Settlement Sum shall not be adjusted or altered in any way whatsoever otherwise than in accordance with this SA1 and/ or the Project Agreement (as revised pursuant to this SA1).

3.8 This SA1 is in full and final settlement and full satisfaction of, and each Party hereby releases and forever discharges, all Released Claims.

3.9 For the avoidance of doubt, Released Claims shall not include:

3.9.1 any claim arising out of the Parties' rights and obligations under this SA1;

3.9.2 any Future Claim;

3.9.3 any issues, claims and disputes between the Parties arising out of or in connection with the water damage following the burst pipe which occurred at the Facilities on Thursday 7 June 2018 ("Water Damage"), including any entitlement of any Insureds (pursuant to Section 1 of Schedule Part 15 (Insurance Requirements)) of the Project Agreement to insurance proceeds under the Insurances set out in Section 1 of Schedule Part 15 (Insurance Requirements) of the Project Agreement in relation to the Water Damage, provided that (without prejudice to the Board's position as to whether there is an entitlement to a Relief Event pursuant to the Project Agreement) any claim under the Project Agreement for a Relief Event in respect of the Water Damage shall not result in any relief from the obligations of Project Co pursuant to the Project Agreement, including (without limitation) their rights pursuant to Clause 40.1.2 (Longstop) of the Project Agreement;

3.9.4 any issues, claims and disputes between the Parties arising out of or in connection with defective workmanship, defective installation, latent defects, faults and/or Snagging Matters, whether or not currently known or unknown to the Parties;

3.9.5 in connection with the Board Changes listed in Part 1 of Schedule Part 8 (Board Changes):

(a) if the Board Change is agreed and instructed by 28 February 2019, and the scope of the Board Change has not materially changed from that reviewed by Project Co as at 21 February 2019, Project Co's rights to any Change in Costs set out at limb (g) and (h) only of Section 1 of Schedule Part 16 (Change Protocol); or

(b) if Clause 3.9.5(a) above does not apply, Project Co's rights to any Change in Costs set out at Section 1 of Schedule Part 16 (Change Protocol);

3.9.6 in connection with the Board Changes listed in Part 2 of Schedule Part 8 (Board Changes) any Change in Costs set out at limb (g) only of Section 1 of Schedule Part 16 (Change Protocol);

3.9.7 any rights, obligations, reliefs or liabilities of the Parties pursuant to Schedule Part 16 (Change Protocol) or otherwise arising as a result of Board Change reference 172 (hospital square and toucan crossing installation).

3.9A In connection with the Board Changes listed in Part 1 of Schedule Part 8 (Board Changes), if the Board Change is agreed and instructed by 28 February 2019 and the scope of the Board Change has not materially changed from that reviewed by Project Co as at 21 February 2019, Project Co shall complete said Board Change by 13 June 2019 or such other date as the Parties agree (acting reasonably).

3.10 This SA1 and its terms and provisions are made and agreed without any admission by the Parties of liability, obligation or fact of any nature or kind whatsoever.

3.11 Not used.

3.12 The Parties shall comply with the provisions of Part 10 of the Schedule (Independent Tester Representations) in respect of the matters detailed therein provided that the Independent Tester agrees to the variation of services pursuant to the Independent Tester Varied Services Letter in Part 9 of the Schedule (Independent Tester Varied Services Letter).

4. PAYMENT

4.1 In consideration of: (i) Project Co carrying out its obligations in compliance with Clause 3.1.1 and clause 6.11; (ii) the costs of the Agreed Resolution; (iii) associated on-site costs; and (iv) senior debt funding payable by Project Co pursuant to the Common Terms Agreement in the period from 20 April 2018 to 31 October 2018; the Board shall pay £11,600,000 plus VAT (the "**Settlement Sum**") to Project Co in instalments on the payment dates set out in Part 7 of the Schedule (Payment and Milestones).

4.2 If the Board fails to pay any instalment of the Settlement Sum by the payment date for that instalment as set out in Part 7 of the Schedule (Payment and Instalments) (a "**Failed Instalment**"), Project Co shall notify the Board in writing that there has been a Failed Instalment as soon as reasonably practicable after it becomes aware that a Failed Instalment has occurred. Unless the Board pays that Failed Instalment within seven (7) days of the date of the notice, the Failed Instalment shall become immediately payable by the Board in full. The Board shall pay interest on any Failed Instalment in accordance with Clause 34.5 (Late Payment) of the Project Agreement.

4.3 On the occurrence of a failure by the Board to pay a Failed Instalment in accordance with Clause 4.1, Project Co:

4.3.1 may suspend performance by it of its obligations under this SA1 and the Project Agreement (as revised pursuant to this SA1) until such time as the Board has rectified such failure; and

4.3.2 shall be entitled to claim a Delay Event and (subsequently) a Compensation Event in accordance with Clause 29 of the Project Agreement (Delay Events), and the calculation of the relevant compensation pursuant to Clause 29.11 of the Project Agreement shall include (without limitation) the debt service costs payable by Project Co during such period of suspension.

4.4 Without prejudice to Clause 4.1, the Parties will each bear their own costs in relation to the Dispute and the negotiation, execution and implementation of this SA1.

4.5 Given that reasonable costs and expenses were to be due:

4.5.1 to the Board from Project Co, in relation to assessing and amending the Project Co Change for the CCTV Works, assessing and amending the CCTV Works Proposals and assessing and amending any provisional Amended Proposal and/or final Amended Proposal to the extent not already covered by the CCTV Works Proposal with regard to the CCTV Works in the Yellow Area; and

4.5.2 to Project Co from the Board, in relation to drafting and negotiating the element of this SA1 which relates to Gross Service Units;

the Parties have agreed that in consideration of the net effect of these costs, it would be prudent for each Party to be responsible for paying its own costs and expenses incurred in connection with Clauses 4.5.1 and 4.5.2.

5. AGREEMENT NOT TO SUE

5.1 Each Party agrees, on behalf of itself and on behalf of its parent, subsidiaries, assigns, successors, transferees, novatees, representatives, principals, agents, contractors, subcontractors of any tier, officers, employees or directors, not to sue, commence, voluntarily aid in any way, prosecute or cause to be commenced or prosecuted against the other Party or its parent, subsidiaries, assigns, successors, transferees, novatees, representatives, principals, agents, contractors, subcontractors of any tier, officers, employees or directors, any action, suit or other proceedings concerning the Released Claims, in this jurisdiction or any other.

5.2 Any Party in default of the agreement in Clause 5.1 above will fully indemnify the other Party against all losses, liability (including without limitation liability in damages, liability to make a contribution, liability to indemnify and liability to pay any sum or incur any expense), costs and expenses of whatever nature sustained by them by reason of such default.

5.3 For the avoidance of doubt, the provisions of this Clause 5 shall not affect the Parties' rights to enforce the terms of this SA1 and/or the Project Agreement (as revised pursuant to this SA1) including their respective rights, claims and entitlements under or arising out of this SA1 and/or the Project Agreement (as revised pursuant to this SA1) and to insist on performance by the other Party of its obligations and liabilities under or arising out of this SA1 and/or the Project Agreement (as revised pursuant to this SA1).

6. AMENDMENTS TO PROJECT AGREEMENT

6.1 The Parties agree that in order to give effect to this SA1, the provisions of the Project Agreement and other documents referred to in Part 1 of the Schedule (Technical Schedule) and Parts A and B of Part 5 of the Schedule (Post Completion Works) shall be:

6.1.1 supplemented and amended as set out in Part 1 of the Schedule (Technical Schedule), Part A of Part 3 of the Schedule (Other Project Agreement Amendments) and/or Parts A and B Part 5 of the Schedule (Post Completion Works) as appropriate; and/ or

6.1.2 (where no express supplement or amendment is set out in Part 1 of the Schedule (Technical Schedule) and/or Parts A and B of Part 5 of the Schedule (Post Completion Works) deemed to have been supplemented and amended in order to give effect to the Agreed Resolution and/or the Post Completion Works Agreed Resolution;

with effect from the SA1 Effective Date.

6.1A The Parties agree that in order to give effect to the Project Co Change in respect of the CCTV Works and the amendment to the GSU table (in respect of Part D of Schedule Part 3 only), the provisions of the Project Agreement shall be supplemented and amended as follows with effect from the SA1 Effective Date:

(a) new amendments shall be inserted into the Project Agreement, as set out in Parts B, C and D of Schedule Part 3 (Other Project Agreement Amendments) of this SA1;

(b) without limitation, the CCTV Works Proposal shall apply to the CCTV Works;

(c) the TMS and Construction Access Strategy shall be deemed to apply to the CCTV Works; and

(d) the CCTV Works Proposal shall be deemed to be the relevant Access Strategy for the purpose of Part 2 of Schedule Part 31 (Consort Interface with Campus Site and/ or Campus Facilities) of the Project Agreement.

6.1B Project Co shall procure that the Contractor shall issue commissioning and testing methodology for the Post Completion Works to the Independent Tester and the Board's Representative not less than five (5) Business Days prior to the date when Project Co (acting reasonably) considers that the Contractor shall commence the Post Completion Works commissioning.

6.1C Project Co shall give the Independent Tester and the Board's Representative not less than three (3) Business Days notice of the date upon which Project Co considers that the Outstanding Works (other than the Outstanding Works Exclusions), Drainage Works, Void Detection Works or Heater Battery Works will be complete and the relevant tests on completion will be carried out. Following receipt of such notice, the Board's Representative and the Independent Tester shall be entitled to inspect the Outstanding Works (other than the Outstanding Works Exclusions), Drainage Works, Void Detection Works or Heater Battery Works (as the case may be) on the date or dates reasonably specified by Project Co, and to attend any of the tests on completion. Project Co shall, if so requested, accompany the Board's Representative and the Independent Tester on any such inspection.

6.1D Subject to Clause 3.3, the Parties shall procure that the Independent Tester, within three (3) Business Days of any inspection made pursuant to Clause 6.1C, notifies Project Co and the Board of any outstanding matters which are required to be attended to before the Outstanding Works (other than the Outstanding Works Exclusions), Drainage Works, Void Detection Works or Heater Battery Works (as the case may be) can be considered to be complete. Project Co shall attend to such matters.

6.1E Any:

(a) failure by the Independent Tester to comply with Clauses 6.1C or 6.1D above, or to certify or issue a certificate in respect of the Post Completion Works pursuant to Clause 3.3.2 or Outstanding Works pursuant to Clause 3.3.4;

(b) assertion by the Independent Tester pursuant to Clause 6.1D that the relevant Post Completion Works Completion Criteria or Outstanding Works Completion Criteria has not been met;

shall be deemed to be confirmation that the Independent Tester does not agree that the relevant Post Completion Works Completion Criteria or Outstanding Works Completion Criteria has been met, and such dispute shall be capable of reference by Project Co to the Dispute Resolution Procedure.

6.2 The Parties agree that all such supplements and amendments as set out in this SA1:

6.2.1 shall, in the event of any inconsistency with the provisions of the Project Agreement or other document referred to in Part 1 of the Schedule (Technical Schedule) and/or Parts A and B of Part 5 of the Schedule (Post Completion Works), take precedence over the Project Agreement or other such document; and

6.2.2 shall be deemed to have been agreed in accordance with the Project Agreement, and that the entry into of this SA1 shall not constitute a breach by either Party of the Project Agreement.

6.3 Project Co shall carry out its obligations pursuant to the Project Agreement as supplemented and amended by this SA1.

6.4 The Parties agree that the design of:

6.4.1 the works set out in Part 1 of the Schedule (Technical Schedule);

6.4.2 the works set out in Parts A and B of Part 5 of the Schedule (Post Completion Works);

6.4.3 the Outstanding Works; and

6.4.4 the CCTV Works;

shall be deemed to have been submitted and reviewed in accordance with Clause 12 (The Design Construction and Commissioning Process) of the Project Agreement and that the Board has confirmed that Project Co is entitled to proceed with construction. Any such design shall be deemed to be an Approved RDD Item. Notwithstanding Clause 12 (The Design Construction and Commissioning Process) of the Project Agreement, such design shall not need to be submitted to the Board for review under Schedule Part 8 (Review Procedure) of the Project Agreement.

6.5 In relation to the Agreed Resolution and the Post Completion Works Agreed Resolution, the Board shall not be entitled to make a finding pursuant to Clause 12.7 (Rectification of Project Co's Proposals) of the Project Agreement that Project Co's Proposals do not fulfil the Board's Construction Requirements to the extent that Project Co's Proposals have been amended or supplemented pursuant to this SA1.

6.6 The Parties agree that the Joint Completion Programme:

6.6.1 is the revised Programme for the purposes of the Project Agreement (as revised pursuant to this SA1);

6.6.2 meets the requirements of, and have been agreed in accordance with, Clause 14 (Programme and Dates for Completion) of the Project Agreement; and

6.6.3 notwithstanding Clause 14 (Programme and Dates for Completion) of the Project Agreement, does not need to be submitted to the Board for review under Schedule Part 8 (Review Procedure) of the Project Agreement.

6.7 The Parties agree that the Joint Completion Programme:

6.7.1 is the revised Final Commissioning Programme for the purposes of the Project Agreement (as revised pursuant to this SA1);

6.7.2 meets the requirements of, and have been agreed in accordance with, Clause 17 (Programme and Dates for Completion) of the Project Agreement; and

6.7.3 notwithstanding Clause 17 (Programme and Dates for Completion) of the Project Agreement, does not need to be submitted to the Board for review under Schedule Part 8 (Review Procedure) of the Project Agreement.

6.8 Project Co shall issue the Joint Completion Programme to the Independent Tester on or about the SA1 Effective Date failing which the Board shall be entitled to do so.

6.9 Save as amended and supplemented in accordance with this SA1, the Project Agreement shall continue in full force and effect.

6.9A For the avoidance of doubt, Project Co shall act as "client" and Project Co shall procure that the Contractor shall act as "principal contractor" and "principal designer" for the purposes of the CDM Regulations for the works which form part of the Post Completion Works or Outstanding Works or works which are included in the Joint Completion Programme until completion of the Post Completion Works and the Outstanding Works. Unless and / or until the Post Completion Works Longstop Date, no works additional to those specified in the Joint Completion Programme shall be undertaken by the Board at the Site prior to completion of the Post Completion Works without the prior consent of Project Co (which consent shall not be unreasonably withheld). Unless and / or until the Post Completion Works Longstop Date, no agents, contractors or sub-contractors of any tier of the Board shall access the Site prior to completion of the Post Completion Works without the prior consent of Project Co (which consent shall not be unreasonably withheld).

6.10 Project Co shall procure that the Project insurances which Project Co is obliged to procure pursuant to Clause 53 (Insurance) of the Project Agreement shall apply equally to the works which form part of the Agreed Resolution, the Post Completion Works and the Outstanding Works.

Post Completion Works and Outstanding Works

6.11 Project Co shall design, construct, test, commission and complete the Post Completion Works as follows:-

Milestone 2 by Milestone 2 Target Completion Date;

Milestone 3 by Milestone 3 Target Completion Date; and

Milestone 4 by Milestone 4 Target Completion Date;

all in accordance with the Project Agreement as amended by this SA1 and the Post Completion Works Agreed Resolution so as to satisfy the Post Completion Works Completion Criteria and all other terms of the Project Agreement (as revised pursuant to this SA1) and this SA1.

6.12 For the avoidance of doubt:

6.12.1 completion of the Post Completion Works and the Outstanding Works shall not be a requirement for the issue of a Certificate of Practical Completion by the Independent Tester pursuant to Clause 17.12 (Completion Certificate) of the Project Agreement or the occurrence of the Actual Completion Date, and the Certificate of Practical Completion shall be issued notwithstanding the dispute between the Parties regarding the Concrete Specification, De-Watering, Geotechnical Reports, Submains Schedule and the Energy Centre Lighting Calcs;

6.12.2 the Independent Tester shall certify the relevant works comprising:

(a) Milestone 2, Milestone 3 and/ or Milestone 4 as the case may be each in accordance with Clause 3.3.2; and

(b) the Outstanding Works in accordance with Clause 3.3.4;

and in accordance with Schedule Part 9 (Independent Tester Varied Services Letter)the Independent Tester shall issue the Certificate of Practical Completion in accordance with Clause 3.3.1;

6.12.3 the Post Completion Works and the Outstanding Works form part of the Facilities; and

6.12.4 the provisions of Clause 29 (Delay Events) and Clause 30 (Relief Events) of the Project Agreement shall apply mutatis mutandis to the Post Completion Works and Outstanding Works, provided that the Milestone 2 Target Completion Date and/or Milestone 3 Target Completion Date and/or Milestone 4 Target Completion Date and/ or the Outstanding Works Target Completion Date (as applicable) and/ or, in respect of the Post Completion Works only, the Post Completion Works Longstop Date (rather than the Completion Date) shall be revised in such circumstances.

6.13A The Board shall comply with any obligations it has pursuant to Parts A and B of Part 5 of the Schedule (Post Completion Works).

6.13 The Board and Project Co agree that the Post Completion Works Agreed Resolution:

6.13.1 resolves the Dispute between the Board and Project Co in respect of the Post Completion Disputed Works;

6.13.2 for the avoidance of doubt, is a variation to the Works as varied, amended or supplemented in accordance with this SA1; and

6.13.3 shall not dilute Project Co's obligation to continue to comply with all relevant obligations relative to the Project Operations pursuant to the Project Agreement (as revised pursuant to this SA1), including for the avoidance of doubt Clause 12.3 (Design responsibility) of the Project Agreement, Snagging Matters, Defects, obligations under Schedule Part 31 of the Project Agreement and/or any other obligations of Project Co relative to the Project Operations in respect of the Project Agreement (as revised pursuant to this SA1).

6.14 Project Co shall carry out and complete the Outstanding Works by the Outstanding Works Target Completion Date all in accordance with the Project Agreement as amended by Schedule Part 6 (Outstanding Works), the Outstanding Works Completion Criteria and all other terms of the Project Agreement (as revised pursuant to this SA1) and this SA1.

6.14A Without prejudice to Project Co's rights in respect of Future Claims, Clause 3.9.5 (Settlement and Release), Clause 3.9.6 (Settlement and Release), Clause 3.9.7 (Settlement and Release), Clause 4 (Payment) and/or Clause 6.17, Project Co waives any and all actions, claims, liabilities, rights, demands, set-offs and counterclaims to additional payment (including without limitation any adjustment to the Annual Service Payment and/or a Monthly Service Payment and/ or Capital Expenditure) and/ or any extension of time to the Completion Date arising out of or in any way connected with the Post Completion Works Agreed Resolution or the Outstanding Works.

6.15 Project Co shall not be obliged to provide any Services to any part of the Facilities directly affected by the carrying out of the Drainage Works providing that such relief shall only apply from the Actual Completion Date until the Milestone 2 Completion Date. The Parties shall agree a process for access to areas of the Facilities in accordance with the Joint Completion Programme where Post Completion Works and/ or Outstanding Works require to be undertaken.

6.16 No Deduction shall apply and the Board shall not issue a Warning Notice or exercise a right of termination pursuant to Clause 40.1.8 (Deductions) or Clause 40.1.9 (Warning Notices) of the Project Agreement where such Deduction, Warning Notice or right of termination arises solely as a result of the carrying out of the relevant Post Completion Works or Outstanding Works providing that such relief shall only apply from the Actual Completion Date until the Milestone 2 Target Completion Date (in respect of the Drainage Works) and / or Milestone 3 Target Completion Date (in respect of the Void Detection Works) and / or Milestone 4 Target Completion Date (in respect of the Heater Battery Works) and/ or the Outstanding Works Target Completion Date (in respect of the Outstanding Works).

6.17 From the Actual Completion Date until the Milestone 2 Completion Date, Milestone 3 Completion Date, Milestone 4 Completion Date and completion of the Outstanding Works (as applicable); or (if earlier) the Post Completion Works Longstop Date, where there is any joint occupation of the Facilities, the Board shall not, and shall procure that any Board Parties shall not, prevent or impede Project Co or any Project Co Party carrying out the Post Completion Works and Outstanding

Works, except where such prevention or impediment is necessary as a result of an act, omission, breach or default by Project Co or any Project Co Party which entitles the Board to take any action pursuant to the Project Agreement (as amended by this SA1). Where such prevention or impediment occurs, Project Co shall be entitled to claim a Delay Event pursuant to Clause 29.3.2 (Delay Events) of the Project Agreement and a Compensation Event in accordance with Clause 29 (Delay Events) of the Project Agreement provided that the Milestone 2 Target Completion Date and / or Milestone 3 Target Completion Date and / or Milestone 4 Target Completion Date and / or the Outstanding Works Target Completion Date (as applicable) and, in respect of the Post Completion Works only, the Post Completion Works Longstop Date (rather than the Completion Date) shall be revised in such circumstances.

6.18 From the Actual Completion Date until Milestone 2 Completion Date, Milestone 3 Completion Date, Milestone 4 Completion Date and completion of the Outstanding Works (as applicable), where there is any period of joint occupation of the Facilities, Project Co and Project Co Parties shall not prevent or impede the Board carrying out the Board's Post Completion Commissioning. Where Project Co or a Project Co Party prevents the Board from carrying out key elements of the Board's Post Completion Commissioning on the dates specified in the Joint Completion Programme, Project Co shall indemnify the Board against all reasonable and properly incurred Direct Losses sustained by the Board as a result of such prevention.

6.19 Subject to the terms of this SA1, any and all rights and entitlements of the Board, the Board's Representative and the Independent Tester and the obligations of Project Co that apply to the Works, prior to the Actual Completion Date, shall continue to apply in respect of the Post Completion Works and the Outstanding Works until the Milestone 2 Completion Date, Milestone 3 Completion Date, Milestone 4 Completion Date and completion of the Outstanding Works (as applicable).

6.20 **Project Co Changes**

Notwithstanding the express terms of the Board's acceptance of the Project Co Change acceptances provided to Project Co prior to the SA1 Effective Date, the Parties agree that such Project Co Changes are: (1) approved by Board pursuant to Section 5 of Schedule Part 16 of the Project Agreement (Change Protocol); and (2) accepted by Board as an Approved RDD Item in accordance with Schedule Part 8 of the Project Agreement (Review Procedure). The Board's right to make a Future Claim in relation to any such Project Co Change is however wholly reserved.

6.21 **Water Testing**

6.21.1 As per the requirements of SHTM 04-01 and L8, Project Co shall undertake a full suite of water analysis for all relevant water systems including storage tanks, domestic water, mains water, hot and cold water, and category 5 water systems in full compliance with SHTM04-01, and using the methodology of water testing undertaken by Project Co in January 2019, including any further points agreed with the Board. The foregoing tests shall be undertaken by Project Co on or before 27 February 2019 ("Water Tests").

6.21.2 The indicative results of the Water Tests shall be made available to the Board by Project Co on or before 5 March 2019. The complete results of the Water Tests shall be made available to the Board by Project Co on or before 8 March 2019.

6.21.3 If the Water Tests results identify any non-compliance with SHTM 04-01, or give reasonable cause for concern by the IT that a future non-compliance may occur, Project Co undertake to address said non-compliance and / or potential non compliance as a matter of urgency in accordance with Project Co's obligations pursuant to the Project Agreement (as amended by this SA1), taking account of any submissions from the Board's Representative.

6.22 **L8 risk assessment**

6.22.1 In accordance with SHTM 04-01, Project Co shall provide a suitable and sufficient water safety management risk assessment to the Board's Representative for review under Schedule Part 8 (Review Procedure) by 11 March 2019.

6.23 **L8 water management regime**

6.23.1 In accordance with SHTM 04-01, Project Co shall provide a suitable and sufficient water safety management regime, specifying the water safety management regime applicable to the following periods of the Operational Term:-

(a) The commissioning period – 22 February 2019 - 5 July 2019; and

(b) The period following full occupation of the Facilities by patients and staff – 5 July 2019 onwards,

to the Board's Representative for review under Schedule Part 8 (Review Procedure) by 11 March 2019.

6.24 Project Co shall include in the water safety management regime a flushing regime during the Board's commissioning period which ensures there are no Little Used Water Outlets on the system.

7. **AMENDMENTS TO OTHER PROJECT DOCUMENTS**

7.1 The Board acknowledges and consents (for all purposes of the Project Agreement (as revised pursuant to this SA1)) to Project Co entering into the Construction Contract Supplemental Agreement and the Performance Guarantee side letter in connection with this SA1 and confirms that Project Co entering into the Construction Contract Supplemental Agreement and Performance Guarantee side letter shall not constitute a breach of Project Co's obligations under the Project Agreement (as revised pursuant to this SA1). Project Co has provided the Board with copies of such supplemental agreement and side letter for their review prior to the SA1 Effective Date. The Board confirms that, notwithstanding the provisions of Clause 4.1 of the Project Agreement, such supplemental agreement and side letter do not need to be submitted to the Board for review under Schedule Part 8 (Review Procedure) of the Project Agreement.

7.2 The Board acknowledges and consents (for all purposes of the Project Agreement (as revised pursuant to this SA1)) to Project Co entering into agreements which are supplemental to the Funding Agreements and new Funding Agreements in connection with this SA1 and confirms that Project Co entering into such supplemental agreements and new Funding Agreements shall not constitute a breach of Project Co's obligations under the Project Agreement (as revised pursuant to this SA1). Project Co has provided the Board with copies of such supplemental agreements and new Funding Agreements for their review prior to the SA1 Effective Date. The Board confirms that, notwithstanding the provisions of Clause 4.6 of the Project Agreement, such supplemental agreements and new Funding Agreements do not need to be submitted to the Board for review not less than ten Business Days before signature of the relevant agreement.

7.3 Without prejudice to the generality of Clauses 7 and 7.2, the Board:

7.3.1 consents for the purposes of Clause 4.1 (Ancillary Documents) of the Project Agreement to making and agreeing material variations to any Ancillary Document, departing from its obligations (or waiving or allowing to lapse any rights it may have) or procuring that others depart from their obligations (or waiving or allowing to lapse any rights they may have) under any Ancillary Documents, and entering into (or permitting the entry into by any other person of) agreements replacing all or part of any Ancillary Document;

7.3.2 consents for the purposes of Clause 4.3 (Ancillary Documents) of the Project Agreement, to amendments of the Funding Agreements and Ancillary Documents which shall have the effect of increasing the Board's liabilities on early termination of the Project Agreement (as revised pursuant to this SA1), and the Board agrees that such documents, and any new Funding Agreements entered into in anticipation of this SA1, shall be deemed to be Subordinated Funding Agreements for the purposes of the Project Agreement (as revised pursuant to this SA1);

7.3.3 consents for the purposes of Clause 4.4 (Ancillary Documents) of the Project Agreement, to the variation, amendment, replacement and entry into of new Funding Agreements;

7.3.4 agrees for the purposes of Paragraph 8 of Schedule Part 23 (Refinancing) of the Project Agreement that it has been notified by Project Co of a Notifiable Financing, and waives any right it may have pursuant to Schedule Part 23 (Refinancing) of the Project Agreement in respect of such Notifiable Financing.

7.4 Based on the cashflows provided to the Board by Project Co on 12 January 2019:

7.4.1 Project Co warrants that the amendments and variations of the Funding Agreements entered into in anticipation of this SA1 shall not constitute a Refinancing and shall not result in a Refinancing Gain; and

7.4.2 the Board agrees that the amendments and variations of the Funding Agreements entered into in anticipation of this SA1 shall not result in a breach of Schedule Part 23 (Refinancing) of the Project Agreement.

7.5 Without prejudice to the terms of Clause 37 of the Project Agreement, both parties acknowledge that the Financial Model will require to be amended to reflect this SA1, the amendments to the Ancillary Documents and the amendments to the Funding Agreements ("**SA1 Financial Model Amendments**") and both parties undertake to work collaboratively and in good faith to reach agreement as soon as is reasonably practicable on the necessary SA1 Financial Model Amendments.

8. JOINT STEERING GROUP

8.1 The Parties and the Contractor shall establish a joint steering group to provide executive management and guidance over the key deliverables of the completion of the Works and the commissioning of the Facilities until completion of the Post Completion Works. The members of the joint steering group will meet at least once per month (or more or less regularly as required) to review progress against the Programme and the Joint Commissioning Programme set out in this SA1 and assist in resolving any matters which have become an issue or blockage in achieving the deliverables.

8.2 The initial members of the joint steering group shall be:

8.2.1 the Board: Jim Crombie and Susan Goldsmith;

8.2.2 Project Co: Richard Osborne, Tony Rose and/or Stephen Gordon; and

8.2.3 Contractor: Callum Tuckett and Ben Keenan.

8.3 Matt Templeton of Project Co will chair the joint steering group and will also be a member. No meeting shall proceed unless at least one member for the Board, one member for Project Co and one member of the Contractor is in attendance and in the case of Project Co, no more than two members shall attend any meeting. The Parties and the Contractor may remove their members and appoint replacements, by written notice delivered to the other Party at any time and in the case of the Contractor, Project Co shall or shall procure that the Board receives written notice. A member on the joint steering group may appoint and remove an alternate (who may be another representative of the applicable Party or the Contractor, as applicable) by written notice to all other members.

8.4 The joint steering group may adopt such procedures and practices for the conduct of the activities of the joint steering group as they consider appropriate, from time to time, provided that:

8.4.1 only decisions that are made unanimously by all of the members present at meetings shall have any effect;

8.4.2 the quorum for a meeting of the joint steering committee shall be two members comprising one member from each of the Board and Project Co.

8.5 Accurate written minutes of all quorate meetings of the joint steering group, which are approved by all members attending the applicable meeting shall be taken and kept by the joint steering group chair, and copies circulated promptly to the Parties. A full set of accurate and agreed written minutes shall be kept by Project Co and shall be open to inspection by the Parties and the Contractor at any time, upon request.

8.6 Neither the Board nor Project Co shall rely on any act or omission of the joint steering group nor any members acting in that capacity, so as to give rise to any waiver or personal bar in respect of any right, benefit, or claim and/or obligation and/or liability of any Party. Project Co shall ensure that the Contractor shall not rely on any act of omission of the joint steering group nor any members acting in that capacity, so as to give rise to any waiver or personal bar in respect of any right, benefit, or claim and/or obligation and/or liability of the Contractor.

9. CONTRACTS (THIRD PARTY RIGHTS) (SCOTLAND) ACT 2017

This SA1 does not create any rights in favour of third parties under the Contracts (Third Party Rights) (Scotland) Act 2017 to enforce or otherwise invoke any provision of this SA1.

10. VARIATION

Any variation of this SA1 shall be in writing and signed by or on behalf of each Party.

11. NON-REPETITION OF CLAIMS

Each Party withdraws all allegations and claims made by it in the Dispute or otherwise in any way related to the subject matter thereof against the other Party and undertakes not to repeat, or authorise the publication or repetition, of the same or any similar allegations or claims.

12. CONFIDENTIALITY

12.1 The fact, existence and terms of this SA1 and the negotiations which led to it are to remain confidential between the Parties save that they may be disclosed as follows:

12.1.1 the Board may make this SA1 freely available to the public (which may include, without limitation, publication on the Board's website pursuant to Clause 61.1. of the Project Agreement, but subject to the restrictions in Clause 61.2 of the Project Agreement which will apply *mutatis mutandis* to this SA1), and Project Co acknowledges and agrees that, subject to the exclusion of information referred to in Clause 61.2.2 of the Project Agreement, the provision or publication of this SA1 shall not give rise to any liability under the terms of this SA1 or the Project Agreement or otherwise. The Board shall notify Project Co in writing not less than ten (10) Business Days prior to any intended provision or publication of information pursuant to this Clause 12.1.1;

12.1.2 the parties agree that the provisions of this SA1, and the Construction Contract Supplemental Agreement which amends any Ancillary Document shall, subject to Clause 61.2.2 of the Project Agreement, not be treated as Confidential Information and may be disclosed without restriction and Project Co acknowledges that the Board shall, subject to Clause 61.2.2 of the Project Agreement be entitled to make this SA1 and the Construction Contract Supplemental Agreement which amends any Ancillary Document available in the public domain;

12.1.3 the Parties shall keep confidential all Confidential Information received by one party from the other party relating to this SA1 and the Construction Contract Supplemental Agreement which amends any Ancillary Document or the Project and shall use all reasonable endeavours to prevent their employees and agents from making any disclosure to any person of any such Confidential Information.

Permitted Disclosure

12.2 Clause 12.1.3 shall not apply to:

12.2.1 any disclosure of information that is reasonably required by any person engaged in the performance of their obligations under this SA1 for the performance of those obligations;

12.2.2 any matter which a party can demonstrate is already or becomes generally available and in the public domain otherwise than as a result of a breach of this Clause 12 and/or Clause 61 of the Project Agreement;

12.2.3 any disclosure to enable a determination to be made under the Dispute Resolution Procedure or in connection with a dispute between Project Co and any of its subcontractors;

12.2.4 any disclosure which is required pursuant to any Law or Parliamentary obligation placed upon the party making the disclosure or the rules of any stock exchange or governmental or regulatory authority having the force of law or, if not having the force of law, compliance with which is in accordance with the general practice of persons subject to the stock exchange or governmental or regulatory authority concerned;

12.2.5 any disclosure of information which is already lawfully in the possession of the receiving party, prior to its disclosure by the disclosing party;

12.2.6 any provision of information to the Parties' own professional advisers or insurance advisers or to the Senior Funders or the Senior Funders' professional advisers or insurance advisers or, where it is proposed that a person should or may provide funds (whether directly or indirectly and whether by loan, equity participation or otherwise) to Project Co to enable it to carry out its obligations under this SA1, or may wish to acquire shares in Project Co and/or Hold Co, Top Co and/or Mac Co in accordance with the provisions of this SA1 to that person or their respective professional advisers but only to the extent reasonably necessary to enable a decision to be taken on the proposal;

12.2.7 any disclosure by the Board of information relating to the design, construction, operation and maintenance of the Project and such other information as may be reasonably required for the purpose of conducting a due diligence exercise, to any proposed new contractor, its advisers and lenders, should the Board decide to retender the Project Agreement; or

12.2.8 any registration or recording of the Consents and property registration required;

12.2.9 any disclosure of information by the Board to any other department, office or agency of the Government or their respective advisers or to the Scottish Futures Trust or to any person engaged in providing services to the Board for any purpose related to or ancillary to this SA1;

12.2.10 any disclosure for the purpose of:

(a) the examination and certification of the Board's or Project Co's accounts;

(b) any examination pursuant to section 6(1) of the National Audit Act 1983 of the economy, efficiency and effectiveness with which the Board has used its resources;

(c) complying with a proper request from either party's insurance adviser, or insurer on placing or renewing any insurance policies; or

(d) (without prejudice to the generality of Clause 12.2.4) compliance with the FOI(S)A and/or the Environmental Information (Scotland) Regulations;

12.2.11 disclosure pursuant to Clause 61.1 of the Project Agreement or Clause 12.1 of this SA1; or

12.2.12 disclosure to the extent required pursuant to Clause 63.2 of the Project Agreement;

provided that, to avoid doubt, neither Clause 12.2.10(d) nor Clause 12.2.4 shall permit disclosure of Confidential Information otherwise prohibited by Clause 61.2.3 of the Project Agreement or Clause 12.1.3 of this SA1 where that information is exempt from disclosure under section 36 of the FOI(S)A.

12.3 Where disclosure is permitted under Clause 12.2, other than under Clauses 12.2.2, 12.2.4, 12.2.5, 12.2.8 and 12.2.10, the party providing the information shall procure that the recipient of the information shall be subject to the same obligation of confidentiality as that contained in this SA1.

12.4 Project Co shall not make use of this SA1 or any information issued or provided by or on behalf of the Board in connection with this SA1 otherwise than for the purpose of this SA1, except with the written consent of the Board.

12.5 Where Project Co, in carrying out its obligations under this SA1, is provided with information relating to any Board Party, Project Co shall not disclose or make use of any such information otherwise than for the purpose for which it was provided, unless Project Co has obtained the prior written consent of that person and has obtained the prior written consent of the Board.

12.6 On or before the Expiry Date, Project Co shall ensure that all documents or computer records in its possession, custody or control, which contain information relating to any patient or Board Party including any documents in the possession, custody or control of a Sub-Contractor, are delivered up to the Board.

12.7 The parties acknowledge that Audit Scotland has the right to publish details of this SA1 (including Commercially Sensitive Information) in its relevant reports to Parliament.

12.8 The provisions of this Clause 12 *(Confidentiality)* are without prejudice to the application of the Official Secrets Acts 1911 to 1989.

Announcements

12.9 Unless otherwise required by any Law or any regulatory or governmental authority (but only to that extent), neither Party shall make or permit or procure to be made any public announcement or disclosure (whether for publication in the press, the radio, television screen or any other medium) of any Confidential Information or in the case of Project Co of its (or any Project Co Party's) interest in the Project or, in any such case, any matters relating thereto, without the prior written consent of the other party (which shall not be unreasonably withheld or delayed).

13. NOT USED

14. ENTIRE AGREEMENT

14.1 Except where expressly provided otherwise in this SA1, this SA1 constitutes the entire agreement between the Parties in connection with its subject matter and supersedes all prior representations, communications, negotiations and understandings concerning the subject matter of this SA1.

14.2 Each of the Parties acknowledges that:

14.2.1 it does not enter into this SA1 on the basis of and does not rely, and has not relied, upon any statement or representation (whether negligent or innocent) or warranty or other provision (in any case whether oral, written, express or implied) made or agreed to by any person (whether a party to this SA1 or not) except those expressly repeated or referred to in this SA1 and the only remedy or remedies available in respect of any misrepresentation or untrue statement made to it shall be any remedy available under this SA1; and

14.2.2 this Clause shall not apply to any statement, representation or warranty made fraudulently, or to any provision of this SA1 which was induced by fraud, for which the remedies available shall be all those available under the law governing this SA1.

15. **COUNTERPARTS AND DELIVERY**

15.1 This SA1 may be executed in any number of counterparts and by each of the Parties on separate counterparts.

15.2 Where executed in counterparts:

15.2.1 this SA1 shall not take effect until both of the counterparts have been delivered; and

15.2.2 delivery will take place when the date of delivery is agreed between the Parties after execution of this SA1

15.3 Where not executed in counterparts, this SA1 shall become effective on the date agreed between the Parties.

16. **ASSIGNATION OF AGREEMENT**

16.1 This SA1 shall be binding on, and shall enure to the benefit of, Project Co (and, for the avoidance of doubt, any Suitable Substitute Contractor (if applicable)) and the Board and their respective statutory successors and permitted transferees and assignees. In the case of the Board, its successors shall include any person to whom the Scottish Ministers, in exercising their statutory powers to transfer property, rights and liabilities of the Board upon the Board ceasing to exist, transfers the property, rights and obligations of the Board under this SA1 and/or the Project Agreement (as revised pursuant to this SA1) and such other agreements in connection with the Project to which the Board and Project Co are both a party.

16.2 Project Co shall not, without the prior written consent of the Board, assign, novate, transfer, sub-contract or otherwise dispose of any interest in this SA1, and any other contract entered into by Project Co for the purposes of performing its obligations under or arising out of this SA1. To avoid doubt:

16.2.1 the Board agrees that Project Co shall be entitled to enter into the Construction Contract Supplemental Agreement and other contracts entered into by Project Co for the purposes of performing its obligations under or arising out of this SA1 on or around the SA1 Effective Date; and

16.2.2 the provisions of this Clause 16.2 do not apply to the grant of any security for any loan made to Project Co under the Initial Funding Agreements which grant was approved by the Board pursuant to clause 57.3.1 of the Project Agreement at Financial Close.

16.3 The Board shall be entitled to assign, transfer or dispose of the whole of this SA1 and/or of any agreement entered into in connection with this SA1 to which the Board and Project Co are both party to:

16.3.1 the Scottish Ministers, another Health Board or any other person or body replacing any of the foregoing (or to whom the Scottish Ministers exercising their statutory rights would be entitled to transfer such benefits) covered by the National Health Service (Residual Liabilities) Act 1996; or

16.3.2 any other person or body to whom the Project Agreement (as revised pursuant to this SA1) is being or has been assigned, transferred or disposed in accordance with Clause 57.4 of the Project Agreement; or

16.3.3 any other person or body with the prior written consent of Project Co (not to be unreasonably withheld or delayed);

provided that nothing in this Clause shall restrict the rights of the Scottish Ministers to effect a statutory transfer.

IN WITNESS WHEREOF these presents typewritten on this and the preceding 24 pages together with the Schedule in 10 Parts are executed by the Parties hereto as follows:

SIGNED for and on behalf of

LOTHIAN HEALTH BOARD

at EDINBURGH

on 22/02/19

by [redacted]

..... Authorised Signatory

V GOLDSMITH ..... Full Name

[redacted] .....

HANNAH MARSHALL Full Name

30 SEMPLE ST ..... Address
EDINBURGH

SIGNED for and on behalf of

IHS LOTHIAN LIMITED acting

[redacted] rector

MATTHEW TEMPLETON Full Name

before this witness

[redacted] .....

KIRSTY ELIN MCLEAN Full Name

PINSENT MASONS LLP ..... Address
SOLICITORS
PRINCES EXCHANGE
1 EARL GREY STREET
EDINBURGH
EH3 9AQ

SCHEDULE 1

PART 1

TECHNICAL SCHEDULE

Item	Dispute	Description of Agreed Resolution
1	**Lighting in fire fighting stairwells** The Board believes Project Co have designated_the 7 fire fighting shafts / stairwells for Emergency Evacuation as well as Fire Fighting. The Board believes this is confirmed in Project Co's Fire Strategy and MPX-RFI-002374. From a Fire Fighting perspective, the Board believes that as well as providing lighting for emergency evacuation, lighting is also required for life safety and fire fighting applications in accordance with BS 7671 and BS 5819. Project Co have not provided this lighting. Project Co's position is that the design and installation of the emergency lighting within the 7 fire fighting shaft / stairwells meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	For the lighting-lux levels in fire-fighting stairwells, Project Co have advised the Non-domestic Technical Handbook, clause 2.B.4 Escape lighting is the most appropriate guidance, and the Board agreed to proceed on that basis. Project Co are therefore required to procure approval to their lighting lux level proposal -in the 7 fire fighting shafts/stairwells from the Building Control Officer and the Independent Tester and Project Co will address any compliance requirements from Building Control Officer and the Independent Tester in accordance with the Project Agreement. Project Co are also required to procure approval from Building Control and the Independent Tester for any tests necessary for all stairwells to comply with the Non-domestic Technical Handbook, clause 2.B.4 Escape lighting. The testing information is as set out in Disputed Works Schedule Appendix 1 Item 4. The carrying out of such tests shall be witnessed by and all test results shall be shared with the Building Control Officer and the Independent Tester and the Board, and Project Co will address any compliance requirements from Building Control Officer and the Independent Tester (in accordance with the Project Agreement) arising from the testing.
2	**Non Fire rated IPS / UPS cabling** For compliance with BS 7671 and Guidance Note 7, and also BS 8519 circuits associated with essential life-support services should be either fire-rated or fire-protected. The implication of this is, in the event of a fire, power may be lost to essential life safety medical equipment in critical areas. The Board believes that Project Co has installed non fire rated cables to UPS boards serving critical areas. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). For the avoidance of doubt, this Dispute only relates to the fire	The agreed resolution of the Dispute submitted by Project Co through the Schedule Part 8 (Review Procedure) and agreed by the Board is set out below and has been given status Level A or Level B. Following a collaborative review of the design between the Board and Project Co, Project Co made changes to 11 Number sub mains cables from UPS switchboard to UPS distribution boards changing these to fire rated. The remaining UPS submains cables from UPS output board in the basement to the UPS distribution board were agreed by the Board and Project Co to be left unaltered. All as noted within Aconex chain of correspondence MPX-Transmit-010735 as set out in Disputed Works Schedule Appendix 1 Item 2. WW-SZ-B1-PL-531-101 Rev 1 UPS 1 Cable Route RDD Status A (13/4/18) WW-SZ-B1-PL-531-102 Rev 1 UPS 2 Cable Route RDD Status B (13/4/18) WW-SZ-B1-PL-531-103 Rev 1 UPS 3 Cable Route RDD Status B (13/4/18)

Item	Dispute	Description of Agreed Resolution
	rated cables serving the UPS output board in the basement to the UPS distribution board. All other IPS / UPS cabling is excluded from this Dispute. Each party disagrees with the other party's position and therefore a dispute has arisen.	WW-SZ-B1-PL-531-104 Rev 1 UPS 4 Cable Route RDD Status A (13/4/18) WW-SZ-B1-PL-531-105 Rev 1 UPS 5 Cable Route RDD Status B (13/4/18) WW-SZ-B1-PL-531-106 Rev 1 UPS 6 Cable Route RDD Status B (13/4/18) WW-SZ-B1-PL-531-107 Rev 1 UPS 7 Cable Route RDD Status A (13/4/18) WW-SZ-B1-PL-531-108 Rev 1 UPS 8 Cable Route RDD Status B (13/4/18) WW-SZ-B1-PL-531-109 Rev 1 Helipad Cable Route RDD Status A (13/4/18) WW-SZ-B1-PL-531-112 Rev 1 UPS 12 Cable Route RDD Status B (13/4/18) WW-SZ-B1-PL-531-114 Rev 1 UPS 14 Cable Route RDD Status A (13/4/18) WW-XX-XX-DC-XXX-010 Rev 3 IPS / UPS Cable Alternative RDD Status B (13/4/18) WW-XX-XX-SC-539-001 Rev G UPS System Schematic RDD Status A (13/4/18).
3	**No earth bonding in certain required areas** The Board's position is that no equipotential bonding has been installed in 180 Group 1&2 rooms. Equipotential bonding is required to prevent electric shock to patients, staff and visitors. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	In accordance with Schedule Part 8 (Review Procedure) the Room by Room Risk Profile as set out in Disputed Works Schedule Appendix 1 Item 3 produced by Project Co has been given status Level B, and the correct grouping and categorisation has been applied to the original 144 rooms mentioned in the description. In accordance with Schedule Part 8 (Review Procedure), the Board / Project Co agreed that a further 36 rooms will be modified. 35 to Group 1 Category 2, and 1 No Group 1 Category 3 in relation to providing equipotential bonding. Aconex MPX-TRANSMIT-010801 as set out in Disputed Works Schedule Appendix 1 Item 3 contains the Room by Room Risk Profile document at rev F and WW-SZ-SL-SH-500-011 Rev F Room by Room Risk Profile Reviewable Design Data Status B (4/5/18). Project Co to ensure all rooms are correctly categorised and grouped per SHTM 06-01 and BS 7671 Table 9.1 of Guidance Note 7. Exclusions are as set out in Disputed Works Schedule Appendix 1 Item 3.

Item	Dispute	Description of Agreed Resolution
4	**Bedroom ventilation pressure regime and air change rate in rooms for neutropenic patients** The Board's position is that the rooms for neutropenic patients should be designed as isolation rooms (+10 positive pressure). However, there are 12_single rooms which Project Co have designed to balanced pressure. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	The design and construction solution for 12_single bed rooms within the Haematology and Oncology Department has been approved through Schedule Part 8 (Review Procedure) and agreed by Project Co and the Board as resolving the Dispute, as set out in Disputed Works Schedule Appendix 1 Item 4. For clarity it is confirmed that the balanced pressure solution agreed is in accordance with the schedules reproduced in Section 1 of Disputed Works Schedule Appendix 1 Item 4 (Formally Project Co Change 050) – Neutropenic Patients Ventilation
5	**25% spare capacity** The Board's position is that 25% spare capacity should be provided by Project Co in terms of main and sub main distribution containment, UPS boards, AHU, physical space in voids and ceilings, risers. The Board are of the opinion that it is apparent from Site visits that the spare capacity has not been provided. Project Co's position is that the design and installation meets the requirements of the Project Agreement, was based on the package approved through Schedule Part 8 (Review Procedure), and spare capacity had been allowed in compliance with the BCRs. Each party disagrees with the other party's position and therefore a dispute has arisen.	The Board and Project Co have reviewed and commented upon the Spare Capacity Statement as set out in Disputed Works Schedule Appendix 1 Item 5. Medical Gas report dated 19 June 2018 as set out in Disputed Works Schedule Appendix 1 Item 5 was prepared by Project Co to respond to Board's comments. No adverse comments have been received from the Board in relation to this Report. The Board and Project Co have reached agreement on this matter all as recorded within Aconex MPX-GC-026751, NHSL-GC-003075 and MPX-GC-027180 as set out in Disputed Works Schedule Appendix 1 Item 5.

Item	Dispute	Description of Agreed Resolution
6	**HV distribution** In relation to system resilience, the Board believes Project Co's design for HV Distribution is non-compliant with the Board's Construction Requirements (BCR's), Project Co Proposal's (PCP's) and SHTM Guidance for the following elements; 1. Resilience of the HV main intake switch room, 2. HV cable distribution, 3. HV / LV substations. The Board believes the design currently creates single points of failure at the HV side of the electrical distribution network. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure), which was based on the Board's reference design. Each party disagrees with the other party's position and therefore a dispute has arisen.	The agreed resolution of the Dispute submitted by Project Co through the Schedule Part 8 (Review Procedure) and agreed by the Board, was for changes to be made to the switch panels within the energy centre to capture the generator panel as part of the ring. Fire protection has been applied to the fire hazard rooms. Drawings and schedules were updated and submitted through Schedule Part 8 (Review Procedure). Details of modifications to be carried out by Project Co are specified in the documents noted below. The Reviewable Design Data as set out below for this item has been given status Level A or Level B in accordance with Schedule Part 8 (Review Procedure). Gas suppression has been agreed to be provided within SS2A and SS2B. As set out within Aconex MPX-Transmit-010823 and MPX-GC-027179 as set out in Schedule Disputed Works Schedule Appendix 1 Item 6 and in the following drawings:- WW-XX-XX-SC-530-001 Rev I HV Distribution Schematic RDD Status B (11/5/18) WW-XX-XX-SC-530-102 Rev 1 Multiplex Alternative HV Room Configuration RDD Status A (11/5/18) WW-XX-XX-SC-530-103 Rev 1 Multiplex Alternative HV Ring Configuration RDD Status B (11/5/18) WW-XX-XX-SC-530-104 Rev 1 Multiplex Alternative HV Ring Configuration Protection System Schematic RDD Status B (11/5/18) WW-XX-XX-SC-530-105 Rev 1 Multiplex Alternative HV Ring Configuration Protection System Blocking Diagram RDD Status A (11/5/18) WW-XX-XX-SC-530-106 Rev 1 MV Cable Routing As Installed RDD Status A (11/5/18) WW-XX-XX-SC-530-107 Rev 1 G59 Connections RDD Status B (11/5/18) WW-XX-XX-SC-530-108 Rev 1 Generator System RDD Status B (15/5/18) WW-SZ-SL-SH-531-204 Rev 3 RHSC & DCN Gas Suppression Basement Substations RDD Status B.

Item	Dispute	Description of Agreed Resolution
7	**4 bed ventilation** In relation to ventilation pressure regimes, the Board believes Project Co's design for the 4 bed ventilation is non-compliant with the Board's Construction Requirements ("**BCRs**"), Project Co Proposal's ("**PCPs**"), SHTM Guidance, and also non-compliant with comments made by the Board on the Environmental Matrix in the Reviewable Design Data schedule at Financial Close, The Board also notes the Environmental Matrix was altered during Preferred Bidder to Financial Close period and was therefore not a direct copy of the reference design environmental matrix. In addition, the Board believe the intake air change rate and the extract air change rate are non-compliant. From a clinical perspective, the principal concern to the Board in continuing with Project Co's proposed pressure regime design means there is an unacceptable risk of the spread of bacterial airborne infections into corridors and surrounding patient rooms (positive to the corridor) The Board requires the pressure regime to be balanced or negative to the corridor. Project Co's position is that the design and installation meets the requirements of the Project Agreement, was based on the package approved through Schedule Part 8 (Review Procedure) which included the environmental matrix which had been discussed and was agreed pre Financial Close. The environmental matrix was a direct copy of the reference design environmental matrix developed during the preferred bidder period. No adverse comments were received prior to or at Financial Close. Each party disagrees with the other party's position and therefore a dispute has arisen.	The Reviewable Design Data noted below for this item has been given status Level B in accordance Schedule Part 8 (Review Procedure). The resolution of the Dispute submitted by Project Co through the Schedule Part 8 (Review Procedure) and agreed by the Board, is for 14 No 4 bed rooms to be balanced or negative to the corridor at 4 ac/hr. The remaining 6No 4 bed wards remain as per the environmental matrix, WW-XX-XX-DC-XXX-001 Rev 11, and rev 07 of the schedule WW-SZ-XX-DC-XXX-010. All as noted within Aconex MM-GC-003999, & MPX-TRANSMIT-010869 as set out in Disputed Works Schedule Appendix 1 Item 7. All as noted on drawings:- WW-Z3-03-PL-524-001 Rev G Zone Z3 Level 03 Ventilation Distribution Sheet 1 of 2 RDD Status B (3/5/18) WW-Z4-00-PL-524-001 Rev K Zone Z4 Level 00 Ventilation Distribution Sheet 1 of 2 RDD Status B (3/5/18) WW-Z4-00-PL-524-002 Rev L Zone Z4 Level 00 Ventilation Distribution Sheet 2 of 2 RDD Status B (3/5/18) WW-Z4-01-PL-524-001 Rev J Zone Z4 Level 01 Ventilation Distribution Sheet 1 of 2 RDD Status B (3/5/18) WW-Z4-03-PL-524-001 Rev G Zone Z4 Level 03 Ventilation Distribution Sheet 1 of 2 RDD Status B (3/5/18) WW-Z4-03-PL-524-002 Rev G Zone Z4 Level 03 Ventilation Distribution Sheet 2 of 2 RDD Status B (3/5/18) WW-SZ-XX-DC-XXX-010 Rev 07 General Ward - Ventilation Amendments Proposal RDD Status B (31/5/18).

Item	Dispute	Description of Agreed Resolution
8	**Bedhead trunking earth bonding points** The Board's position is that all bedhead trunking installed in Group 2 Medical Locations is provided with only 2 supplementary equipotential bonding points. This is not in compliance with GN7, which requires minimum 4 for IPS sockets. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	The Reviewable Design Data noted below for this item has been given status Level A or B in accordance with Schedule Part 8 (Review Procedure). The resolution to the Dispute agreed by the Board and Project Co required Project Co to provide a minimum 4 supplementary earthing points for medical IT sockets. All as noted within MPX-TRANSMIT-010733 & MPX-TRANSMIT-010714 as set out in Disputed Works Schedule Appendix 1 Item 8 All as per drawings:- WW-SZ-SL-SH-500-011 Rev F Room by Room Risk Profile RDD Status B (4/5/18) WW-Z3-00-PL-531-001 Rev M Zone Z3 Level 00 Small Power Layout Sheet 1 of 2 RDD Status B (13/4/18) WW-Z3-00-PL-531-002 Rev M Zone Z3 Level 00 Small Power Layout Sheet 2of 2 RDD Status B (13/4/18) WW-Z3-01-PL-531-001 Rev J Zone Z3 Level 01 Small Power Layout Sheet 1 of 2 RDD Status A (13/4/18) WW-Z3-01-PL-531-002 Rev P Zone Z3 Level 01 Small Power Layout Sheet 2 of 2 RDD Status B (13/4/18) WW-Z4-00-PL-531-002 Rev O Zone Z4 Level 00 Small Power Layout Sheet 2 of 2 RDD Status B (13/4/18) WW-Z4-01-PL-531-001 Rev K Zone Z4 Level 01 Small Power Layout Sheet 1 of 2 RDD Status A (13/4/18) WW-Z4-01-PL-531-002 Rev K Zone Z4 Level 01 Small Power Layout Sheet 2 of 2 RDD Status A (13/4/18) WW-Z4-03-PL-531-002 Rev I Zone Z4 Level 03 Small Power Layout Sheet 2 of 2 RDD Status A (13/4/18). Project Co to ensure (i) all rooms are correctly categorised and grouped as per SHTM 06-01 and BS 7671 Table 9.1 of Guidance Note 7; and (ii) all necessary associated works are completed.

Item	Dispute	Description of Agreed Resolution
9	**Lack of non IPS sockets in theatres** The Board's position is that all socket outlets within these departments except for Cleaners outlets and a limited number of "raw power" sockets in some areas, are Medical Equipment blue sockets. No provision has been made for equipment that should be plugged into an RCB protected outlet whilst in the patient zone. Also, no x ray sockets (dedicated socket). Project Co's position is the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	The Reviewable Design Data as set out below for this item has been given status Level A or B in accordance with Schedule Part 8 (Review Procedure). Resolution of the Dispute agreed by the Board and Project Co includes provision for the equipment requiring to be plugged into RCB protected circuits. All as recorded within MPX-TRANSMIT-010733, MPX-TRANSMIT-010714 & MPX-GC-026898 as set out in Disputed Works Schedule Appendix 1 Item 9. All as per drawings:- WW-Z3-00-PL-531-001 Rev M Zone Z3 Level 00 Small Power Layout Sheet 1 of 2 RDD Status B (13/4/18) WW-Z3-00-PL-531-002 Rev M Zone Z3 Level 00 Small Power Layout Sheet 2 of 2 RDD Status B (13/4/18) WW-Z3-01-PL-531-001 Rev J Zone Z3 Level 01 Small Power Layout Sheet 1 of 2 RDD Status A (13/4/18) WW-Z3-01-PL-531-002 Rev P Zone Z3 Level 01 Small Power Layout Sheet 2 of 2 RDD Status B (13/4/18) WW-Z4-00-PL-531-002 Rev O Zone Z4 Level 00 Small Power Layout Sheet 2 of 2 RDD Status B (13/4/18) WW-Z4-01-PL-531-001 Rev K Zone Z4 Level 01 Small Power Layout Sheet 1 of 2 RDD Status A (13/4/18) WW-Z4-01-PL-531-002 Rev K Zone Z4 Level 01 Small Power Layout Sheet 2 of 2 RDD Status A (13/4/18) WW-Z4-03-PL-531-002 Rev I Zone Z4 Level 03 Small Power Layout Sheet 2 of 2 RDD Status A (13/4/18). Project Co to ensure (i) all rooms are correctly categorised and grouped as per SHTM 06-01 and BS 7671 Table 9.1 of Guidance Note 7; and (ii) all necessary associated works are completed.
10	**Drainage above IPS rooms / above IPS panels / Node Rooms** It is the Board's position that Project Co has installed drainage above exclusion zones, electrical equipment and other high risk locations except above MRI rooms where this has been completely removed.	The following rooms are where Project Co have installed drainage and water services above IPS rooms / IPS panel / electrical distribution services. The resolution for these examples have been identified and the resolution of the Dispute agreed by the Board and Project is outlined below: **Basement** 1 - Node room B-T1-001 Drainage will change to HDPE within the room and extend for at least a metre out with either wall.

Item	Dispute	Description of Agreed Resolution
	Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). For the avoidance of doubt this Dispute relates to the drainage in following areas only:- **Basement** 1 - Node room B-T1-001 2 - Node room B-T1-002 HDPE 3 - Switch cupboard B-S3-030 4 - UPS room **Ground floor** 5 - UPS room in basement to ground floor and connecting into CWST tank room stack. 6 -Drainage pipework through switch cupboard G-F1-095 7 - Drainage pipework in IPS room G-Q1-002 **Level 1** 8 - Drainage to HDPE in IPS room 1-B1-044 9 - Drainage to HDPE in Switch cupboard 1- L1-107 **Level 3** 10 - Vent pipe in switch cupboard 3-k2-083 Each party disagrees with the other party's position and therefore a dispute has arisen.	2 - Node room B-T1-002 HDPE drainage will be fusion welded and will extend into the office up until the first joint. 3 - Switch cupboard B-S3-030 will be installed in HDPE as shown within agreed sketches within MPX-GC-026626 as set out in Disputed Works Schedule Appendix 1 Item 10 4 - UPS Drainage will be routed once the walls are opened up where we have recesses to suit the best requirements. Drip trays will be installed under any drainage within the UPS room as noted on Drainage Changes.pdf as set out in Disputed Works Schedule Appendix 1 Item 10. **Ground floor** 5 - Drainage re-routed from UPS room in basement to ground floor and connecting into CWST tank room stack. 6 -Drainage pipework already running through switch cupboard G-F1-095 will be changed to HDPE 7 - Drainage pipework with no joints in IPS room G-Q1-002 can stay if joints are not directly next to wall either side of the cupboard (corridor and Nappy change) **Level 1** 8 - Drainage to change to HDPE in IPS room 1-B1-044 with the tundish moving into cylinder store and boxed in with access hatch. 9 - Drainage to change to HDPE in Switch cupboard 1- L1-107 only needs to extend 1 mtr into the disposal hold room and not as shown on the Drainage Changes.pdf. **Level 3** 10 - Vent pipe in switch cupboard 3-k2-083 (with no electrical equipment) can stay while drainage pipe will re-route as Drainage Changes.pdf. The above resolutions are noted within Aconex reference MPX-GC-026626 as set out in Disputed Works Schedule Appendix 1 Item 10 and Drainage Changes.pdf, and are deemed to have Reviewable Design Data status Level B.
11	**NOT USED**	-
12	**Lack of tamper proof flush fitted sockets in CAMHs** In the Board's opinion, sockets are not installed as per small power layout drawings and anti-ligature strategy drawing (HLM-SZ-00-PL-330-100. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the technical sub package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	The resolution of the Dispute agreed by the Board and Project Co was for plastic faceplates to be replaced with metal flush fitted tamperproof sockets.
13	**Single Bedroom Ventilation air changes**	The Board / Project Co agree this item is closed, and the agreed technical solution approved through Schedule Part 8 (Review Procedure) and, agreed by the Board and Project Co as resolving the Dispute

Item	Dispute	Description of Agreed Resolution
	In relation to ventilation air change rates, the Board believes Project Co's design for the single bed ventilation is non-compliant with the Board's Construction Requirements ("**BCRs**"), Project Co Proposal's ("**PCPs**"), SHTM Guidance, and also non-compliant with comments made by the Board on the Environmental Matrix in the Reviewable Design Data schedule at Financial Close. 4ac/h supply provided to the bedrooms instead of the required 6ac/h. The ensuite extract rate proposed in excess of 10ac/h where requirements of SHTM 03-01 is 3ac/h. The Board also notes the Environmental Matrix was altered during Preferred Bidder to Financial Close period and was therefore not a direct copy of the reference design environmental matrix. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure) which included the environmental matrix which had been discussed and agreed pre Financial Close. The environmental matrix was a direct copy of the reference design environmental matrix developed during the preferred bidder period. Comments were received pre Financial Close and these were documented and the design amended to reflect the Board's comments. Each party disagrees with the other party's position and therefore a dispute has arisen.	is as set out in Disputed Works Schedule Appendix 1 Item 13.
14	**Smoke clearance in fire fighting stairwells** As per the Non Domestic Technical Handbook and project specific Fire Strategy, all fire fighting stairwells shall be provided with appropriate ventilation for heat and smoke control. Currently only a percentage of stairwells appear to have openings for high level ventilator. No details of electrical connections including fire rated cables for fire fighting plant as per BS 8519 have been provided. Project Co do not dispute the Board's position.	The remote activation and minimum free area opening is as noted in MPX-GC-026280: "In line with clause 2.14.6 (and table 2.16) of the NDTH, each of the stairs are designed with a mix of 'ventilators' achieving 1sqm ea. to the top of the stair (either smoke vents or windows). The strategy to each stair is noted below: • Stair 1 – Openable window to stair (1sqm window to top of stair) *CHSL* • Stair 2 – Openable window to stair (1sqm window to top of stair), mechanical ventilation to the bed evac lobby. Push buttons to topmost storey and access level as per 2.14.6 *CHSL* • Stair 3- Openable (mechanical) roof vent to stair, mechanical ventilation to the bed evac lobby. Push buttons to topmost storey and access level as per 2.14.6

Item	Dispute	Description of Agreed Resolution
		• Stair 4- Openable (mechanical) roof vent to stair. Push buttons to topmost storey and access level as per 2.14.6 • Stair 5 – Openable window to stair (window at each level, however topmost floor window to have local automated actuator allowing the window to open under actuation to achieve 1m2) *Velfac* • Stair 6 – Openable window to stair (window at each level, however topmost floor window to have local automated actuator allowing the window to open under actuation to achieve 1m2) *Velfac* • Stair 7- Openable (mechanical) vent to stair- exhausts via plant room area at L04. Push buttons to topmost storey and access level as per 2.14.6 In order to comply with section of 5.12 of the BCRs, all opening windows (including those to stairs 1, 2, 5 and 6) are lockable and fitted with restrictors. The CHSL Schuco Windows are provided with 'Custodian Handle Housings' with 'Custodian Keys' as per CHSL Technical Submittal no. 13 allowing the windows to the top of stairs 1 and 2 to open fully and achieve in excess of the min 1sqm requirement of the building regulations. The Velfac WT-022 windows to stairs 5 and 6 are provided with 'Espagnolette Handle with Lock' with 'Allen Key Lockable Restrictor'. The topmost window in each stair is to be fitted with localised actuation. This only allows opening by operatives as the locks and restrictors must be omitted. The actuators shall be activated locally by button control at 2m above floor level so as not easily accessible to public. This is in accordance with NDTH 2.14.6. The fire service carry the tool required to operate the CHSL windows and the key shall also be stored in a secure location near the windows i.e. break glass. All as noted within Aconex MPX-GC-026280, MM-GC-003950 and MPX-GC-026538 as set out in Disputed Works Schedule Appendix 1 Item 14 the above actions are agreed by the Board and Project Co to resolve this Dispute.
15	**Access hatches** It is the Board's position that a proliferation of Access hatches has been installed within theatre suites which is non-compliant with BCR clause 8.14 Service Routes and "Good Industry Practice". Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure).	Project Co agreed to the reduction of hatches in theatres, as noted within Aconex MPX-GC-027183 and as set out in Disputed Works Schedule Appendix 1 Item 15. This will be reflected in the as-built documentation. Updated versions of the following Reflected ceiling to be included in the As Built. HLM-Z3-01-PL-332-410;411;412;413.

Item	Dispute	Description of Agreed Resolution
	Each party disagrees with the other party's position and therefore a dispute has arisen.	
16	**Reductions to ceiling heights** In addition to the Project Co Change 016 (Basement Ceiling Heights), further Height reduction in Room Number 4-COR-007 and Room Number G-A1-062 appears to have been reduced without the agreement of the Board. Project Co do not dispute the Board's position.	The Board / Project Co agree this item is closed, and the agreed technical solution approved through Schedule Part 8 (Review Procedure) and, agreed by the Board and Project Co as resolving the Dispute is as set out in Disputed Works Schedule Appendix 1 Item 16.
17	**Duct Cleaning** The Board's position is that SHTM states all ducts must be cleaned unless they have been protected. The Contractor is not proposing to clean all ducts as believe they have sufficiently protected the ducts following installation. Independent Tester advised the Contractor will have to do a check to confirm ducts aren't dirty Project Co's position is that ducts were being protected, and will be sampled at commissioning stage - any failing the test will then being cleaned. Each party disagrees with the other party's position and therefore a dispute has arisen.	The extent of ductwork requiring to be cleaned has been captured within the following Aconex; Duct Cleaning – Aconex MM-GC-004106, MPX-GC-027187 as set out in Disputed Works Schedule Appendix 1 Item 17. It is agreed by the Board and Contactor that this Dispute item shall be resolved through witnessing and testing of the system, to demonstrate compliance with the BCR's / PCP's / Completion Criteria. For the avoidance of doubt, any other ducts that fail any checks or tests, shall be appropriately cleaned by Project Co.
18	**Bed Lift to Basement of Core 3** The Boards position is the Financial Close submission [IHSL-XX-XX-DC-4.15 Vertical Transportation] stated that the bed lift in core 3 would serve 5 floors. The Board notes the installed bed lift in core 3 only serves 4 floors. Project Co do not dispute the Board's position and has issued a Project Co Change for this item.	The Board / Project Co agree this item is closed, and the agreed technical solution approved through Schedule Part 8 (Review Procedure) and, agreed by the Board and Project Co as resolving the Dispute is as set out in Disputed Works Schedule Appendix 1 Item 18.

Item	Dispute	Description of Agreed Resolution
19	**Helipad fire fighting system (Water Pressure)** The Boards position is the Helipad fire fighting system does not comply with the guidance of HBN 15-03 Hospital Helipads clause 5.22. There does not appear to be a pressurised main supply, nor is there a system of inert gas to pressurise the system. Project Co's position is that a pressurised main supply and a system of inert gas to pressurise the system is not required. Each party disagrees with the other party's position and therefore a dispute has arisen.	The Board and Project Co note the CAAi has certified the helipad is fit for purpose as installed. Reference is made to letter received by the Contractor from CAAi dated 07 March "it is with pleasure that we can issue this letter of completion which, subject to certain conditions outside of Multiplex's control being met before the heliport commences operations, confirms the rooftop heliport at RHSC & DCN is regarded as fit for purpose.". Documentation is noted within Aconex MPX-GC-027315 as set out in Disputed Works Schedule Appendix 1 Item 19. For the avoidance of doubt, whilst the CAAi has certified the helipad is fit for purpose, this item 19 relates to the Helipad fire fighting system (water pressure) only. All other elements of the Helipad compliance are as set out in the Project Agreement.
20	**Vegetation around air intakes in Neuroscience and Staff Courtyards** It is the Board's position that Landscape design around intake vents in Neuroscience Courtyard is potentially non-compliant with SHTM 03-01 which states: Air Intake 1.42 An uncontaminated air supply to the system is essential. In order to achieve this, the air intake will be positioned so that air discharged from extract systems or other dubious sources cannot be drawn in. Exhaust fumes from vehicles can present particular problems. The area surrounding the intake will need to be kept clean and free of vegetation and waste material in order to reduce the possibility of biohazards or fire. The intake itself will be protected by a louvre and mesh screen to prevent rainwater, vermin and insects etc. from entering the system. Project Co's position is that the design has been approved by the Board through RDD.	The Board / Project Co agree the Reviewable Design Data for this item has been given status Level A or B in accordance with Schedule Part 8 (Review Procedure). The following design measures proposed by Project Co and agreed with the Board to resolve the dispute, limit planting in the area surrounding the intake vents. This satisfies SHTM 03-01A Clause 1.42 in so far is it allows the area surrounding the vents to be clean and free of vegetation and waste material in order to reduce the possibility of biohazards or fire. Neuroscience Courtyard Project Co have replaced the planting around the air intake vents with artificial grass with the exception of one area which has been planted with sedum as per the Boards request. Staff Courtyard Project Co have incorporated a 600mm 'no plant zone' to the perimeter of the air intake vents." All as noted within Drawing HLM-Z0-03-PL-700-002 Rev E; Drawing HLM-Z0-00-PL-700-026 Rev E; and Aconex MM-GC-003873 as set out in Disputed Works Schedule Appendix 1 Item 20.
21	**"Do not use" labels removed from Medical Gas Outlets before commissioning.** It is the Board's position that Medical gas outlet "Do Not Use" labels removed before commissioning, non-compliance with SHTM02-01. Project Co's position is that there was no non-compliance relating to this issue. Project Co's position is that the installation was work in progress and would comply prior to the Actual Completion Date.	Through discussion it was agreed by Project Co and the Board that this Dispute will be resolved by the Medical gas outlet "Do Not Use" labels being put in place prior to commissioning, thus ensuring compliance with SHTM 02-01.

Item	Dispute	Description of Agreed Resolution
22	**Isolation Room supply ventilation relative to low building.** It is the Board's position that Isolation room ventilation is non-compliant for a 'low' building. Project Co's position is that the design and installation was based on isolation room ventilation report produced and tabled with the Board. This is compliant with the requirements of the Project Agreement. Each party disagrees with the other party's position and therefore a dispute has arisen.	The Board / Project Co agree this item is closed, and the agreed technical solution approved through Schedule Part 8 (Review Procedure) and, agreed by the Board and Project Co as resolving the Dispute is as set out in Disputed Works Schedule Appendix 1 Item 22.
23	**Drainage joints in slabs** It is the Board's position that Drainage joints have been installed in the slab between floors with no access for maintenance or repair. This means there is no manufacturer warranty for the drainage connection. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	Through discussion and site review with the Independent Tester, John Edwards (Arcadis) agreement has been reached on compliance and sign off. Reference is made to Aconex MPX-RFI-002569 and RBP-GC-002637 and the confirmation from the Independent Tester as set out in Disputed Works Schedule Appendix 1 Item 23.
24	**Fire Collar installation** Fire collars for drainage are not directly connected to the slab+C19. Project Co's position is that the installation was work in progress and would comply prior to the Actual Completion Date. Each party disagrees with the other party's position and therefore a dispute has arisen.	The Board and Project Co agree this Dispute is closed and no further action is required. Confirmation has been received from the Project Co that the installation is ongoing and Project Co will procure compliance with BCRs prior to the Actual Completion Date.

Item	Dispute	Description of Agreed Resolution
25	**Level and position of smoke detectors** It is the Board's position that smoke detectors are installed at low levels above the ceiling i.e. not installed at the heights specified for void detectors Project Co's position is that the design and installation is in accordance with the requirements of the Project Agreement, was based on the package approved through Schedule Part 8 (Review Procedure) in compliance with the BCRs, and will be signed off by the installer as compliant. Each party disagrees with the other party's position and therefore a dispute has arisen.	Following discussion and site review, in relation to the level and position of the smoke detections, the Independent Tester has closed this item on basis of compliance. Summary of agreement contained with Aconex ECH-GC-000129 as set out in Schedule Disputed Works Schedule Appendix 1 Item 25.
26	**Ventilation in IPS** It is the Board's position that –Project Co have shown 3ac/h extract ventilation in the Environmental Matrix, but not all rooms have been provided with extract vent in the room - Potential heat gain issue. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	Project Co confirm that all IPS rooms shall have extract ventilation of 3 ac/hr, and Project Co confirm that the environment and temperature within all IPS's room are within safe limits.
27	**Hot and Cold water supply pipe configuration** It is the Board's position that Hot and cold water supply pipes are crossed behind the sink in some rooms and in some instances the cold pipe is above the hot water pipe or touching the pipe meaning the will be heat transferred to the cold water supply. Not best practice and non-compliance with SHTM 04-01. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	Through discussion and site review it was agreed between the Board and Project Co that Project Co shall modify the installation to maintain pipework separation and distance as per valve body so that the hot and cold water pipework doesn't touch or cross, in accordance with SHTM 04-01. Aconex MPX-GC-027580 as set out in Disputed Works Schedule Appendix 1 Item 27 specifies details of the changes made on Site. For the avoidance of doubt, Project Co to procure that the Agreed Resolution is applied in all requisite areas.

<table>
<tr><th>Item</th><th>Dispute</th><th>Description of Agreed Resolution</th></tr>
<tr><td>28</td><td>Windows/Partition in 1-B1-055

It is the Board's position that the GA and C sheet illustrates a 3 panel window however, in construction one panel appears to be 'false' with a partition behind it. From the inside it appears to be only 2 windows.

Project Co do not dispute the Board's position.</td><td>Agreement between the Board and Project Co was reached on this item at the Project Technical Review Meeting where it was agreed no further action was required (dated 31.01.18) as set out in Disputed Works Schedule Appendix 1 Item 28.

As built documentation shall reflect this.</td></tr>
<tr><td>29</td><td>Mounting heights for clinical lights (3-C1.4 -084, 3-C1.4 -061 and 3-D9-022)

It is the Board's position the Examination lights coded as LIG958 in 3-C1.4 -084, 3-C1.4 -061 and 3-D9-022 have been mounted in such a way as to cause obstruction.

Project Co's position is that the data sheets provided in accordance with Schedule Part 8(Review Procedure) should have caused the Board to pass comment during the review process, rather than wait until these had been constructed on Site.

Each party disagrees with the other party's position and therefore a dispute has arisen.</td><td>Through discussion and agreement between the Board and Project Co, it was agreed to relocate the Examination lights coded as LIG958 in 3-C1.4 -084, 3-C1.4 -061 and 3-D9-022 to 2100mm. Reference is made to MM-RTRFI-000315 as set out in Disputed Works Schedule Appendix 1 Item 29.</td></tr>
<tr><td>30</td><td>Lightning Protection

It is the Board's position that Project Co have potentially deviated from design agreed with Consort.

Project Co's position is that the design and installation was based on the package approved through Schedule Part 8 (Review Procedure). Project Co does not agree with the comments raised.

Each party disagrees with the other party's position and therefore a dispute has arisen.</td><td>The Board and Project Co agree the Reviewable Design Data for this item has been given status Level A in accordance with Schedule Part 8 (Review Procedure) and the Dispute has been resolved.

<table><tr><th>File Reference</th><th>Rev</th><th>Title</th><th>Status</th></tr><tr><td>ME-XX-XX-DC-579-002</td><td>01</td><td>Lightning Protection Interface between new RHSC & existing RIE</td><td>A</td></tr></table>
Reference is made to Aconex MPX-TRANSMIT-008497 as set out in Disputed Works Schedule Appendix 1 Item 30.</td></tr>
<tr><td>31</td><td>Gas supply to bedhead trunking

Supply has not been installed on Site as per Board comments during Schedule Part 8 (Review Procedure).

Project Co constructed position was that the design and installation was based on the package approved through Schedule Part 8 (Review Procedure).
Each party disagrees with the other party's position and</td><td>The Board and Project Co agree the Reviewable Design Data for this item has been given status Level A in accordance with Schedule Part 8 (Review Procedure) and the Dispute has been resolved.

<table><tr><th>File Reference</th><th>Rev</th><th>Title</th><th>Status</th></tr><tr><td>ME-XX-XX-DC-400-105</td><td>B</td><td>Bedhead Trunking Drawings</td><td>A</td></tr></table></td></tr>
</table>

Item	Dispute	Description of Agreed Resolution
	therefore a dispute has arisen.	
32	**Concealed ceiling grids** Ceiling Grids are not concealed and not constructed in line with drawings agreed in accordance with Schedule Part 8 (Review Procedure). Project Co do not dispute this position.	The Board / Project Co agree this item is closed, and the agreed technical solution approved through Schedule Part 8 (Review Procedure) and, agreed by the Board and Project Co as resolving the Dispute is as set out in Disputed Works Schedule Appendix 1 Item 32.
33	**Soft Landscaping planting specification** It is the Board's opinion that planting on Site was not as per planting schedule. i.e. clematis appears to be climbing but should be bush/ground variety. Project Co's position is that that this comment relates to unfinished works and is accordingly the Board's comment is premature.	These plants were left with the canes in them so that the Contractor could tend the bark mulch underneath before removing the canes. The canes will be removed so that the plant can lay on the ground.
34	**Wrong terminators fitted in warning lights** It is the Board's opinion in relation to Warning Lights that: - Terminal strip connector in theatres to be removed and correct terminations provided, all warning light boxes. - light box deformed where glanded Project Co's position is that the installation was still work in progress and will be compliant prior to the Actual Completion Date. The Board's comment is premature. Each party disagrees with the other party's position and therefore a dispute has arisen.	Due to quantity and size of cables not possible to terminate to manufacturers termination point, supplementary terminal block installed. The Board / Project Co agree this Dispute is closed, and no further action required.
35	**No evidence of IPS circuit bonding conductors** It is the Board's opinion that there is no evidence of IPS circuit bonding conductors at the IPS cabinets. The Main Bonding conductor between the IPS & the ERB is present. Project Co's position is that the installation is still a work in progress and will be compliant prior to the Actual Completion Date. The Board's comment is premature. Each party disagrees with the other party's position and therefore a dispute has arisen.	Project Co earthing philosophy was explained to the satisfaction of the Board and whilst differing from the guidance, it is deemed to be compliant. The Board / Project Co agree this Dispute is closed, and no further action required.

Item	Dispute	Description of Agreed Resolution
36	**Fire resistance of radiology door frame** Radiology: Door frame packed out in door opening, not in accordance within manufacturer's limits to maintain fire resistance of doorset. Project Co do not dispute this position.	As set out within Aconex MPX-GC-026747, MPX-GC-027156, NHSL-GC-003201 and MPX-GC-027646 as set out in Disputed Works Schedule Appendix 1 Item 36, the door frame has been rectified.
37	**UPS output switchboard with incorrect poles** It is the Board's position that the UPS output Switchboard 2 Switchboard is supposedly a Form 4 type 6 board. Schneider state that to achieve Form 4 type 2 or 6 that the incoming devices should be 4 poles. The incoming devices are three poles with un switched neutral. Project Co's position is that the design and installation is in accordance with the requirements of the Project Agreement and was based on the tech sub package approved through the approval process. Each party disagrees with the other party's position and therefore a dispute has arisen.	The Board and Project Co agree that this switchboard can be fully isolated locally. The Board / Project Co agree this Dispute is closed and no further action required.
38	**Corridor service door handles** It is the Board's position that the Corridor service doors as installed include pull handles which are not acceptable as advised by the Board 30/01/17 (MM-GC-002483) during room review (corners of handles at children's head height). Project Co's position is that the design and installation complies with the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	The solution agreed by the Board and the Contractor to resolve the Dispute was to remove the pull handles and replace them with standard flat escutcheon.
39	**NOT USED**	-
40	**NOT USED**	-

Item	Dispute	Description of Agreed Resolution
41	**As Built Energy Model / Seasonal Commissioning** It is the Board position that there is potential for some seasonal commissioning tests to be completed post hand over. Project Co's position is that seasonal commissioning would always be required to be carried out post the Actual Completion Date. Each party disagrees with the other party's position and therefore a dispute has arisen.	The Board / Project Co agree this item is closed, and the agreed technical solution approved through Schedule Part 8 (Review Procedure) and, agreed by the Board and Project Co as resolving the Dispute is as set out in Disputed Works Schedule Appendix 1 Item 41.
42	**NOT USED**	-
43	**Routing of services. Corridor layouts against any non-compliance with standards to be tabled.** It is the Board's position that services are currently running through clinical areas that were not included within the original Project Co derogation. Project Co's position is that the design and installation meets the Project Agreement was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	The Board and Project Co acknowledge that Project Co have routed services through clinical area. This is not in compliance with the Board's Construction Requirements. The Board acknowledges that Project Co will not re-route these services. The areas impacted are as set out in Disputed Works Schedule Appendix 1 Item 43. Whilst the Board has agreed Project Co do not need to move the services, Project Co to procure that all other elements of the BCR's are fully complied with, for example if there are any acoustic issues associated with ventilation / drainage running through the rooms, Project Co shall at its own cost, resolve any compliance issues. Project Co confirm that any additional costs incurred to be borne by Project Co.
44	**Nurse call in WC** It is the Board's position that there is evidence from the Site (room C1.1-070) that nurse call pull cords have been installed in some visitor's WCs. However no nurse call should be installed in visitor's WCs. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	The process agreed between the Board and Project Co to resolve the Dispute was for the Board to issue a Board Change. This has been received and Project Co is progressing the Board Change 142 as noted within NHSL-BCP-0142 as set out in Disputed Works Schedule Appendix 1 Item 44.
45	**Unidentified Circuits** Electrical circuits are not identified or labelled at terminal rail	The Board visited site with Multiplex and Mercury Engineering. Electrician confirmed spare circuits and these were identified accordingly.

Item	Dispute	Description of Agreed Resolution
	inside trunking. Consequently, there is no way to identify which cables enter and leave the circuit terminal strips. Project Co dispute this position and consider that the design and installation meets the requirements of the Project Agreement. Each party disagrees with the other party's position and therefore a dispute has arisen.	The Board and Project Co agreed that no further action required.
46	**Fire alarm cable bands** It is the position that cable bands for fire alarms are plastic rather than metal. Metal ties are required by BS and are proposed by Project Co M&E specifications (4.23.3 of Section 4 of Schedule Part 6). Project Co' position is that the installation was still work in progress and would be compliant prior to the Actual Completion Date. Each party disagrees with the other party's position and therefore a dispute has arisen.	Project Co shall procure that installation is compliant with the BCRs, by installing metal cable bands as required.
47	**IPS units earthbar termination - 1-B1-044 – IPS Room** Project Co's position is that the installation was still work in progress and would be compliant prior to the Actual Completion Date.	Project Co earthing philosophy was explained to the satisfaction of the Board and whilst differing from the guidance, it is deemed to be compliant. Through discussion and site review it was agreed between the Board and Project Co that no further action required to resolve this Dispute.
48	**IPS sockets supplying non medical equipment** It is the Board's position that IPS sockets have been found on Site providing power for the television, scale of the issue still to be determined. Project Co's position that the installation was still a work in progress and will be compliant prior to the Actual Completion Date. The Board's position is premature. Each party disagrees with the other party's position and therefore a dispute has arisen.	The Board have observed on site that locations previously identified have been rectified and this item is now closed. It was agreed between the Board and Project Co that no further action is required to resolve this Dispute.

<table>
<tr><th>Item</th><th>Dispute</th><th>Description of Agreed Resolution</th></tr>
<tr><td>49</td><td>Interleaved circuits

It is the Board's opinion, as per SHTM 06-01 and note 7 on design drawings, that all sockets including pendants supplies, for Cat 3, 4 and 5 should be interleaved. However, the evidence from Site suggests this has not been installed.

Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure).

Each party disagrees with the other party's position and therefore a dispute has arisen.</td><td>The Reviewable Design Data noted below for this item has been given status Level A or B in accordance with Schedule Part 8 (Review Procedure).

<table>
<tr><th>File Reference</th><th>Rev</th><th>Title</th><th>Status</th></tr>
<tr><td>WW-SZ-SL-SH-500-011</td><td>F</td><td>Room by Room Risk Profile</td><td>B (04/05/18)</td></tr>
<tr><td>WW-Z3-00-PL-531-001</td><td>M</td><td>Zone Z3 Level 00 Small Power Layout Sheet 1 of 2</td><td>B (13/04/17)</td></tr>
<tr><td>WW-Z3-00-PL-531-002</td><td>M</td><td>Zone Z3 Level 00 Small Power Layout Sheet 2of 2</td><td>B (13/04/17)</td></tr>
<tr><td>WW-Z3-01-PL-531-001</td><td>J</td><td>Zone Z3 Level 01 Small Power Layout Sheet 1 of 2</td><td>A (13/04/17)</td></tr>
<tr><td>WW-Z3-01-PL-531-002</td><td>P</td><td>Zone Z3 Level 01 Small Power Layout Sheet 2 of 2</td><td>B (13/04/17)</td></tr>
<tr><td>WW-Z4-00-PL-531-002</td><td>O</td><td>Zone Z4 Level 00 Small Power Layout Sheet 2 of 2</td><td>B (13/04/17)</td></tr>
<tr><td>WW-Z4-01-PL-531-001</td><td>K</td><td>Zone Z4 Level 01 Small Power Layout Sheet 1 of 2</td><td>A (13/04/17)</td></tr>
<tr><td>WW-Z4-01-PL-531-002</td><td>K</td><td>Zone Z4 Level 01 Small Power Layout Sheet 2 of 2</td><td>A (13/04/17)</td></tr>
<tr><td>WW-Z4-03-PL-531-002</td><td>I</td><td>Zone Z4 Level 03 Small Power Layout Sheet 2 of 2</td><td>A (13/04/17)</td></tr>
</table>

Project Co to ensure (i) all rooms are correctly categorised and grouped as per SHTM 06-01 and BS 7671 Table 9.1 of Guidance Note 7; and (ii) all necessary associated works are completed.</td></tr>
</table>

<table>
<tr><th>Item</th><th>Dispute</th><th>Description of Agreed Resolution</th></tr>
<tr><td>50</td><td>Access and Maintenance Strategy

Access and Maintenance Strategy - lack of clear access and maintenance strategy submitted to date.

Project Co's position is that this is a work in progress and will be compliant prior to the Actual Completion Date. The Board's position is premature.

Each party disagrees with the other party's position and therefore a dispute has arisen.</td><td>The Reviewable Design Data noted below for this item has been given status [Level B] in accordance with Schedule Part 8 (Review Procedure) in relation to revision 14. For the avoidance of doubt, Reviewable Design Data has not been submitted by Project Co (nor reviewed by NHSL) for the drainage resolution nor to take into account any impact on the Access and Maintenance Strategies for the drainage resolution. Accordingly neither the drainage resolution nor the Access and Maintenance Strategies have status [Level B approval] in respect of the drainage resolution or any impact of the drainage resolution. The design and specification of the drainage resolution and any impact on the Access and Maintenance Strategies to take account of the drainage resolution, will be submitted by Project Co as further Reviewable Design Data.

<table><tr><th>File Reference</th><th>Rev</th><th>Title</th><th>Status</th></tr><tr><td>HLM-XX-XX-DC-450-001</td><td>14</td><td>Access and Maintenance Strategies</td><td>Status B (except in relation to the drainage resolution or any impact on the Access and Maintenance Strategies for the drainage resolution, as detailed above)</td></tr></table></td></tr>
<tr><td>51</td><td>Lux levels in clean utilities

It is the Board's position that Lux levels in clean utilities rooms may not be sufficient for functionality of the space. Currently LG2 150 lux however due to the layout of the room / cupboards.

Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the environmental matrix approved through Schedule Part 8 (Review Procedure).

Each party disagrees with the other party's position and therefore a dispute has arisen.</td><td>Project Co confirm that all clean utilities rooms shall have a minimum of 150 lux level at the work surface and additional light fittings will be provided if the levels are not achieved due to room layout / cupboards locations.</td></tr>
<tr><td>52</td><td>Breaches of Fire stopping

It is the Board's position that during the construction phase there were breaches of the fire stopping.

Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure).

Each party disagrees with the other party's position and therefore a dispute has arisen.</td><td>The process agreed is for Project Co to issue the FIRAS Certificate to show compliance in accordance with the provisions of the Project Agreement.

For the avoidance of doubt, this does not release Project Co of their obligations to comply with the BCRs which relate to Fire Stopping.</td></tr>
</table>

Item	Dispute	Description of Agreed Resolution
53	**Egg crate Grilles in clinical areas** It is the Board's position that the Egg box grid is not suitable for cleaning. A technical submittal was issued and signed off by the Board, however a sample of the grid was not issued through the Review Procedure, hence the Board did not have a chance to view the type of product before it was installed. Project Co's position is that the design and installation was based on the package approved through Schedule Part 8 (Review Procedure) – photos of the products were provided which the Board should have used to raise comments at the appropriate time. Each party disagrees with the other party's position and therefore a dispute has arisen.	The process agreed between the Board and Project Co was for Project Co to procure Board preferred grills. This is set out within Aconex MPX-GC-025802 as set out in Disputed Works Schedule Appendix 1 Item 53.
54	**Curtain track and ceiling Hoist clashes** Hoists and curtain tracks clash and will need to be reviewed on a room by room basis. Project Co's position is that this is a work in progress and will be compliant prior to the Actual Completion Date. The Board's position is premature.	There has been a review of hoist and curtain tracks clashes by Project Co and Project Co to procure all clashes are resolved. As built documentation will record any alterations made.
55	**Wrong room configuration (G-Q1-074)** G-Q1-074 not constructed in line with C-Sheet (wrong sequence for data points and socket outlets) Project Co's position is that this is a work in progress and will be compliant prior to the Actual Completion Date. The Board's position is premature.	In relation to the orientation of the data points and socket outlets only, Project Co have amended on site the layout of the data points and sockets outlets, and it was agreed that no further action is required relating to this item.
56	**Helipad Ramp Lights** Helipad ramp now includes lighting however HBN 15-03 recommends that the luminaire should be lower than 25 cm and pointing down toward ramp. Calculations have not been submitted for lighting levels to ascertain if this complies with relevant standards. Project Co dispute the non-compliance alleged. Each party disagrees with the other party's position and therefore a dispute has arisen.	Through discussion between Project Co and the Board and site review it was agreed that no further action required relating to this item.

Item	Dispute	Description of Agreed Resolution
57	**Reduced access to electrical panels** It is the Board's position that Electrical panels should not be placed in reduced access areas. The Board understand this should have been designed in conjunction SHTM – Best Practice for Healthcare Engineering – Chapter 9 Engineering services. (For example 4-PLANT-001 – Central AHU Plant Room 01, 3 COR-008A - Switch cupboard) Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	As noted within Aconex MPX-GC-027300 as set out in Disputed Works Schedule Appendix 1 Item 57, Project CO reviewed on Site the 12 areas of concern with the Independent Tester, these were captured within the sketches contained within the Aconex, and this item has now been closed by the Independent Tester. Project Co confirm that any additional costs incurred to be borne by Project Co.
58	**Lighting in Service yard** It is the Board's position that lighting levels within service yard were initially designed at an average of 23 lux levels (i.e. the level required for a car park as per SLL Lighting Guide). This has now been corrected to 50 lux average however the uniformity is not in accordance with the requirements. Project Co's position was that the design and installation will comply with the Project Agreement, the BCRs, and design and calculations would be submitted through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	A process was agreed to capture the Board concern in relation to uniformity, update service yard with twin heads, and resubmit drawing, WW-EW-XX-DC-716-001 to the Board. This action is now complete. As noted within Aconex MPX-GC-027119 as set out in Disputed Works Schedule Appendix 1 Item 58. WW-EW-XX-DC-716-002 Service Yard Uniformity Calculation was submitted through the Review Procedure and given Level B by the Board, as noted in Aconex MPX-TRANSMIT-011188 as set out in Disputed Works Schedule Appendix 1 Item 58.
59	**Lighting in B-COR-014** It is the Board's position that L14 luminaries are missing in the corridor. Project Co's position is that the design and installation meets the requirements of the Employer's Requirements and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	Project Co confirms lighting design has been amended to ensure the minimum height of 2.4m will not be impacted by the luminaires installed. This will be reflected within the as built information. Project Co confirms no luminaires are missing within corridor B-COR-014.
60	**3-T2-018: QP - Riser door missing**	The door has now been installed.

<table>
<tr><th>Item</th><th>Dispute</th><th>Description of Agreed Resolution</th></tr>
<tr><td></td><td>It is the Board's position that the riser wall should have a door to access pipework

Project Co's position is that the installation was still work in progress and would be compliant prior to the Actual Completion Date. The Board's comment was premature.</td><td></td></tr>
<tr><td>61</td><td>Provision of 360o CCTV Coverage

It is the Board's position that as illustrated in external CCTV drawing (ME-EW-XX-PL-571-001 Rev D) there are gaps within CCTV coverage on approach to the NW elevation of the Facility. Non-compliant with BCR Clause 7.6 (n) (Hard Landscaping).

The Board's position is not disputed by Project Co.</td><td>The Board and Project Co agreed that Project Co would update and resubmit drawing ME-EW-XX-PL-571-001.

This action is now complete. Project Co is to demonstrate compliance on Site when the system is commissioned.

Project Co confirms revision F of the aforementioned drawing was updated and issued for information.

<table><tr><th>File Reference</th><th>Rev</th><th>Title</th><th>Status</th></tr><tr><td>ME-EW-XX-PL-571-001</td><td>E</td><td>Site Plan. External CCTV Layout</td><td>B (23/05/18)</td></tr></table></td></tr>
<tr><td>62</td><td>Hazard classification and fire stopping in MRI suites

It is the Board's position that the MRI Suites are currently not operationally functional as hazard classification of the MRI equipment room prevents installation of waveguides between equipment and examination rooms which cannot be fire stopped.

Project Co's position is the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure).

Each party disagrees with the other party's position and therefore a dispute has arisen.</td><td>The Board and Project agree that the Revised Fire Strategy drawings for MRI suites indicate the altered compartmentation lines. These provide the necessary FR ratings and allow the Board to install their protection as required.

Drawing extract indicates change made on Aconex mail MPX-GC-027481 as set out in Schedule Disputed Works Schedule Appendix 1 Item 62.</td></tr>
<tr><td>63</td><td>Entrance to Service Yard for Large Vehicles

As witnessed at the trial on 17th Feb 2018, due to the location of the barrier, large vehicles extend into the blue light route (by Approximately 3ft) when waiting for access through the barrier.

The Board's position is not disputed by Project Co.</td><td>Project Co has submitted a revised service yard design drawing HLM-Z0-00-PL-711-007 Rev 5; NEW Z5 XXPL 720-001 Rev B and -002 Rev B reflecting the outcome of onsite testing. This has been reviewed through Schedule Part 8 (Review Procedure), agreed by the Board and given status Level B.

A bespoke swan neck access control pedestal was designed by Project Co to alleviate the potential for vehicle overhang.
Reference is made to Disputed Works Schedule Appendix 1 Item 63.</td></tr>
</table>

Item	Dispute	Description of Agreed Resolution
64	**Quench Pipe Route** Board's position is that Project Co has not left a clear route for the quench pipes to run. Project Co's position is that the route meets the requirements of the Project Agreement and was based around the design and installation package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	Position resolving the Dispute as agreed by the Board and Project Co is recorded within Aconex MPX-GC-027186, as set out in Disputed Works Schedule Appendix 1 Item 64. Reference is also made to the quench pipe work scope Disputed Works Schedule Appendix 1 Item 64 and responsibility matrix for both parties Disputed Works Schedule Appendix 1 Item 64. For the avoidance of doubt, in relation to the quench pipe route, Project Co procure that the Facilities are fully compliant with the Project Agreement. Any costs associated with providing a clear route in the construction and operational phase are the responsibility of Project Co.
65	**CAMHS/PICU Glazing/DCN Acute** It is the Board's position that Project Co has not effectively designed glazing in PICU and CAMHS and DCN Acute to allow for adequate patient privacy from public spaces. As per Clinical Output Specifications and BCR Clauses 2.2/3.2.1/3.5.2/3.5.4/3.5.6/5.12/5.16.2. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). The privacy issue was discussed prior to any review under Schedule Part 8 (Review Procedure) and measures introduced to eliminate Board concerns during design stage. Each party disagrees with the other party's position and therefore a dispute has arisen.	The Board/Project Co agree to resolve the Dispute based on the email of "31 July 2018 RE: Privacy Glazing Final Position" and "Summary of Rooms requiring privacy screening 31072018 Vers 4" as set out in Disputed Works Schedule Appendix 1 Item 65. As built documentation will be issued by Project Co to record the agreed position.
66	**NOT USED**	-
67	**NOT USED**	-

Item	Dispute	Description of Agreed Resolution
68	**Security for CAMHS courtyards** The Board's position is that the height of fencing and hedge is currently not sufficient to prevent access to the CAHMS courtyards. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). The height of the fence was discussed extensively pre-FC and the Board specifically did not want a major boundary between public and private areas. Each party disagrees with the other party's position and therefore a dispute has arisen.	The Board / Project Co agree to resolve the Dispute based on the following; Project Co proceeding with install of 2.4m high fence to match existing install at service yard, to the length of the existing installation. Hedge to be replaced with (as close to) 2.4m high hedge and including return up the back of the spine wall. Project Co has submitted updated design data as set out in Disputed Works Schedule Appendix 1 Item 68. This has been reviewed through Schedule Part 8 (Review Procedure), agreed by the Board and given status Level B.
69	**Service Yard Gate** The location of the induction loops for automatic gates / barriers will have to ensure there is safe and unobstructed egress from service yard. Project Co's position is that the installation was still a work in progress and will be compliant prior to handover the Actual Completion Date. The Board's comment is premature. Each party disagrees with the other party's position and therefore a dispute has arisen.	It is agreed by the Board and Project Co that Project Co will procure automated gates (both open on entry, but with capability for only the exit side gate to open on exit if size of vehicle does not require it. Service yard drawings to be updated by Project Co to reflect this position. This information is recorded on the following drawings contained in Disputed Works Schedule Appendix 1 Item 69; HLM-Z0-00-PL-711-007 Landscape GA - Service Yard Entrance Rev 5 NEW-Z5-XX-PL-720-001 Pedestrian Gate Layout Rev B NEW-Z5-XX-PL-720-002 LAYOUT AND FOUNDATIONS RAM GATES Rev B Project Co confirm that any additional costs incurred to be borne by Project Co.
70	**ED Drugs store ventilation** It is the Board's position that current ventilation provision for drugs store is not in line with Clinical Specific Requirements for the space and therefore is not compliant. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	The Board and Project Co agree to proceed based on the following Board change NHSL-CCP-138 ED Drug Store Ventilation as set out Disputed Works Schedule Appendix 1 Item 70. Project Co to implement Board Change. Project Co confirm that any additional costs incurred to be borne by Project Co.
71	**Movement Joint outstanding action** Item 6.6 of the Boards Construction Requirements Schedule part 6; Section 3, states:	The Board / Project Co agree this item is closed, and the agreed technical solution approved through Schedule Part 8 (Review Procedure) and, agreed by the Board and Project Co as resolving the Dispute is as set out Disputed Works Schedule Appendix 1 Item 71.

Item	Dispute	Description of Agreed Resolution
	6.6 Movement Joints Structural movement joints shall not be located through a) Theatre rooms; b) Treatment and surgery rooms; c) X-ray and imaging rooms; d) Pharmacy manufacturing rooms; e) Kitchens and food preparation areas; f) Any room with (now or in the future) with ceiling mounted tracking hoists or other similar lifting equipment; and g) Any other room requiring a sterile environment; and h) Any rooms where there is a risk of biological or other hazard, or risk of penetration by water, grease/oil, or other hazardous or detrimental substance. Lateral stability bracing systems shall not obstruct or hinder clinical or non-clinical operations and shall not obscure the windows or doors. Project Co wishes to derogate from the requirements above for the following areas; a) Gamma Camera – G-Q1-044 (ceiling only) b) MRI room 2 – G-Q1-110 (ceiling only) c) Ward Kitchen – G-A2-041 (ceiling only) d) Utility room 1-1-P1-041 e) Corridor – 1-L1-105 f) Single bed – 1-L1-093 g) Corridor – 1-COR-007 h) Exit Bay – 1-P1-040 i) Hot toilet - 3-C1.4-078 J) Single Bedroom G-Q1-048	Project Co confirm that any additional costs incurred to be borne by Project Co.
72	**Heating pumps pressure** In the Board's opinion there is an issue with heating pumps pressure to distribute hot water around the Facility. Pumps may not be sized correctly. Project Co's position is that the installation was still a work in progress and will be compliant prior to the Actual Completion Date. The Board's comment was premature.	The Board and Project Agree that Project Co will capture the commissioning results and table these with the Board to confirm Contract compliance. All results are being uploaded to the Zutec as built document management system.

Item	Dispute	Description of Agreed Resolution
73	**Fridge Spaces** Spaces for fridges mid units are too small for the equipment. Project Co does not dispute this item.	The Board has agreed to reduce the sizes of some of the fridges. Project Co has agreed to provide adequate fridge space in line with the Board's requirement's, all as recorded on Aconex MPX-GC-027104 as set out in Disputed Works Schedule Appendix 1 Item 73.
74	**Incline in L2** The floor appears to be inclined in L2 department. Project Co disputes this position. Each party disagrees with the other party's position and therefore a dispute has arisen.	Through discussion between the Board and Project Co it was agreed no further action required.
75	**Row of work benches too close together - D6 first floor** It is the Board's position that the location of desks in therapies adjusted due to the location of power pole. This created the space between two rows of desks of around 1100cm which is not sufficient. Project Co does not dispute this item.	It was agreed by the Board and Project Co that Project Co should amend on Site the location of work benches at D6 first Floor. This work has been completed.
76	**Pot wash ceiling** Incorrect ceiling installed. Should be the same as the "high spec" ceiling in restaurant The ceiling tiles might be sufficient however the ceiling grid in non-compliant. Project Co does not dispute this item.	Through discussion and site review it was agreed between the Board and Project Co that Project Co would rectify this ceiling so that the specification is equal to the restaurant; Type H K40/115H and K40/250CR. This remedial work is to be captured by Project Co within the as built documentation.
77	**Socket outlets in Group 2 rooms** It is the Board's position, as per GN7, all socket outlets in group 2 rooms should be provided with metal plates. This however has not been provided by Project Co. Principle for plastic plates agreed in principle however Project Co Change is required. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	Through discussion and site review between the Board and Project Co it has been agreed that plastic switchplates are acceptable. Aconex MPX-CCP-063 as set out in Disputed Works Schedule Appendix 1 Item 77 documents the agreed change.

Item	Dispute	Description of Agreed Resolution
78	**Penetrations for services** It is the Board's position that desks fitted at touchdown bases have no penetrations for cabling that will need to be connected to sockets under the desks. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	The desk penetrations have now been fitted. This facilitates desk mounted IT equipment to below desk sockets.
79	**Pendants** It is the Board's position that there no evident fibre cabling has been provided and there is no cut out to terminate cables. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure).	Through discussion and agreement between the Board and Project Co, the Board is to procure final patching leads direct from the Board's preferred supplier (OUT 904). Aconex MPX-CCP-046 OUT904 Connections as set out in Disputed Works Schedule Appendix 1 Item 79 documents this position.
80	**NOT USED**	-
81	**NOT USED**	-

PART 2

TECHNICAL SCHEDULE DOCUMENTATION

Part 2 Technical Schedule Documentation is as set out on the USB memory stick in the Agreed Form identified and executed as Part 2 Technical Schedule Documentation of this SA1, referred to in and forming part of this SA1

PART 3

OTHER PROJECT AGREEMENT AMENDMENTS

PART A: DISPUTE RELATED AMENDMENTS

The following amendments shall be made to the Project Agreement with effect from the SA1 Effective Date (unless specified otherwise):

1. Access Rights

1.1 Clause 9.2 (Access following Construction) shall be amended as follows:

1.1.1 In line 3 of the opening paragraph, add "8" after "paragraphs 1" and before "and 10"; and

1.1.2 In Clause 9.2.2, add "and carrying out the Post Completion Works and Outstanding Works" after "Clause 23.15 (Board Maintenance Obligations)" and before ";".

1.2 In paragraph 8 (Site Compound/Car Park E) of Section 3 (Ancillary Rights) of Schedule Part 5 (Land Matters) "Project Co shall be entitled to occupy Car Park E" shall be deleted and replaced with:

"Project Co shall be entitled to occupy Car Park E and thereafter undertake reinstatement of Car Park E"

1.3 In paragraph 8 *(Site Compound/Car Park E)* of Section 3 *(Ancillary Rights)* of Schedule Part 5 *(Land Matters)*, the following shall be added on line one after "During the Construction Phase" and before "Project Co shall be entitled to occupy Car Park E and thereafter undertake reinstatement of Car Park E" as follows:

1.3.1 "and until 28 June 2019 ,".

1.4 In paragraph 1 of Section 3 *(Site Compound/Car Park E)* of Part 1 of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* of the Project Agreement, the following shall be added on line one after "During the Construction Phase" and before "Project Co shall be entitled to occupy Car Park E and thereafter undertake reinstatement of Car Park E" as follows:

1.4.1 "and until 28 June 2019 (such occupation rights terminating on the Expiry Date or (if earlier) the Termination Date),".

2. Clause 10

2.1 A new clause 10.4.1A shall be added as follows:

"until completion of the Post Completion Works where such matter arises solely as a result of the carrying out of the Post Completion Works, any such matter shall be deemed to be a Compensation Event for the purposes of this Agreement.".

2.2 In clause 10.4.2 and 10.4.3 the following shall be added after "Operational Term":

"(except where clause 10.4.1A applies)".

3. The words "(other than the Post Completion Works and the Outstanding Works)" shall be inserted after the word "Works" in the following provisions:

3.1 Clause 14.1 (Dates for Completion);

3.2 Clause 17.5 (Pre-Completion Commissioning and Completion);

3.3 Clause 17.10 (Pre-Completion inspection);

3.4 Clause 17.11 (Pre-Completion matters).

4. The words "(other than in respect of the Post Completion Works and the Outstanding Works)" shall be inserted after the words "are complete" in Clauses 17.12 and 17.13 (Completion Certificate);

5. After the words "Certificate of Practical Completion" as it appears in Clause 17.14, insert "and the certificate of completion of the Drainage Works; Void Detection Works; Heater Battery Works and Outstanding Works".

6. Clause 17.18 (As-built specification) shall be replaced as follows:

17.18.1 "Within ten (10) Business Days after the issue of the Certificate of Practical Completion, Project Co shall provide to the Board an electronic copy of the as-built building specification together with all drawings relating to the Works (other than the Post Completion Works and the Outstanding Works).

17.18.2 Within ten (10) Business Days after the certification by the Independent Tester of completion of the Drainage Works in accordance with the Drainage Completion Criteria, Project Co shall provide to the Board an electronic copy of the as-built building specification together with all drawings relating to the Drainage Works.

17.18.3 Within ten (10) Business Days after the certification by the Independent Tester of completion of the Void Detection Works in accordance with the Void Detection Completion Criteria, Project Co shall provide to the Board an electronic copy of the as-built building specification together with all drawings relating to the Void Detection Works.

17.18.4 Within ten (10) Business Days after the certification by the Independent Tester of completion of the Heater Battery Works in accordance with the Heater Battery Completion Criteria, Project Co shall provide to the Board an electronic copy of the as-built building specification together with all drawings relating to the Heater Battery Works.

17.18.5 Within ten (10) Business Days after the completion of the Outstanding Works in accordance with the Project Agreement (as amended by this Agreement), Project Co shall provide to the Board an electronic copy of the as-built building specification together with all drawings relating to the Outstanding Works.".

7. A new Clause 18.5.2A (Operational Manuals) shall be added as follows:

"Project Co shall make available on the Site to the Board's Representative:-

18.5.2A.1 on or before Milestone 2, Milestone 3 and / or Milestone 4 (as the case may be) two (2) electronic copies of a final draft operation and maintenance manual insofar as they relate to the Post Completion Works in sufficient detail to allow the Board to operate and use the Facilities safely and efficiently;

18.5.2A.2 within ten (10) Business Days following Milestone 2, Milestone 3 and / or Milestone 4 (as the case may be) three (3) electronic copies the principal operation and maintenance manual.

18.5.2A.3 on or before completion of the Outstanding Works two (2) electronic copies of a final draft operation and maintenance manual insofar as they relate to the Outstanding Works in sufficient detail to allow the Board to operate and use the Facilities safely and efficiently;

18.5.2A.4 within ten (10) Business Days following completion of the Outstanding Works three (3) electronic copies of the principal operation and maintenance manual.".

8. Clause 29 (Delay Events) shall be amended as follows:

8.1 In Clause 29.1, the words ", Post Completion Works Longstop Date, Milestone 2 Target Completion Date, Milestone 3 Target Completion Date and/ or Milestone 4 Target Completion Date as applicable" shall be inserted after the words "Completion Date" in the penultimate line.

8.2 In Clause 29.3, the words "or a delay in completion of the Drainage Works, Void Detection Works, Heater Battery Works or Outstanding Works" shall be inserted at the end of the first paragraph and at the end of Clause 29.3.1.

8.3 A new Clause 29.3.13 shall be inserted as follows:

"the suspension by Project Co of performance in accordance with Clause 4.3 of the SA1;".

8.4 A new Clause 29.3.14 shall be inserted as follows:

"the prevention or impediment of Project Co pursuant to Clause 6.18 of SA1 (Post Completion Works).".

8.5 In Clause 29.4, the words "or upon completion of the Drainage Works, Void Detection Works, Heater Battery Works or Outstanding Works" shall be inserted at the end of Clause 29.4.4.

8.6 In Clause 29.7, the words ", Outstanding Works Target Completion Date, Milestone 2 Target Completion Date, Milestone 3 Target Completion Date and/ or Milestone 4 Target Completion Date and/ or, in the case of the Post Completion Works only, the Post Completion Works Longstop Date" shall be inserted after the words "Completion Date" in the second line.

8.7 In Clause 29.10.1, the words "and 29.3.12" in the second line shall be replaced with ", 29.3.12, 29.3.13 and 29.3.14".

9. A new Clause 40.1.12 shall be inserted as follows:

"**Post Completion Works Longstop Date**

Project Co failing to complete the Post Completion Works by the Post Completion Works Longstop Date;".

10. In Clause 40.3.1 (Board's options) of the Project Agreement, the words "or 40.1.10 (Payment)" shall be replaced with the following:

", 40.1.10 (Payment) or 40.1.12 (Post Completion Works Longstop Date)".

11. The definition of "Completion Criteria" in Schedule Part 1 (Definitions and Interpretation) shall be replaced with the following:

""Completion Criteria" means, where the context permits, the Completion Tests as defined in Appendix B of Schedule Part 10 (*Outline Commissioning Programme*) or the Agreed Resolution, provided that in the event of conflict or inconsistency between the Agreed Resolution and the Completion Tests, the Agreed Resolution shall prevail;".

12. New definitions shall be inserted in Schedule Part 1 (Definitions and Interpretation) as follows:

"**Agreement**" or "**Project Agreement**" means this project agreement between the Board and Project Co dated 12th and 13th February 2015 as amended or supplemented from time to time in accordance with the terms of this Agreement;";

""**Drainage Completion Criteria**" means the drainage completion criteria as set out in Part C of Part 5 of the Schedule (Post Completion Works) to SA1;";

""**Drainage Works**" means the drainage works as described in Parts A and B of Part 5 of the Schedule (Post Completion Works) to SA1;";

""**Failed Instalment**" has the meaning given in Clause 4.1 (Payment) of SA1;";

""**Heater Battery Completion Criteria**" means the heater battery completion criteria as described in Part C of Part 5 of the Schedule (Post Completion Works) to SA1;";

""**Heater Battery Works**" means the heater battery works as described in Parts A and B of Part 5 of the Schedule (Post Completion Works) to SA1;";

""**Outstanding Works**" means the works set out in Part 6 of the Schedule (Outstanding Works) to SA1 which the Parties have agreed will be completed after the Actual Completion Date;";

""**Post Completion Works**" means the Drainage Works, Void Detection Works and Heater Battery Works all as described in Parts A and B of Part 5 of the Schedule (Post Completion Works) to the SA1;";

""**Post Completion Works Longstop Date**" means 26th July 2019 or such revised date as may be specified by the Board's Representative pursuant to Clause 29 (Delay Events) or such other date as may be agreed by the Parties;";

""**SA1**" means the supplemental agreement to this Agreement entered into between the Parties on 22 February 2019;";

""**Void Detection Completion Criteria**" means the void detection completion criteria as set out in Part C of Part 5 of the Schedule (Post Completion Works) to the SA1;";

""**Void Detection Works**" means the void detection works as described in Parts A and B of Part 5 of the Schedule (Post Completion Works) to the SA1;".

13. The words "(including for the avoidance of doubt the carrying out of the Post Completion Works and the Outstanding Works)" shall be inserted after the word "Works" in the definition of "Project Operations" in Schedule Part 1 (Definitions and Interpretation).

14. **Schedule Part 10**

Appendix B (Completion Criteria) of Schedule Part 10 (Outline Commissioning Programme) of the Project Agreement shall be amended as follows:-

14.1.1 The opening paragraph of section 3 (Handover Clean) shall be deleted and replaced with the following:-

"On completion of the Works (excluding the Post Completion Works and the Outstanding Works), Project Co shall have carried out and completed the Handover Clean (as defined in this paragraph 3 (Handover Clean) of Appendix B (Completion Criteria) of Schedule Part 10 (Outline Commissioning Programme)) in all areas of the Facilities, except those areas where the Post Completion Works and/or Outstanding Works will be undertaken by Project Co following the Actual Completion Date.

On completion of Milestone 2, Milestone 3, Milestone 4 and the Outstanding Works respectively, Project Co shall have carried out and completed the Handover Clean (as defined in this paragraph 3 (Handover Clean) of Appendix B (Completion Criteria) of Schedule Part 10 (Outline Commissioning Programme)) in each of the areas where the Drainage Works, Heater Battery Works, Void Detection Works and Outstanding Works have been undertaken.";

14.1.2 Paragraph 4.1.1 shall be deleted and replaced with the following:-

4.1.1 "Temporary Occupation Certificate;

4.1.1A Project Co shall procure that a Building Warrant Completion Certificate shall be produced by 31 March 2019;".

15. **Schedule Part 14**

15.1 The following new paragraphs 4.1A and 4.1B shall be added to Section 3 (Deductions for Availability Failures) of Schedule Part 14 (Payment Mechanism) as follows:-

15.2 A new Paragraph 4.1A shall be inserted as follows:

"4.1A Where a Service Event occurs which results in a failure by Project Co to provide that one of the three basement sump pumps is operational (which, for the avoidance of doubt, means a simultaneous and consecutive failure of the in situ duty pump, in-situ standby pump and third emergency pump) ("Total Basement Pump Failure") and:-

(i) the Total Basement Pump Failure is not Rectified within the Rectification Period; and

(ii) the Board in its absolute discretion has vacated the Functional Areas which are those areas highlighted in blue and/or referred to as "Basement Pump Additional Functional Areas" as set out in Appendix 3 *(Clinical Assessment Basement GSU)* of Schedule Part 14 *(Payment Mechanism)* ("**Basement Pump Additional Functional Areas**");

subject to paragraph 4.1A3, the Basement Pump Additional Functional Areas shall be deemed to be Unavailable from the commencement of the Service Failure Time until such time as the Total Basement Pump Failure is Rectified.

4.1A2 If a Total Basement Pump Failure occurs and

(i) the Total Basement Pump Failure is not Rectified within the Rectification Period; and

(ii) the Board, in its absolute discretion has vacated the Functional Areas which are those areas highlighted in green and/or referred to as "Basement Pump Functional Areas" as set out in Appendix 3 *(Clinical Assessment Basement GSU)* of Schedule Part 14 *(Payment Mechanism*] ("**Basement Pump Functional Areas**")

subject to paragraph 4.1A3 the Basement Pump Functional Areas shall be deemed to be Unavailable from the Service Failure Time until such time as the Total Basement Pump Failure is Rectified.

4.1A3 If the Board in its absolute discretion does not vacate both the Basement Pump Functional Areas and the Basement Pump Additional Functional Areas then no Unavailability or Service Event will have occurred in respect of the Basement Pump Additional Functional Areas and Deductions will not apply to the Basement Pump Additional Functional Areas."

15.3 A new Paragraph 4.1B shall be inserted as follows:

4.1B Where a Service Event occurs which results in a failure by Project Co to ensure that the external sump pump is operational (which, for the avoidance of doubt, means a failure of the in situ pumps and spare pump) ("**Total External Pump Failure**") and:

(i) the Total External Pump Failure is not Rectified within the Rectification Period; and

(ii) the Board in its absolute discretion has vacated the Functional Areas which are those areas highlighted in blue and/or referred to as "External Pump Additional Functional Areas" as set out in Appendix 4 *(Clinical Assessment PARU GSU)* of Schedule Part 14 *(Payment Mechanism)* ("**External Pump Additional Functional Areas**");

subject to paragraph 4.1A3, the External Pump Additional Functional Areas shall be deemed to be Unavailable from the commencement of the Service Failure Time until such time as the Total External Pump Failure is Rectified.

4.1B2 If a Total External Pump Failure occurs and:

(i) the Total External Pump Failure is not Rectified within the Rectification Period; and

(ii) the Board, in its absolute discretion has vacated the Functional Areas which are those areas highlighted in green and/or referred to as "External Pump Functional Areas" as set out in Appendix 4 *(Clinical Assessment PARU GSU)* of Schedule Part 14 *(Payment Mechanism)* ("**External Pump Functional Areas**")

subject to paragraph 4.1A3 the External Pump Functional Areas shall be deemed to be Unavailable from the Service Failure Time until such time as the Total External Pump Failure is Rectified.

4.1B3 If the Board in its absolute discretion does not vacate both the External Pump Functional Areas and the External Pump Additional Functional Areas then no Unavailability or Service Event will have occurred in respect of the External Pump Additional Functional Areas and Deductions will not apply to the External Pump Additional Functional Areas.

16. A new Appendix 3 (Clinical Assessment Basement GSU) as set out in Part E of Part 3 of the Schedule to SA1 shall be added to Schedule Part 14 (Payment Mechanism.

17. A new Appendix 4 (Clinical Assessment Paru GSU) as set out in Part F of Part 3 of the Schedule to SA1 shall be added to Schedule Part 14 (Payment Mechanism).

18. The definition of "Deemed New Agreement" in Section 6 (Definitions) of Schedule Part 17 (Compensation on Termination) shall be replaced with the following:

"means an agreement on the same terms and conditions as this Agreement (including, for the avoidance of doubt SA1), as at the Termination Date, but with the following amendments

(a) if this Agreement is terminated prior to:

(i) the Actual Completion Date, then the Longstop Date shall be extended by a period to allow a New Project Co (had one been appointed) to achieve the Actual Completion Date prior to the Longstop Date;

(ii) completion of the Post Completion Works, then the Post Completion Works Longstop Date shall be extended by a period to allow a New Project Co (had one been appointed) to complete the Post Completion Works prior to the Post Completion Works Longstop Date;

(b) any accrued Deductions and / or Warning Notices shall, for the purposes of termination only, and without prejudice to the rights of the Board to make financial deductions, be cancelled; and

(c) the term of such agreement shall be for a period equal to the term from the Termination Date to the Expiry Date;

19. The definition of " New Agreement" in Section 6 (Definitions) of Schedule Part 17 (Compensation on Termination) shall be replaced with the following:

"means an agreement on the same terms and conditions as this Agreement (including, for the avoidance of doubt SA1), at the Termination Date, but with the following amendments

(a) if this Agreement is terminated prior to:

(i) the Actual Completion Date, then the Longstop Date shall be extended by a period to allow a New Project Co to achieve the Actual Completion Date prior to the Longstop Date;

(ii) completion of the Post Completion Works, then the Post Completion Works Longstop Date shall be extended by a period to allow a New Project Co to complete the Post Completion Works prior to the Post Completion Works Longstop Date;

(b) any accrued Deductions and / or Warning Notices shall, for the purposes of termination only, and without prejudice to the rights of the Board to make financial deductions, be cancelled;

(c) the term of such agreement shall be for a period equal to the term from the Termination Date to the Expiry Date; and

(d) any other amendments which do not adversely affect the Project Co;".

16. Paragraph 4.3.3 (c) of Section 2 of Schedule Part 17 (Compensation on Termination) of the Project Agreement shall be amended as follows:-

After the word "Works)" in line 3 the following will be added:- "(including for the avoidance of doubt, any rectification costs associated with SA1 which rectification costs shall be valued at the level of the outstanding Element of the Settlement Sum attributable to Milestone 2 and / or Milestone 3 and / or Milestone 4 (as applicable) set out in Schedule Part 7 (Payment and Milestones) of SA1)"

PART B – CCTV RELATED AMENDMENTS

With effect from SA1 Effective Date, the provisions of the Project Agreement shall be amended as set out in this Part B of Schedule Part 3 (Other Project Agreement Amendments) and construed accordingly.

1. Schedule Part 1 of the Project Agreement *(Definitions and Interpretations)*

The following definitions shall be inserted and/or deleted and restated, as applicable, in Schedule Part 1 *(Definitions and Interpretations)* as follows:

""**CCTV Infrastructure"** means the infrastructure resulting from the CCTV Works;"

""**CCTV Infrastructure Sites"** means the Sites of the CCTV Infrastructure shown indicatively as a "P○" on drawing number ME-EW-XX-PL-571-001 version E, which forms part of the CCTV Works Proposal or such other sites as are otherwise agreed between the Parties;"

""**CCTV Works"** means the design (including preparation of all Design Data), construction, testing, commissioning and completion of the CCTV Infrastructure and thereafter maintaining, repairing and renewing the CCTV Infrastructure at the CCTV Infrastructure Sites in the Yellow Area, as described in the CCTV Works Proposal;"

""**CCTV Works Proposal"** means the information for the design and construction of the CCTV Works detailed in Part B of Schedule Part 3 (Other Project Agreement Amendments) of SA1 as amended from time to time in accordance with the Project Agreement;"

""**Interface Proposals**" means any of the Access Strategy, Connection Proposal, Construction Access Proposal, Oversail Strategy, Service Proposal, Supplemental Drainage Proposal, Traffic Management Strategy, CCTV Works Proposal and any strategy or proposal agreed or determined pursuant to the terms of Part 2 *(Interface Proposals Procedure)* of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)*, which Interface Proposals form part of Project Co's Proposals and Method Statements;"

""**Off-Site Works**" means the RIE Works, Hospital Square Works, Cycle Paths Works, Substation Works, Petrol Station Site Works, Surface Water Drainage Works and/ or CCTV Works;".

2. Schedule Part 5 of the Project Agreement *(Land Matters)*

2.1 In paragraph 4 *(Access Areas)* of Section 3 *(Ancillary Rights)* of Schedule Part 5 *(Land Matters),* delete "and" at end of paragraph 4.4, insert "and" at end of paragraph 4.5 and insert a new paragraph 4.6 after paragraph 4.5 as follows:

"4.6 carry out the CCTV Works including the rights to construct and lay service media to and from the Site as necessary to serve the CCTV Works within the Yellow Area;".

2.2 In the last paragraph of paragraph 4 *(Access Areas)* of Section 3 *(Ancillary Rights)* of Schedule Part 5 *(Land Matters)* at the end of the paragraph insert after "Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)*," the following:

2.3 ", and without limiting the foregoing, further in relation to the matters in the foregoing paragraph 4.6, complying with the CCTV Works Proposals".

2.4 After paragraph 10.5 of paragraph 10 *(Operational Access)* of Section 3 *(Ancillary Rights)* of Schedule Part 5 *(Land Matters)* insert a NEW paragraph 10.6 as follows:

"During the Operational Term Project Co shall have a right of access to the Yellow Area to maintain, repair and renew the CCTV Infrastructure and service media serving such CCTV Infrastructure within the Yellow Area subject to Project Co complying with the terms of Section 2 *(Operational Construction Issues)* and Section 5 *(Access Areas and Drainage)* of Part 1 *(Interface*

Construction Issues and Interface Proposals) of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* and the CCTV Works Proposal.".

3. Schedule Part 14 of the Project Agreement (Payment Mechanism)

The disc in the Agreed Form which sets out Appendix 2 (Functional Areas and GSUs) of Schedule Part 14 of the Project Agreement (Payment Mechanism) and which was initialled on or around the date of the Project Agreement, shall be replaced with the updated Appendix 2 (Functional Areas and GSUs) of Schedule Part 14 of the Project Agreement (Payment Mechanism) set out in in Part D of this Schedule Part 3 (Other Project Agreement Amendments).

4. Schedule Part 31 (*Consort Interface with Campus Site and/or Campus Facilities*) of the Project Agreement

4.1 In Annex 5 (Access to RIE Site and RIE Facilities during the Operational Term – Foul Service Strip) and Annex 6 (Access to RIE Site and RIE Facilities during the Operational Term – Service Strip) of Appendix 7 of Schedule Part 31, delete the heading reference "Part B" and replace this reference with "Part C".

4.2 In Section 2 *(Operational Construction Issues)* of Part 1 *(Interface Construction Issues and Interface Proposals)* of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* delete the words "Not Used" in paragraph 4 and replace with the following:

"4. CCTV Works

Without limiting the terms of paragraph 1 *(Access to RIE Site and RIE Facilities)*, during the Operational Term Project Co shall maintain, repair and renew the CCTV Infrastructure and service media serving such CCTV Infrastructure installed within the Yellow Area pursuant to the Board's Construction Requirements and/or the CCTV Works Proposal."

4.3 In Section 5 (*Access Areas and Drainage*) of Part 1 *(Interface Construction Issues and Interface Proposals)* of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)*, add a new paragraph 1.1.7 as follows:

"1.1.7 carry out the CCTV Works within the Yellow Area, in the form of notice set out in Annex 3 of Part B of Appendix 4 of this Schedule Part 31."

4.4 In Section 5 *(Access Areas and Drainage)* of Part 1 *(Interface Construction Issues and Interface Proposals)* of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)*, at paragraph 4 delete "Not Used" and insert a new paragraph 4 *(CCTV Works)* as follows:

"4. CCTV Works

4.1 In addition to the requirements of paragraph 1 of this Section 5 (*Access Areas and Drainage*) of Part 1 (*Interface Construction Issues and Interface Proposals*) of this Schedule Part 31, in regard to the CCTV Works within the Yellow Area under paragraph 1.1.7 of this Section 5 the following additional requirements shall apply:-

4.1.1 Project Co shall comply with and procure compliance by Project Co Parties with the CCTV Works Proposal;

4.1.2 the information for the CCTV Works Proposal shall contain full details of the design, construction, programme and method statements sufficient to enable a full assessment of the proposed works and shall provide that the works will:-

(a) be safe to any personnel or equipment or any part of the Campus Site and/or Campus Facilities; and

(b) comply with Good Industry Practice and Law; and

(c) have the effect that the operational and/or structural performance of the Campus Site and/or Campus Facilities will be of an equivalent standard of performance compared with the standard of performance if the CCTV Works Proposal were not implemented and/or that the functionality or design life of the Campus Site and/or Campus Facilities or any material part thereof and/or the Board's, Consort's and/or the University's and/or any other operations at the Campus Site and Campus Facilities are not materially adversely affected, and the Board and/or any Board Party and/or Consort and/or any Consort Party or any party on behalf of any of them shall be entitled to observe the works for the protection of existing service media serving the Campus Site and/or Campus Facilities within the relevant part of the Access Areas;

4.1.3 as at the SA1 Effective Date, the CCTV Works Proposal set out in Part C of Part 3 of the Schedule to SA1 (CCTV Works Proposal) shall be deemed to be agreed by all relevant parties as satisfying the requirements of this Agreement."

4.5 In Section 5 *(Access Areas and Drainage)* of Part 1 *(Interface Construction Issues and Interface Proposals)* of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)*, after NEW paragraph 4 *(CCTV Works)* insert a NEW Paragraph 4A *(Maintenance, Repair and Renewal)* as follows:

"4A Maintenance, Repair and Renewal of CCTV Works

4A.1 Where the works to be carried out by Project Co pursuant to paragraph 1.1.7 of this Section 5 involve the maintenance, repair or renewal of CCTV Infrastructure the following provisions shall apply:

4A.1.1 except in the case of emergency works (which for the purposes of this paragraph shall include any circumstances which give or may give rise to the occurrence of a Service Event) of maintenance, repair or renewal, the condition of the relevant part of the Yellow Area will be recorded in a Schedule of Condition to be prepared pursuant to paragraph 2 (Schedules of Condition) of Part 3 (General Matters) of this Schedule Part 31;

4A.1.2 the works shall be carried out in such a manner as shall cause the minimum practicable disruption to the use and occupation of the relevant area and shall be completed as soon as reasonably practicable;

4A.1.3 on completion of the works Project Co shall and shall procure that Project Co Parties shall reinstate the relevant area and any buildings, structures and others erected thereon and any plant, machinery and equipment to no worse condition than that which existed prior to Project Co taking occupation of the relevant area to carry out the works evidenced by the Schedule of Condition referred to at paragraph 4A.1.1 and that as soon as practicable, and in the event Project Co fails or fails to procure any such reinstatement is effected as soon as reasonably practicable then the Board and/or any Board Party and/or Consort and/or any Consort Party and/or or any party on behalf of any of them shall be entitled to effect such reinstatement at Project Co's cost;

4A.1.4 Project Co shall be obliged to give the Board notice of completion of the works in the form of notice set out in Annex 10 of Part B of Appendix 10 of this Schedule Part 31 as applicable and the reinstatement works forthwith on the works being completed and the relevant area being vacated by Project Co;

4A.1.5 Project Co shall be liable and the provisions of Clause 49.*1 (Project Co Indemnities to Board)* of this Agreement shall apply for the consequences of failing to comply with and/or any breach of and/or any negligent act in complying with the requirements in this paragraph 4A of this Section 5

(Access and Drainage) of Part 1 *(Interface Construction Issues and Interface Proposals)* of this Schedule Part 31 and/or the losses which may be suffered or incurred by any Campus Party as a result of any act or omission of Project Co and/or a Project Co Party exercising any of the rights and/or performing any of its obligations and/or failing to do so including without limitation costs of repair, replacement, renewal and/or reinstatement of the Yellow Area and/or the existing service media within any of them."

4.6 In Part 2 (Interface Proposals Procedure) of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)*, insert a new Section 4 after Section 3 *(Amended Service Proposal (Service Strip and Foul Service Strip))* as follows:

"Section 4

CCTV Works Proposal Amendments

1. In the event that the route, depth, size or condition of any existing service media within the Yellow Area is found to be different from that which was anticipated in the CCTV Works Proposal, with the result that the CCTV Works Proposal cannot be implemented and requires to be amended then:

1.1 Project Co shall provide written notice to the Board in the form of notice set out in Annex 7 of Part B of Appendix 7 of this Schedule Part 31 of how the CCTV Works Proposal cannot be implemented and the changes required together with details outlining the issue with the existing service media and providing an amended CCTV Works Proposal with such additional detail, information and drawings as are available. The Board shall deliver a copy of the amended CCTV Works Proposal to Consort not later than two (2) Business Days after receipt of the amended CCTV Works Proposal from Project Co;

1.2 Not later than seven (7) Business Days following the date upon which notice has been given to the Board pursuant to paragraph 1.1 Project Co and the Board shall and the Board shall use reasonable endeavours to procure that Consort (or the respective representatives thereof) shall meet on site to review the amended CCTV Works Proposal and inspect the existing service media, and the Board and Project Co shall use all reasonable endeavours, and the Board shall use reasonable endeavours to procure that Consort use all reasonable endeavours (acting in good faith) to provisionally agree the amended CCTV Works Proposal and any variations thereto which will allow the service media installation(s) to proceed;

1.3 Not later than five (5) Business Days following the meeting held pursuant to paragraph 1.2 Project Co and the Board shall, and the Board shall use reasonable endeavours to procure that Consort shall further review the detail of the amended CCTV Works Proposal proposed at the meeting, with a view to reaching agreement on a final amended CCTV Works Proposal including updated plans and/or specifications for the applicable service media installations;

1.4 Dispute

1.4.1 In the event that the Board has not intimated to Project Co that the amended CCTV Works Proposal has been agreed by the Board and Consort by the date ten (10) Business Days after the date of the meeting held pursuant to paragraph 1.2 then the Board shall, where the amended CCTV Works Proposal is not agreed by Consort and if requested to do so by Project Co, refer the determination of the amended CCTV Works Proposal to the Independent Expert (who in this case, in the event of a failure by the Board and Consort to agree on the proposed expert, shall be nominated by the Institution of Engineering and Technology, Institution of Mechanical Engineers or the Chartered Institution of Building Services Engineers, as appropriate);

1.4.2 The Independent Expert shall act as an expert and will accept as a condition of his appointment that he shall give a decision within five (5) Business Days of his

appointment. The Independent Expert shall require to determine the amendments that should be made to the CCTV Works Proposal to enable the applicable service media installations to proceed within the Yellow Area while taking into account the need to protect the existing service media within the Yellow Area serving the Campus Site and/or Campus Facilities and the requirement for the Board and/or any Board Party and/or Consort and/or any Consort Party to access such service media in order to comply with its maintenance obligations;

1.4.3 Before nominating a person to act as Independent Expert or agreeing to the nomination by Consort, the Board shall take account of any reasonable representations made by Project Co with regard to the identity of the proposed Independent Expert provided that Project Co shall have regard to the requirement that the Independent Expert should be suitably qualified and have not less than seven (7) years' experience in groundworks/infrastructure. In referring matters to the Independent Expert the Board shall give due regard to any written representations received from Project Co which the Board acting reasonably consider are proper and reasonable and shall keep Project Co advised as to all communications to and from the Independent Expert;

1.4.4 The decision of the Independent Expert shall be final and binding on the Board, Project Co and Consort. In the event that the Independent Expert decides wholly or partly in favour of Consort, Project Co shall meet any award as to the costs of and associated with the referral proceedings including without limitation the costs of the Independent Expert, Consort, the Board and any other party involved in the referral;

1.5 Project Co shall and shall procure that Project Co Parties shall comply with and the provisions of paragraphs 1, 3, 4, 4A and 5 of Section 5 *(Access Areas and Drainage)* of Part 1 *(Interface Construction Issues and Interface Proposals)* of this Schedule Part 31 shall apply in respect of any matters carried out pursuant to the CCTV Works Proposal agreed or determined pursuant to this Section 4.

4.7 In Paragraph 1.4 of Part 3 *(General Matters) of* Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* delete paragraph 1.4.4 and substitute the following:

"paragraphs 1.1, 1.3.1 and/or 4A.1.4 of Section 5 *(Access Areas and Drainage)* of Part 1;"

4.8 In paragraph 1.4.of Part 3 *(General Matters)* of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* insert a NEW paragraph 1.4.8 after paragraph 1.4.7 as follows:

"1.4.8 paragraph 1.1 of Section 4 *(CCTV Works Proposal Amendments)* of Part 2;"

4.9 In paragraph 4.1.2 of Part 3 of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* after "Section 3 *(Amended Service Proposal)*" in the penultimate line insert the following:

"and Section 4 *(CCTV Works Proposal Amendments)* of Part 2 *(Interface Proposals Procedure)"*

4.10 In paragraph 4.2 of Part 3 *(General Matters)* of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* insert at the end of the paragraph the following:

"provided however that where the alleged failure and/or Defect is in the CCTV Infrastructure Project Co shall or shall ensure that immediate action to remedy the alleged failure and/or Defect is taken and Project Co shall be provided with an opportunity to do so."

4.11 Amend Annex 3 of Part B of Appendix 4 of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* as follows:

4.11.1 delete Annex 3 title and insert "Cycle Path Works and CCTV Works in the Yellow Area";

4.11.2 in "Notice Period" add "and/or CCTV Works" after "Cycle Path Works" and before "in the Yellow Area" and add the following comment;

"**[NB: THE NOTICE PERIOD DOES NOT APPLY IN AN EMERGENCY WHERE AS MUCH NOTICE AS PRACTICABLE IN THE CIRCUMSTANCES IS TO BE GIVEN]**";

4.11.3 in "Notice Order Provision" add "and/or paragraph 1.1.7" after "1.1.6";

4.11.4 in "Description of Requirements" insert "[/CCTV Works]]" after "Cycle Path" on line 1;

4.11.5 in the "Schedule of Condition" section after "Form of Notice]" insert

"**[NB THIS IS NOT REQUIRED WHERE THERE ARE EMERGENCY WORKS TO MAINTAIN, REPAIR OR RENEW SERVICE MEDIA]**";

4.12 Amend Annex 5 of Part C of Appendix 4 of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* in the "Other Requirements" section by adding "and paragraph 4 *(CCTV Works)*" after "paragraph 1 *(Access to RIE and RIE Facilities)*" on line 2.

4.13 Insert a new Annex 7 in Part B of Appendix 7 of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* as follows:

"APPENDIX 7

PART B – FORM OF NOTICES FOR CONSTRUCTION PHASE

ANNEX 7 - CCTV WORKS PROPOSAL

Notice Period:	**Notice Order Provisions:**	
Not applicable.	Paragraph 1.1 of Section 4 *(Amended Proposal – CCTV Works)* of Part 2 of this Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities).*	
Date of Notice:	**Reference:**	
[ ]	**Board: [ ]**	**Project Co: [ ]**
Description of requirements:		
The [route, depth, size or condition – insert exact details of the problem of the existing service media in the Yellow Area differs from what has been provided for in the CCTV Works Proposal with the result the CCTV Works Proposal cannot be implemented [insert how the Proposal cannot be implemented] and requires to be amended.		
Amended CCTV Works **Proposal:**		
The amended CCTV Works Proposal is attached and includes: • existing service media; • additional details of works; • information and drawings.		
Meeting and inspection:		
Project Co agrees to meet the Board (and if required Consort) at site not later than seven (7) Business Days after this notice has been given to the Board to review the amended CCTV Works Proposal and inspect the existing service media and to attend any further meetings within five (5) Business Days of the meeting at site (as required) to endeavour to agree the Amended Proposal.		
Approvals (if applicable):		

Schedule of Condition:
A Schedule of Condition of the Access Area being occupied has been prepared in accordance with paragraph 2 of Part 3 of this Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* [and a copy is attached to this Form of Notice]
Construction Access Strategy:
Project Co shall comply at all times with the Construction Access Strategy.
Traffic management arrangements:
Project Co's traffic arrangements (e.g. one way and contra flow) shall be managed by [identity of contractor] and supervised by [identity of supervisors, their duties and responsibilities, contact details (telephone numbers, bleep numbers, etc).]
Journeys:
Project Co anticipates the following number of journeys shall be [ ].
Timing of access:
Project requests that the time of day when access is required shall be [ ].
Construction traffic:
Project Co's construction traffic will comprise the following [vehicle size/type, access requirements].
Activities of construction traffic:
Project Co's construction traffic will be doing the following activities [off-loading, etc].
Compliance with [paragraph 1.2 of Section 5] OR [paragraph 1.1 of Section 2 of Part 2] of Part 1 of this Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities):*
As per [paragraph 1.2 of Section 5 of Part 1] OR [paragraph 1.1 of Section 2 of Part 2] of this Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)*, Project Co shall also implement and comply with any with any other measures and operations reasonably requested by the Board for the proper implementation of the Access Strategy, including measures which should be taken to reduce any health and safety risks to all visitors, staff and patients at the Campus Site and/or Campus Facilities. For the avoidance of doubt, Project Co shall: 1 not used; 2 ensure the imposition, where appropriate, of a suitable Permit to Work System and any other reasonable requirement of the Board, appropriate to the nature of the CCTV Works; 3 ensure restrictions on the periods during which construction access may be taken; 4 not used; 5 re-sequencing (and/or temporary cessation) the performance of elements of the CCTV Works/ activities; and 6 implement other reasonable measures which should be taken to (1) ensure sufficient and appropriate continued pedestrian and vehicular access to the Campus Site and/or Campus Facilities and part of the Retained Site and/or Retained Estate during the period of occupation, and (2) to reduce any health and safety risks to all visitors, staff and patients at the Campus

Site and/or Campus Facilities.
Hoarding off Access Area:
The affected part of the [Access Areas] shall be securely hoarded off by Project Co
Other requirements of this Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)*:
Project Co acknowledges and shall comply with the other requirements set out in: • paragraphs 1, 3, 4 and 4A and on completion in the relevant area, paragraph 5 of Section 5 *(Access Areas and Drainage)* of Part 1; • [paragraph 1 and 4 of Section 2 *(Operational Construction Issues)* of Part 1; and] • the applicable requirements in Part 3 *(General Matters);* of this Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)*, in respect of any matters carried out pursuant to the agreed or determined amended CCTV Works Proposal.
Issued by: [ ] for Project Co
Signed..... **Print name**..... **Title**.....

4.14 Amend Annex 4 of Part A of Appendix 10 of Schedule Part 31 (*Consort Interface with Campus Site and/or Campus Facilities*) as follows:

4.14.1 in Annex 4 title insert "and/or CCTV Works" after "Cycle Path Works" but before "in the Yellow Area";

4.14.2 in Annex 4 "Notice Order Provisions" add "or paragraph 1.1.7)" after "paragraph 1.1.6" on line 1;

4.14.3 in Annex 4 "Description of completion of construction and date of completion" add "[form the CCTV Works]" after "[form the Cycle Path Works]" on line 1.

4.15 Insert a new Annex 10 of Part B of Appendix 10 of Schedule Part 31 (*Consort Interface with Campus Site and/or Campus Facilities*) of the Project Agreement as follows:

"**APPENDIX 10**

FORM OF NOTICES FOR COMPLETION AND VACATION

PART B – FORM OF NOTICES FOR OPERATIONAL TERM

ANNEX 10 - COMPLETION OF MAINTENANCE, REPAIR OR RENEWAL OF CCTV INFRASTRUCTURE IN AND VACATION OF THE YELLOW AREA (WHICH IS NOT SERVICE STRIP OR FOUL STRIP)

Notice Period:	Notice Order Provisions:
Not applicable.	Paragraph 4A of Section 5 (*Access Areas and Drainage*) of Part 1 (Interface Construction Issues and Interface Proposals) of Schedule Part 31

	(Consort Interface with Campus Site and/or Campus Facilities)	
Date of Notice:	**Reference:**	
[ ]	**Board: [ ]**	**Project Co: [ ]**
Description of completion of construction and date of completion:		
Project Co hereby gives notice that it has completed the works to [repair maintain, renew] service media for the CCTV Infrastructure within the Yellow Area shown on plan [ ] attached which were notified in Project Co's notice to the Board dated [ ] and Project Co has reinstated the area to its prior condition as evidenced by the Schedule of Condition and has vacated the area. Completion of these works occurred on [ ]. Reinstatement of the area occurred on [ ]. Vacation of the area occurred on [ ].		
Further Schedule of Condition:		
A further Schedule of Condition of the Access Area which is no longer being used should now be prepared in accordance with paragraph 2 *(Schedules of Condition)* of Part 3 *(General Matters)* of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* of this Agreement.		
Issued by: [ ] for Project Co		
Signed..... **Print name**..... **Title**....."		

PART C - CCTV WORKS PROPOSAL

Part C of Schedule Part 3 CCTV Works Proposal is in the Agreed Form identified and executed as Part C of Schedule Part 3CCTV Works Proposal of this SA1, referred to in and forming part of this SA1

APPENDIX 4

Part B – Form of Notices for Construction Phase

ANNEX 3 – Cycle Path Works in the Yellow Area

Notice Period:	**Notice Order Provisions:**	
Notwithstanding the period of Notice required from the date upon which Project Co intends to carry out works to form Cycle Path Works in the Yellow Area the parties agree access was granted on 9th November 2017.	Paragraph 1.1 (relative to paragraph 1.1.6) of Section 5 (Access Areas and Drainage) of Part 1) of Schedule 31 *(Consort Interface with Campus Site and/or Campus Facilities)* of this Agreement.	
Date of Notice:	**Reference:**	
17th July 2018	**Board:**	**Project Co: 039**
Description of requirements:		
As part of the Works to form the Cycle Path Works (cycle path & reconfigure landscaped areas) within the Yellow Area, CCTV works are required. Information listed below refers: • Plan 2 • 091-MS-CRUM-058-00-CCTV Ducting • 1545 BAS cat v4.1 • ME-EW-XX-PL-571-001_E • RAMS Method Statement Temp CCTV Fibre Works • WW-EW-XX-PL-716-001		
Area or areas of the Retained Site where access will be required:		
The Yellow Area shown on plan 2 attached.		
Date or dates on which access will be required:		
Notwithstanding the Notice periods within Schedule Part 31 to the PA it has been agreed between the parties (MPX/IHSL/Board/Consort) at Interface meetings that access is granted from 9th November 2017 for the period up to Actual Completion as defined in the Project Agreement.		

Schedule of Condition:
A Schedule of Condition of the Access Area being occupied has been prepared in accordance with paragraph 2 of Part 3 of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* of this Agreement and a copy is in the possession of both the Board and Consort.
Access Strategy:
Project Co shall ensure pedestrian and vehicular access to the Campus Site and Campus Facilities must be maintained at all times and shall comply with the Access Strategy, which in turn shall comply with the requirements of paragraph 1.2 of Section 5 of Part 1 of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* of this Agreement, when taking any access over the Orange Area.
Responsibility for traffic management:
Project Co shall will be responsible for management of traffic across the Orange Area adjacent to the Yellow Area and primary responsibility for health and safety of all users of the Orange Area and road traffic signage and pedestrian crossings within the Orange Area
Arrangements for traffic management:
Project Co's traffic arrangements shall be managed by Multiplex Construction Europe Ltd (MPX) and supervised by Stuart Jackson (Project Manager) 07912 575 611 who may delegate authority to a competent and suitably qualified employee of MPX, contact details of whom will be communicated timeously.
Journeys:
Project Co is unable to quantify the expected number of journeys. All deliveries and unloading will be subject to Method Statement '091-MS-CRUM-058-00-CCTV Ducting' (2 pages) & 'RAMS Method Statement Temp CCTV Fibre Works' (3 pages) attached.
Timing of access:
Project Co requests that the time of day when access is required shall generally be 0700hrs to 1800hrs.
Construction traffic:
Project Co's construction traffic will be directed in accordance with Method Statement '091-MS-CRUM-058-00-CCTV Ducting' (2 pages) & 'RAMS Method Statement Temp CCTV Fibre Works' (3

pages) attached.

Activities of construction traffic:

Project Co's construction traffic will be carrying out the activities as defined Method Statement'091-MS-CRUM-058-00-CCTV Ducting' (2 pages) & 'RAMS Method Statement Temp CCTV Fibre Works' (3 pages) attached.

Compliance with paragraph 1.2 of Section 5 of Part 1 of Schedule 31*(Consort Interface with Campus Site and/or Campus Facilities)* of this Agreement:

As per paragraph 1.2 of Section 5 of Part 1 of Schedule 31 *(Consort Interface with Campus Site and/or Campus Facilities)* of this Agreement, Project Co shall also implement and comply with any with any other measures and operations reasonably requested by the Board for the proper implementation of the Access Strategy, including measures which should be taken to reduce any health and safety risks to all visitors, staff and patients at the Campus Site and/or Campus Facilities. For the avoidance of doubt, Project Co shall:

1 ensure the he imposition, where appropriate, of a suitable Permit to Work System and any other reasonable requirement of the Board, appropriate to the nature of the Works;

2 ensure restrictions on the periods during which construction access may be taken;

3 re-sequencing (and/or temporary cessation) the performance of elements of the Works/activities; and

4 implement other reasonable measures which should be taken (1) to ensure sufficient and appropriate continued pedestrian and vehicular access to the Campus Site and/or Campus Facilities and part of the Retained Site and/or Retained Estate during the period of occupation, and (2) to reduce any health and safety risks to all visitors, staff and patients at the Campus Site and/or Campus Facilities;

Hoarding off Access Area:

The affected part of the Access Areas shall be securely hoarded off by Project Co.

Other requirements of Schedule Part 31*(Consort Interface with Campus Site and/or Campus Facilities)* of this Agreement:

Project Co acknowledges and shall comply and/or shall procure compliance with the other requirements set out in paragraph 1 *(Access Areas)*, and on completion of the works, paragraph 5 *(Other General Matters)* of Section 5 *(Access Areas and Drainage)* of Part 1, and the applicable completion and vacation requirements of Part 3 *(General Matters)* of Schedule Part 31 *(Consort Interface with Campus Site and/or Campus Facilities)* of this Agreement.

Issued by: Multiplex Construction Europe Ltd for IHS Lothian Ltd (Project Co)
Signed.. [redacted] **Print name: G Coupé** **Title: Commercial Manager**

Statement of Proposed Method

Contract: RHSC **Contract No: J2045**

Client: Multiplex **Method Statement Ref: MS058-00**

Operation: Construction of CCTV Bases and installation of associated ducting.

Location: Cycle Path

Description of Method and Sequence of Operations:

This document will be briefed to the operatives on site by the site Supervisor prior to starting the works and will be signed by them to say they have received and understand it.
Works Manager will manage and monitor the assessment and Project Manager will check, review and update the assessment.

1. Ensuring Multiplex staff are advised in advance of planned excavations to ensure co-ordination with all relevant parties, works will only begin once relevant permits are in place
2. Multiplex will offer daily permit cover all excavations. The work area will be barriered off to ensure no access by the general public.
3. Trial digs shall then be carried out at the locations of known services by means of Hand excavation (this may be assisted by a small excavator **in strict accordance with HSG47** - Avoiding danger from underground services).
4. Prior to any excavations taking place all service records shall be checked and a CAT scan carried out for the section of trench excavation to be undertaken. Hand excavations shall be employed in areas of known or suspected services as per HSG47.
5. The depth of the excavation works is expected to be no greater than 1m. Stepped excavation will be used if necessary.
6. Should any obstructions be found, the works are to stop and MPX notified.
7. CCTV BASES: Once excavated, the levels will be checked and the joiners will hang the supplied bolts ready for concrete to be installed. Concrete will be installed by hand directly from a dumper. On completion the bolts will be checked for line and Level.
8. DUCTING: Once excavated the 100mm ducting will be installed with a sand surround, with warning tape placed above the sand. Trench shall be backfilled in layers with as dug material (or otherwise approved backfill material) and suitably compacted.
9. On completion of the work the work are will be made safe and permit signed off.

Delivery:	Direct to Location
Access:	Guided by Banksman
P.P.E.:	Safety glasses, overalls and gloves to be worn at all times with Steel-toed anti-static lacing boots, Hard Hat, Hi-Vis vest. Dust Mask/goggles

Do's	Don'ts
1. Ensure all Permits are in place prior to commencing 2. Wear appropriate PPE during this operation 3. Have qualified banksman with delivery vehicles at all times 4. Fence off excavations at all times 5. Follow Method of excavation **in strict accordance with HSG47** - Avoiding danger from underground services 6. Exercise caution when excavating near existing services	1. Carry out tasks until inducted/trained or briefed. 2. Walk on the blind side of the delivery vehicle or any road user. 3. Reverse vehicles unless absolutely necessary. 4. Ignore approaching Emergency Vehicles
Labour 1. Banksman 2. Operatives and Plant Operatives 3. Site Engineer 4. Site Supervisor	**Plant** Delivery Vehicles Small Excavator Forward/Reverse Compaction Plate Floor Saw Road Plates Small Dumper
Materials Concrete	**Risk Assessments (attached)** RA- 0.003 Manual Handling 0.004 Noise 0.005 Re-Fueling Plant 0.006 Compaction 0.007 General Labouring Duties 0.008 Spoil Earth Removal 0.009 Access and Egress 0.010 Buried Services 0.011 Use of Dumpers 0.012 Cutting with Road Saw 0.015 Exposing Live Services 0.024 Abrasive Wheels

Cabinet Based Poles Gallery ←

Altron Cabinet Based Poles are versatile and robust with the facility for 2 or more compartments therefore making them ideal for multiple use installations - such as CCTV and traffic light mounting.

AW1545/6/DD/UP with gold banding

AW1545/6/DD/UP with gold banding

AW1545/6/300/DD/UP with banding and screw in swan neck

→ Cabinet Based Poles Gallery

AW1545/5/TD/UP

AW1545/8/UP

AW1545/8/UP

AW1545/6/UP in stainless steel

AW2075

AW1545/BAS

AW1545/UP

Altron AW1545 cabinet based camera poles were originally introduced in 1994 as the first CCTV cabinet based pole product. They have been used and specified extensively since then and are now a common feature in urban areas throughout the UK. Ideal for mounting camera equipment within, they provide a cost effective installation and reduce street furniture and clutter. The tilt-down range enables camera equipment to be serviced easily at ground level, without the need for a man lift. Recent developments have been aimed at producing a clean and aesthetic outline, whilst enhancing security, so close fitting flush doors and our heavy duty secure locks are now common across the range.

The AW2075 Cylindrical cabinet based version, with parallel or tapered shafts are popular for installations with an architectural theme.

Altron's numerous security design features ensure a good level of protection against vandal attacks.

→ AW1545/BAS Cabinet Based Pole

AW1545/8/BAS

Fixed height range 4m - 12m
Tilt Down height range 4m -12m

The 'basic' AW1545 BAS cabinet based pole range offers a cost effective means of mounting CCTV equipment within the one pole structure. More commonly used for industrial and commercial type installations, it does not have venting and high security locks, that come as standard on the UP range, but does offer the other security features common to our cabinet based poles and also the clean, aesthetic appearance, common to the AW1545 ranges and is backed up with a full range of accessories.

Typically used for the following types of installation

- Public area CCTV
- Industrial and commercial premises
- Schools and universities
- Prisons and detention facilities
- Utilities sites
- Railway platforms & car parks
- Car parks
- Retail Parks
- Sports stadia

Security Features

- Internal cabling
- Close fitting flush doors
- Solid secure heavy duty door locks
- Internal padlock facility on tilt down poles to protect against un-authorised lowering

General Features

- Stable structures for all camera types
- Available in 6 standard cabinet sizes, 300, 350, 400, 450, 500 and 600 square (350mm square as standard if not specified)
- Flush fitting door, level with cabinet surface, no external frame combined with flush fitting Altron secure locks giving enhanced security and a clean aesthetic appearance
- Treated wooden backboard within cabinet
- 4 point security door locking option
- Demountable winches allow for a secure installation whilst also reducing costs on multiple installations
- A wide range of standard Altron Accessories and Brackets available
- Pole adaptations available to suit customers/project specific requirements
- Constructed in high tensile steel and hot dip galvanised after fabrication for durability
- Option of painting over the galvanised finish in colours available from BS and RAL colour charts
- For design, manufacturing and finishing standards, see details on page 107

AW1545/6TD/BAS in tilted position

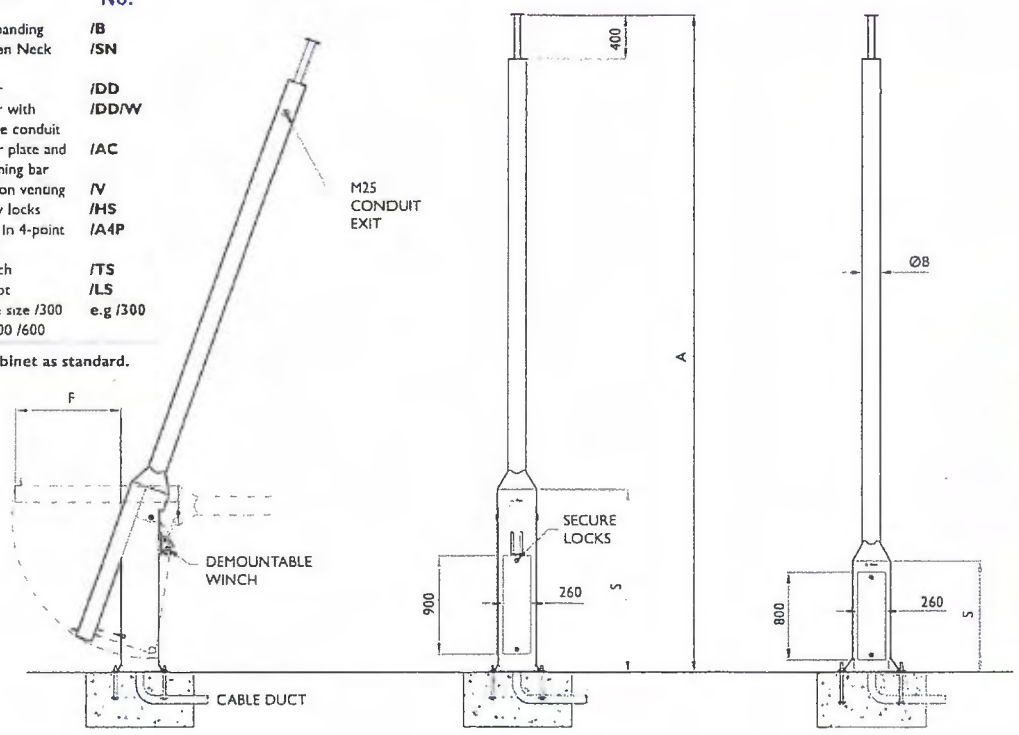
AW1545/BAS Cabinet Based Pole Technical Specification ←

Options

	PT No.
Decorative banding	/B
Screw in Swan Neck adaptor	/SN
Double door	/DD
Double door with washer bottle conduit	/DD/W
Access cover plate and cable restraining bar	/AC
Full convection venting	/V
High security locks	/HS
Altron locks in 4-point arrangement	/A4P
Tamper switch	/TS
Lighting spigot	/LS
Cabinet base size /300 /400 /450 /500 /600	e.g /300

350mm³ cabinet as standard.

AW1545BAS TD



AW1545BAS

Pole is fixed in the vertical position using 2 no. bolts and locked with internal nuts - has the facility to be padlocked internally to stop unauthorised tilting.

Poles complete with treated equipment mounting board inside compartment. Earthing lugs within pole & on door

All camera mounting plates are Ø 127 with 8 No Ø 8.5 equi-spaced on 101.6 PCD. Ø 40 thro' column spacer

FOR FOUNDATION AND BOLTING DETAILS REFER TO PAGE 41

Model No	Height in mtrs A	Max equip weight at top kgs	Max equip surface area m²	Pole ØB	Cabinet height above ground S	Pole rear clearance when tilting F	Winch part number	Product weight kgs
AW1545BAS-Fixed								
AW1545/4/BAS	4	40	0.25	168	1000	-	-	153
AW1545/5/BAS	5	40	0.25	168	1000	-	-	175
AW1545/6/BAS	6	40	0.25	168	1000	-	-	197
AW1545/7/BAS	7	40	0.25	168	1000	-	-	219
AW1545/8/BAS	8	40	0.25	168	1000	-	-	251
AW1545/8HD/BAS	8	50	0.5	193	1300	-	-	341
AW1545/9/BAS	9	40	0.25	193	1300	-	-	371
AW1545/10/BAS	10	40	0.25	193	1300	-	-	401
AW1545/12/BAS	12	40	0.25	193	1300	-	-	462
AW1545BAS TD-Tilt Down								
AW1545/4TD/BAS	4	40	0.25	168	1700	1150	**DW1000/45**	236
AW1545/6TD/BAS	6	30	0.25	168	1700	1150	**DW1000/45**	280
AW1545/8TD/BAS	8	25	0.25	168	1700	1150	**DW1500/45**	334
AW1545/10TD/BAS	10	40	0.25	193	2850	2150	**DW2500/45**	592
AW1545/12TD/BAS	12	25	0.25	193	2850	2150	**DW2500/45**	643

Where payloads are greater than those stated above, please contact Altron
All dimensions in mm unless stated otherwise

Accessories

Top mounting brackets for Fixed and PTZ cameras	P76
Swanneck brackets for Dome cameras	P81
Anti-climb guards	P77
Clamp-on camera mounting brackets	P79
Telemetry box mounting brackets	P77
Pole top mounting cages	P83
PIR mounting ring	P84

Quick reference

Single fixed camera knuckle	**PTS-1**
Twin fixed camera bracket	**TB2-600F**
Half swanneck for dome	**AW1699H**
Full swanneck for dome	**AW1699F**
Anti climb guard	**SGC**
PIR mounting ring	**AW1962**
Telemetry bracket	**ATBP**

→ Cabinet Based Poles Foundations & Bolting Details

FOUNDATION SIZES FOR THE UK

MODEL NO	HEIGHT MTRS	BOLT CENTRES 'P'	BASE PLATE SIZE 'H'	BURIED DEPTH 'D'	SERVICE ENTRY SIZE	HOLDING DOWN BOLT SIZE D X L	COUNTRY LOCATION AREA A	COUNTRY LOCATION AREA B	COUNTRY LOCATION AREA C	TOWN LOCATION AREA A	TOWN LOCATION AREA B	TOWN LOCATION AREA C
AW1545/UP												
Fixed cabinet based pole. Standard cabinet base size of 400mm²												
AW1545/4	4	550	630	200	370x370	M24x325	0.9 x 0.9 x 0.5	0.9 x 0.9 x 0.5	1.0 x 1.0 x 0.5	0.9 x 0.9 x 0.5	0.9 x 0.9 x 0.5	0.9 x 0.9 x 0.5
AW1545/5	5	550	630	200	370x370	M24x325	1.0 x 1.0 x 0.5	1.1 x 1.1 x 0.55	1.1 x 1.1 x 0.55	0.9 x 0.9 x 0.5	1.0 x 1.0 x 0.5	1.0 x 1.0 x 0.5
AW1545/6	6	550	630	200	370x370	M24x325	1.1 x 1.1 x 0.55	1.1 x 1.1 x 0.55	1.2 x 1.2 x 0.6	1.0 x 1.0 x 0.5	1.1 x 1.1 x 0.55	1.1 x 1.1 x 0.55
AW1545/7	7	550	630	200	370x370	M24x325	1.1 x 1.1 x 0.55	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65	1.1 x 1.1 x 0.55	1.1 x 1.1 x 0.55	1.2 x 1.2 x 0.6
AW1545/8	8	550	630	200	370x370	M24x425	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65	1.3 x 1.3 x 0.65	1.2 x 1.2 x 0.6	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65
AW1545/8HD	8	550	630	200	370x370	M24x425	1.4 x 1.4 x 0.7	1.4 x 1.4 x 0.7	1.5 x 1.5 x 0.75	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7	1.4 x 1.4 x 0.7
AW1545/9	9	550	630	200	370x370	M24x425	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7	1.4 x 1.4 x 0.7	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7
AW1545/10	10	550	630	200	370x370	M24x425	1.4 x 1.4 x 0.7	1.5 x 1.5 x 0.75	1.6 x 1.6 x 0.8	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7	1.5 x 1.5 x 0.75
AW1545/10HD	10	700	800	200	470x470	M27x600	1.6 x 1.6 x 0.8	1.7 x 1.7 x 0.9	1.8 x 1.8 x 0.9	1.5 x 1.5 x 0.75	1.6 x 1.6 x 0.8	1.7 x 1.7 x 0.9
AW1545/12	12	700	800	200	470x470	M27x600	1.6 x 1.6 x 0.8	1.7 x 1.7 x 0.9	1.8 x 1.8 x 0.9	1.5 x 1.5 x 0.75	1.6 x 1.6 x 0.8	1.7 x 1.7 x 0.9
AW1545/15	15	700	800	200	470x470	M27x600	1.9 x 1.9 x 1.0	2.0 x 2.0 x 1.0	2.1 x 2.1 x 1.0	1.8 x 1.8 x 0.9	1.9 x 1.9 x 1.0	2.0 x 2.0 x 1.0
AW1545/UP/TD												
Tilt down cabinet based pole. Standard cabinet base size of 400mm²												
AW1545/4TD	4	550	630	75	370x370	M24x325	1.0 x 1.0 x 0.5	1.0 x 1.0 x 0.5	1.1 x 1.1 x 0.55	0.9 x 0.9 x 0.5	0.9 x 0.9 x 0.5	1.0 x 1.0 x 0.5
AW1545/6TD	6	550	630	75	370x370	M24x325	1.1 x 1.1 x 0.55	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65	1.1 x 1.1 x 0.55	1.1 x 1.1 x 0.55	1.2 x 1.2 x 0.6
AW1545/8TD	8	550	630	75	370x370	M24x425	1.3 x 1.3 x 0.65	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65	1.3 x 1.3 x 0.65
AW1545/10TD	10	550	630	200	370x370	M24x425	1.4 x 1.4 x 0.7	1.5 x 1.5 x 0.75	1.6 x 1.6 x 0.8	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7	1.5 x 1.5 x 0.75
AW1545/12TD	12	550	630	200	370x370	M24x425	1.6 x 1.6 x 0.8	1.7 x 1.7 x 0.9	1.8 x 1.8 x 0.9	1.5 x 1.5 x 0.75	1.6 x 1.6 x 0.8	1.7 x 1.7 x 0.9
AW1545/BAS												
Fixed cabinet based pole. Standard cabinet base size of 350mm²												
AW1545/4	4	450	510	N/A	330x330	M20x325	0.9 x 0.9 x 0.5	0.9 x 0.9 x 0.5	1.0 x 1.0 x 0.5	0.9 x 0.9 x 0.5	0.9 x 0.9 x 0.5	0.9 x 0.9 x 0.5
AW1545/5	5	450	510	N/A	330x330	M20x325	1.0 x 1.0 x 0.5	1.1 x 1.1 x 0.55	1.1 x 1.1 x 0.55	0.9 x 0.9 x 0.5	1.0 x 1.0 x 0.5	1.0 x 1.0 x 0.5
AW1545/6	6	450	510	N/A	330x330	M20x325	1.1 x 1.1 x 0.55	1.1 x 1.1 x 0.55	1.2 x 1.2 x 0.6	1.0 x 1.0 x 0.5	1.1 x 1.1 x 0.55	1.1 x 1.1 x 0.55
AW1545/7	7	450	510	N/A	330x330	M20x325	1.1 x 1.1 x 0.55	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65	1.1 x 1.1 x 0.55	1.1 x 1.1 x 0.55	1.2 x 1.2 x 0.6
AW1545/8	8	550	630	N/A	330x330	M24x425	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65	1.3 x 1.3 x 0.65	1.2 x 1.2 x 0.6	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65
AW1545/8HD	8	550	630	N/A	330x330	M24x425	1.4 x 1.4 x 0.7	1.4 x 1.4 x 0.7	1.5 x 1.5 x 0.75	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7	1.4 x 1.4 x 0.7
AW1545/9	9	550	630	N/A	330x330	M24x425	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7	1.5 x 1.5 x 0.75	1.3 x 1.3 x 0.65	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7
AW1545/10	10	550	630	N/A	330x330	M24x425	1.4 x 1.4 x 0.7	1.4 x 1.4 x 0.7	1.5 x 1.5 x 0.75	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7	1.4 x 1.4 x 0.7
AW1545/12	12	550	630	N/A	330x330	M24x425	1.6 x 1.6 x 0.8	1.7 x 1.7 x 0.9	1.8 x 1.8 x 0.9	1.4 x 1.4 x 0.7	1.6 x 1.6 x 0.8	1.7 x 1.7 x 0.9
AW1545/BAS/TD												
Tilt down cabinet based pole. Standard cabinet base size of 350mm²												
AW1545/4TD	4	450	510	75	330x330	M20x325	1.0 x 1.0 x 0.5	1.0 x 1.0 x 0.5	1.1 x 1.1 x 0.55	0.9 x 0.9 x 0.5	0.9 x 0.9 x 0.5	1.0 x 1.0 x 0.5
AW1545/6TD	6	450	510	75	330x330	M20x325	1.1 x 1.1 x 0.55	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65	1.1 x 1.1 x 0.55	1.1 x 1.1 x 0.55	1.2 x 1.2 x 0.6
AW1545/8TD	8	550	630	75	330x330	M24x425	1.3 x 1.3 x 0.65	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65	1.3 x 1.3 x 0.65
AW1545/10TD	10	550	630	200	330x330	M24x425	1.4 x 1.4 x 0.7	1.5 x 1.5 x 0.75	1.6 x 1.6 x 0.8	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7	1.5 x 1.5 x 0.75
AW1545/12TD	12	550	630	200	330x330	M24x425	1.5 x 1.5 x 0.75	1.6 x 1.6 x 0.8	1.7 x 1.7 x 0.9	1.4 x 1.4 x 0.75	1.5 x 1.5 x 0.75	1.6 x 1.6 x 0.8
AW2075 - AW2075/TD												
both fixed and tilt-down poles have a Ø457mm cabinet base only												
AW2075/4	4	450	510	200	Ø420	M20x325	0.9 x 0.9 x 0.5	0.9 x 0.9 x 0.5	1.0 x 1.0 x 0.5	0.9 x 0.9 x 0.5	0.9 x 0.9 x 0.5	0.9 x 0.9 x 0.5
AW2075/6	6	450	510	200	Ø420	M20x325	1.1 x 1.1 x 0.55	1.1 x 1.1 x 0.55	1.2 x 1.2 x 0.6	1.0 x 1.0 x 0.5	1.1 x 1.1 x 0.55	1.1 x 1.1 x 0.55
AW2075/8	8	550	630	200	Ø420	M24x425	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7	1.2 x 1.2 x 0.6	1.2 x 1.2 x 0.6	1.3 x 1.3 x 0.65
AW2075/10	10	550	630	200	Ø420	M24x425	1.4 x 1.4 x 0.7	1.5 x 1.5 x 0.75	1.6 x 1.6 x 0.8	1.3 x 1.3 x 0.65	1.4 x 1.4 x 0.7	1.5 x 1.5 x 0.75

Table dimensions in mm

Base plate and bolt sizes are for the standard cabinet sizes shown. For other cabinet sizes please contact our technical department for confirmation of sizes

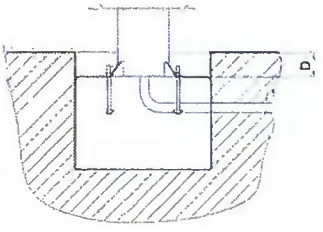
Foundation sizes in table are W x W x D
Dimensions in metres

*D= 1000 on PM and buried flange/embedded base models

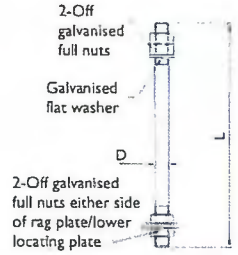
- For area D locations and exposed locations over 100m above sea level for areas A, B and 150m above sea level for area C, we recommend increased foundation sizes. Please refer to the table on page 101 for conformation of these.
- A minimum soil bearing capacity of 75 kN/m² is assumed.
- Foundation base dimensions are typical and may vary depending on site conditions.
- Please refer to the foundations & windloading section on pages 101-103 for further guidance.

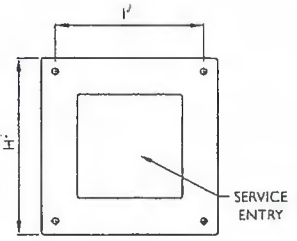
REFER TO INSTALLATION METHODS ON PAGES 104-106

BURIED DEPTH BELOW GROUND LEVEL



GALVANISED HOLDING DOWN BOLTS





NHS Lothian

RHSC & DCN Project at Little France

N

A

D

F

E

C

Former Little France Service Station

25 0 25 50 metres

Plan 2

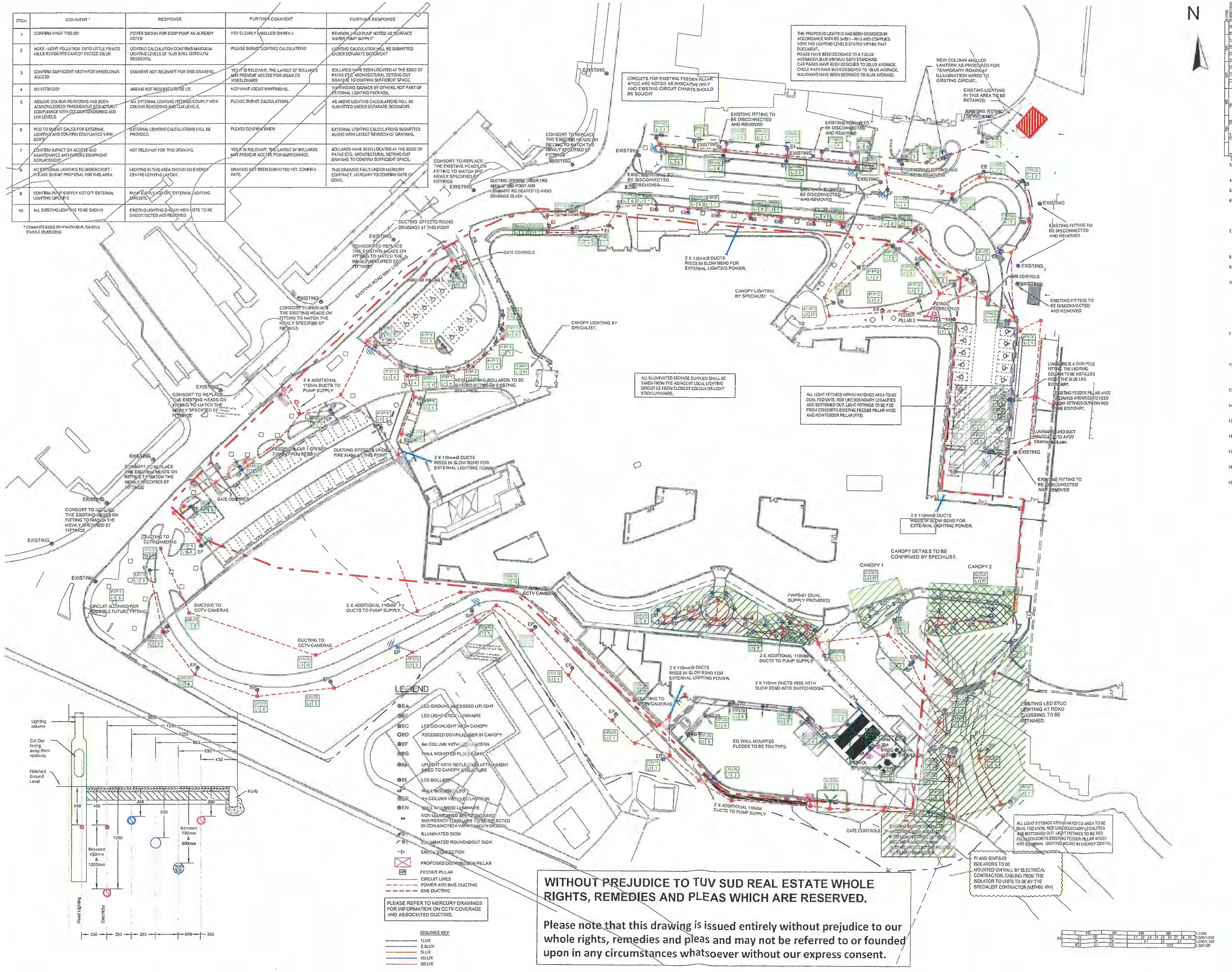
(YELLOW AREA, ORANGE AREA, CONNECTION AREA, SERVICE STRIP AND PETROL STATION SITE)

September 2014

A46676816

ITEM	COMMENT *	RESPONSE	FURTHER COMMENT	FURTHER RESPONSE
1	CONFIRM WHAT THIS IS?	POWER SHOWN FOR SUMP PUMP AS ALREADY NOTED	NOT CLEARLY LABELLED ON REV J	REVISION J HAD PUMP NOTED AS 'SURFACE WATER PUMP SUPPLY'
2	NOTE - LIGHT POLLUTION ONTO LITTLE FRANCE MILLS RESIDENTS CANNOT EXCEED 25LUX	LIGHTING CALCULATION CONFIRMS MAXIMUM LIGHTING LEVELS OF 1LUX SPILL ONTO LFM RESIDENTS.	PLEASE SUBMIT LIGHTING CALCULATIONS	LIGHTING CALCULATION WILL BE SUBMITTED UNDER SEPARATE DOCUMENT
3	CONFIRM SUFFICIENT WIDTH FOR WHEELCHAIR ACCESS	COMMENT NOT RELEVANT FOR THIS DRAWING.	YES IT IS RELEVANT. THE LAYOUT OF BOLLARDS MAY PREVENT ACCESS FOR DISABLED WHEELCHAIRS	BOLLARDS HAVE BEEN LOCATED AT THE EDGE OF PATHS ETC. ARCHITECTURAL SETTING OUT DRAWING TO CONFIRM SUFFICIENT SPACE.
4	NO FITTINGS?	AREA IS NOT REQUIRED TO BE LIT.	NO? WHAT ABOUT WAYFINDING..	WAYFINDING SIGNAGE BY OTHERS, NOT PART OF EXTERNAL LIGHTING PACKAGE.
5	ASSUME COLOUR RENDERING HAS BEEN ACKNOWLEDGED THROUGHOUT STRUCTURE - COMPLIANCE WITH COLOUR RENDERING AND LUX LEVELS.	ALL EXTERNAL LIGHTING FITTINGS COMPLY WITH COLOUR RENDERING AND LUX LEVELS.	PLEASE SUBMIT CALCULATIONS.	AS ABOVE LIGHTING CALCULATIONS WILL BE SUBMITTED UNDER SEPARATE DOCUMENT.
6	PCO TO SUBMIT CALCS FOR EXTERNAL LIGHTING AND CONFIRM COMPLIANCE WITH BCR'S	EXTERNAL LIGHTING CALCULATIONS WILL BE PROVIDED.	PLEASE CONFIRM WHEN	EXTERNAL LIGHTING CALCULATIONS SUBMITTED ALONG WITH LATEST REVISION OF DRAWING.
7	CONFIRM IMPACT ON ACCESS AND MAINTENANCE AND FUTURE EQUIPMENT REPLACEMENT	NOT RELEVANT FOR THIS DRAWING.	YES IT IS RELEVANT. THE LAYOUT OF BOLLARDS MAY PREVENT ACCESS FOR MAINTENANCE.	BOLLARDS HAVE BEEN LOCATED AT THE EDGE OF PATHS ETC. ARCHITECTURAL SETTING OUT DRAWING TO CONFIRM SUFFICIENT SPACE.
8	NO EXTERNAL LIGHTING TO UNDERCROFT - PLEASE SUBMIT PROPOSAL FOR THIS AREA.	LIGHTING IN THIS AREA SHOWN ON ENERGY CENTRE LIGHTING LAYOUT.	DRAWING NOT BEEN SUBMITTED YET. CONFIRM DATE.	THIS DRAWING FALLS UNDER MERCURY CONTRACT. MERCURY TO CONFIRM DATE OF ISSUE.
9	CONFIRM PUMP SUPPLY NOT OFF EXTERNAL LIGHTING CIRCUITS	PUMP SUPPLY NOT OFF EXTERNAL LIGHTING CIRCUITS.		
10	ALL EXISTING LIGHTING TO BE SHOWN	EXISTING LIGHTING SHOWN WITH NOTE TO BE DISCONNECTED AND REMOVED.		

* COMMENTS BASED ON WW-EW-XX-PL 716-001-K STATUS C (01/09/2016)



WITHOUT PREJUDICE TO TUV SUD REAL ESTATE WHOLE RIGHTS, REMEDIES AND PLEAS WHICH ARE RESERVED.

Please note that this drawing is issued entirely without prejudice to our whole rights, remedies and pleas and may not be referred to or founded upon in any circumstances whatsoever without our express consent.

Notes

Check all dimensions on site. Do not scale from this drawing.
Report any discrepancies and omissions to drawing originator.

Designer Identification of Hazard Risk

- Indicates a Residual Risk requiring a Compulsory Action
- Indicates a Residual Risk for Information
- Indicates a Residual Risk requiring a Prohibitive Action
- Indicates a Residual Risk as a Warning

EXTERNAL SERVICES NOTES

1. ALL DUCTS TO BE C/W HEAVY DUTY DRAW CORD & HAVE ENDS SEALED ON COMPLETION OF INSTALLATION TO PREVENT INGRESS OF MOISTURE & VERMIN.
2. ALL DUCTS TO HAVE SLOW RADIUS BENDS (MINIMUM OF 8 TIMES DUCT OD.
3. ALL DUCTS TO HAVE MINIMUM 600mm COVER TO TOP OF DUCT UNLESS DETAILED OTHERWISE.
4. CIVIL ENGINEER TO DETAIL BUILDING/FOUNDATION PENETRATION DETAILS.
5. LANDSCAPE ARCHITECT TO DETAIL MANHOLE COVERS.
6. DUCTS INSTALLED IN TRAFFIC AREAS/ROAD CROSSING AREAS SHALL HAVE ADDITIONAL PROTECTION TO MEET REQUIREMENTS FOR ROAD CROSSINGS i.e.- THEY SHALL BE LOWERED & HAUNCHED IN CONCRETE AS PER THE MANUFACTURERS & UTILITY PROVIDERS RECOMMENDATIONS. MINIMUM DEPTH 750mm TO TOP OF DUCT.
7. CCTV BASES TO BE DETAILED BY STRUCTURAL ENGINEER IN ACCORDANCE WITH MANUFACTURERS DETAILS. BASES TO INCORPORATE CAST-IN ANCHORS & DUCT ACCESS. MANHOLES ARE REQUIRED ADJACENT TO CCTV BASES FOR CABLING ACCESS. (NOT SHOWN FOR CLARITY)
8. ALL DUCTS & SERVICE ROUTES TO BE IDENTIFIED WITH TAPE & MARKERS.
9. THE CONTRACTOR SHALL PRODUCE FULLY CO-ORDINATED DRAWINGS SHOWING ALL EXISTING & PROPOSED SERVICES BEFORE WORKS COMMENCE.
10. WHERE EXISTING SERVICES WILL BE EXPOSED OR POTENTIALLY DAMAGED DURING THE WORKS THE CONTRACTOR SHALL SEEK APPROVAL FROM THE RELEVANT UTILITY PROVIDER AND ALLOW FOR ADDITIONAL PROTECTION MEASURES TO ENSURE THE INTEGRITY OF THE SERVICE IS NOT COMPROMISED IN ANY WAY. WHERE DIVERSIONS ARE REQUIRED THE CONTRACTOR SHALL TAKE FULL RESPONSIBILITY TO ENSURE THAT THIS IS CARRIED OUT WITH THE RELEVANT UTILITY PROVIDERS WRITTEN CONSENT. THE CONTRACTOR SHALL MANAGE ALL WORKS ASSOCIATED WITH THE DIVERSIONARY WORKS.
11. MANHOLES / ACCESS CHAMBERS SHALL BE PROVIDED AT EVERY CHANGE IN DIRECTION. NOT SHOWN FOR CLARITY. MANHOLES SHOWN ARE INDICATIVE ONLY. IT IS THE CONTRACTORS RESPONSIBILITY TO ENSURE THAT A SUITABLE AMOUNT OF MANHOLES / ACCESS CHAMBERS SHALL BE PROVIDED BY THE SPECIALIST CONTRACTOR.
12. IT WILL BE THE CONTRACTORS RESPONSIBILITY TO ENSURE DUCTS AND SERVICES ARE INSTALLED AT THE CORRECT LEVELS. CONTRACTOR MUST CONFIRM FINISHED GROUND LEVEL TO ENABLE DUCTS TO HAVE SUFFICIENT COVER.
13. THE CONTRACTOR SHALL ALLOW FOR ALL EXTERNAL MANHOLES / ACCESS CHAMBERS TO BE LOCKABLE OUTSIDE OF THE SECURE PERIMETER FENCE.
14. DUCTING ENTERING THE LIGHTING COLUMN BASE SHALL BE 35/100mm INSIDE DIAMETER PURPLE DUCT. REFER TO DUCTING DETAILS.
15. THE CONTRACTOR SHALL ALLOW FOR DUCTS TO BE INSPECTED BEFORE ANY BACKFILLING COMMENCES.
16. FINAL ROUTING OF ALL UTILITY SERVICES TO BE CO-ORDINATED FULLY WITH THE NOMINATED UTILITY SUPPLIER.
17. LIGHTING SUPPLIES TO CANOPY TO BE FED VIA CANOPY LEG. DETAILS TO BE AGREED WITH CANOPY SUPPLIER.
18. FEEDER PILLAR TO BE TEMPORARILY FED FROM SITE SERVICES SUPPLY WITH CHANGE OVER TO BUILDING SUPPLY WHEN AVAILABLE.
19. LIGHTING TO BE CONTROLLED FROM DAY LIGHT SENSOR WITH MANUAL OVERIDE

S	30.05 2018	6M COLUMNS IN SERVICE YARD CONVERTED TO TWIN HEAD FITTINGS.	DB JC	PC SJ
R	21.12 2017	ENERGY CENTRE WALL MOUNTED FITTINGS ADDED AND UPPED TO 70W	DB JC	PC SJ
Q	31.08 2017	LIGHTING AT UNIVERSITY DELETED AS DIRECTED BY CLIENT. GENERAL FITTINGS ADDED. CIRCUIT REFS ADDED TO EACH FITTING. CANOPY CIRCUITS ALLOCATED.	JB JC	PC SJ
P	09.03 2017	UPDATED TO SUIT NEW HARD LANDSCAPE DRAWING. PUMP SUPPLIES ALTERED	DB JC	PC SJ
O	04.11 2016	ISOLINE PLOT ADDED TO DRAWING. FINAL COMMENTS FROM CONSORT	DB JC	PC SJ
N	03.11 2016	DUAL SUPPLIES UPDATED AFTER CONSORT COMMENTS.	DB JC	PC SJ

Revisions

Project

Re-provision of RHSC and DCN at Little France

Client

NHS Lothian

Title

EXTERNAL LIGHTING LAYOUT AND INDICATIVE DUCT ROUTING.

Drawing No.: WW-EW-XX-PL-716-001

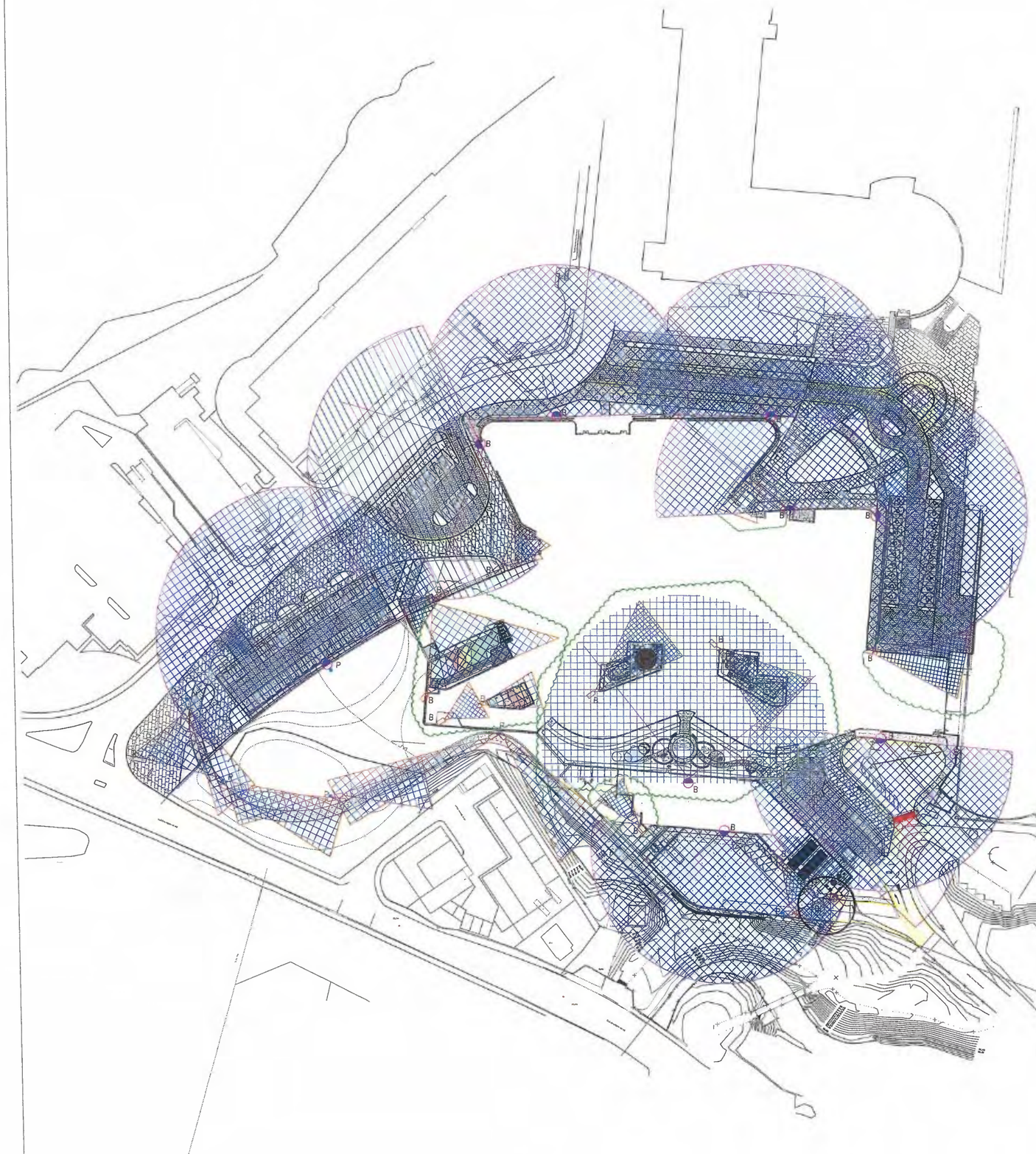
Revision: S

Scale @ A1: 1.500 @ A1

Date: APR. 2014

Status: CONSTRUCTION

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS



Scale 1:100

Status Given	Comments on Rev 3	Mercury Response
C	Please confirm how / If secured by design achieved	Secure by Design is a strategy to build safer building, we meet these criteria's by being a MSI Gold approved company and working with the operational requirements within the design specification this being the case the current CCTV design covers car parking with general surveillance, all entrances to the car parks and entrances to the hospital are covered by CCTV, internally cameras cover entrances to wards and critical areas like pharmacy areas and concourse areas.
	Please confirm how / If park safe is achieved	HLM to confirm.
	Please confirm how areas highlighted on the drawings are covered by CCTV including Helipad	The Helipad will be covered by two cameras on opposing sides of the deck installed no more than 250mm from the deck surface to maintain the safety of the Heli-Deck, to maintain the image quality camera will have the capability to invert the image to overcome the camera being installed as close to the deck surface.
	Please confirm how glare on the south facing cameras being addressed	Sun Glare – all cameras being proposed are dome based and are designed to work externally and have built in auto iris lens, the camera are building mounted and will be installed at a height where sun glare should not be a mitigating factor. Some building factors that need to be checked will be no reflective surfaces that can cause glare into the cameras and maintenance regimes as poor maintenance can cause glare from dirt on the surface of the cameras.
	Cameras required at car park barriers	Car Park Barriers are Covered with Building mounted CCTV.
	Service yard security office has to be able to view footage of service yard	The security office PC will be given access to the CCTV system
	No CCTV indicated	Static mounted CCTV now facing Main and DCN entrance
	No fixed camera for ED	Area covered with building mounted CCTV Camera.

Status Given	Comments on Rev B	Mercury Response
B	HLM Comments to be incorporated reviewed as per HLM-GC-004520	HLM comments have been reviewed, refer to updated layout.

Status Given	Comments on Rev D - 30/01/18	Mercury Response
C	How are these gaps being covered?	CCTV coverage now highlighted on drawing.
	Area not covered by CCTV	180 CCTV covers this area now.
	Entrance not covered by CCTV	Additional external added to cover door.
	This camera to be coordinated with bin washer & tipper for maximum view.	Due to bin location CCTV moved to be building mounted covering entrance.
	Sufficient cable to be rolled to allow for potential relocation.	Additional service loop of cabled coiled.
	1. Review comments noted.	All comments have been reviewed/noted.
	2. Confirm which / any comments taken on board from previous review	All comments have been reviewed and actioned as required.
	3 Review CAMHS coverage BCR 9 17.7 - All external cameras to be shown on one drawing.	All courtyard CCTV now shown on drawing.

N

Notes
Check all dimensions on site. Do not scale from this drawing.
Report any discrepancies and omissions to drawing originator.
This Drawing is Copyright ©

Development Specification & Hazard Risk

- Indicates a Residual Risk requiring a Compulsory Action
- Indicates a Residual Risk Architectural
- Indicates a Residual Risk requiring a Protective Action
- Indicates a Residual Risk as a Warning

NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL CONTRACT DOCUMENTATION.

- 180 DEGREES CAMERA
- FIXED CAMERA
- CCTV POLE
- BUILDING MOUNTED
- CAMERA COVERAGE
- BARRIER INTERCOM, 2 LEVEL INTERCOM FOR BARRIER RELEASE ON PILLAR (BY OTHERS).
- PEDESTRIAN GATE SWIPE CARD ACCESS CONTROL BACK TO OFFICE RECEPTION G-GU-016 & G-FI-003 SECURITY OFFICE.
- SWIPE CARD ACCESS POINT

Rev	Description	Date	Drn	Chk
E	For Construction Issue T3 Update	11.05.18	JP	BR
D	For Construction Issue T3 Update	19.12.17	JP	BR
C	For Construction Issue T3 Update	05.11.17	JP	BR
B	For Construction Issue T3	25.01.17	JP	BR
A	For Construction Issue T3	10.11.16	JP	BR
D1	Submission for SAB	04.11.16	JP	BR
D5	For T1 ROD Issue	25.08.16	JP	BR
D2	For Information	29.09.14	JP	BR
D1	For Information	15.07.14	JP	BR

Revisions

Project

Re-provision of RHSC and DCN at Little France

Client

NHS Lothian

Title

SITE PLAN
EXTERNAL CCTV / ACCESS CONTROL LAYOUT

Drawing No.	Revision
ME-EW-XX-PL-571-001	E
Scale @ A0	Date
1:500	18.07.14

Status

For Construction Issue T3

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INTEGRATED HEALTH SOLUTIONS

A46676816

PART D - GSU TABLE

Part D of Schedule Part 3 GSU is in the Agreed Form identified and executed as Part D of Schedule Part 3 GSU Table of this SA1, referred to in and forming part of this SA1

	Room No	Room Name	Area No.	Department	No of Rooms	Consequential Unavailability	Comment	GSU
1	G-A1-001A	Corridor	A1	A1 EMERGENCY	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A1-001B	Corridor	A1	A1 EMERGENCY	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A1-002	Disposal Hold	A1	A1 EMERGENCY	1			0.8
1	G-A1-003	Store - Medical Gas Cylinders	A1	A1 EMERGENCY	1			0.8
1	G-A1-004	Processing Room	A1	A1 EMERGENCY	1		Grouped with G-A1-006, G-A1-005	200
1	G-A1-005	Changing Cubicle	A1	A1 EMERGENCY	1		Grouped with G-A1-004, G-A1-006	16
1	G-A1-006	General X-Ray Room	A1	A1 EMERGENCY	1		Grouped with G-A1-004, G-A1-005	200
1	G-A1-007	Dirty Utility	A1	A1 EMERGENCY	1			21
1	G-A1-008	Washdown Room	A1	A1 EMERGENCY	1			0.8
1	G-A1-009	WC - Wheelchair accessible	A1	A1 EMERGENCY	1			0.8
1	G-A1-010	ED Laboratory	A1	A1 EMERGENCY	1		Grouped with G-A1-039	50
1	G-A1-011	Linen Bay (1 trolley)	A1	A1 EMERGENCY	1		Not measurable against availability standards	0
1	G-A1-012	Bay 5	A1	A1 EMERGENCY	1			50
1	G-A1-013	Bay 14	A1	A1 EMERGENCY	1			50
1	G-A1-014	Bay 6	A1	A1 EMERGENCY	1			50
1	G-A1-015	Bay 13	A1	A1 EMERGENCY	1			200
1	G-A1-016	Staff Base	A1	A1 EMERGENCY	1			50
1	G-A1-017	Clean Utility	A1	A1 EMERGENCY	1			21
1	G-A1-018	Bay 7	A1	A1 EMERGENCY	1			50
1	G-A1-019	Bay 12	A1	A1 EMERGENCY	1			50
1	G-A1-020	Bay 8	A1	A1 EMERGENCY	1			50
1	G-A1-021	Bay 11	A1	A1 EMERGENCY	1			50
1	G-A1-022	Bay 9	A1	A1 EMERGENCY	1			50
1	G-A1-023	Store Room	A1	A1 EMERGENCY	1			0.4
1	G-A1-024	Corridor	A1	A1 EMERGENCY	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A1-025	Bay 10	A1	A1 EMERGENCY	1			50
1	G-A1-026	Emergency/Ambulance Entrance	A1	A1 EMERGENCY	1			100
1	G-A1-027	Corridor	A1	A1 EMERGENCY	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A1-028	Resus 1	A1	A1 EMERGENCY	1			200
1	G-A1-029	Resus 2	A1	A1 EMERGENCY	1			200
1	G-A1-030	IPS Room	A1	A1 EMERGENCY	1			200
1	G-A1-031	Viewing Room	A1	A1 EMERGENCY	1			21
1	G-A1-032	Relatives Room	A1	A1 EMERGENCY	1			21
1	G-A1-033	WC - Wheelchair accessible	A1	A1 EMERGENCY	1			0.8
1	G-A1-034	Store - Major Incident / Ambulance Equipment	A1	A1 EMERGENCY	1			21
1	G-A1-035	Triage Room	A1	A1 EMERGENCY	1			200
1	G-A1-036	Reception:2 staff	A1	A1 EMERGENCY	1			200
1	G-A1-037	Parking Bay: 6 wheelchairs	A1	A1 EMERGENCY	1		Grouped with G-A1-038	0
1	G-A1-038	Main Entrance Draught Lobby (Ambulant)	A1	A1 EMERGENCY	1		Grouped with G-A1-037	100

1	G-A1-039	Parking Bay: 3 accident trolleys & 3 wheelchairs	A1	A1 EMERGENCY	1		Grouped with G-A1-010	0
1	G-A1-040	Store - Equipment & Supplies	A1	A1 EMERGENCY	1			0.2
1	G-A1-041	WC - Wheelchair accessible	A1	A1 EMERGENCY	1			0.8
1	G-A1-042	WC - Wheelchair accessible	A1	A1 EMERGENCY	1			0.8
1	G-A1-043	Female Staff Changing and Lockers: 30 places	A1	A1 EMERGENCY	1			0.7
1	G-A1-044	Staff Shower: ambulant	A1	A1 EMERGENCY	1			0.6
1	G-A1-045	Waiting Area inc Play Area	A1	A1 EMERGENCY	1			100
1	G-A1-046	Baby/Infant Feeding Room	A1	A1 EMERGENCY	1			0.8
1	G-A1-047	Nappy Change	A1	A1 EMERGENCY	1			0.8
1	G-A1-048	Male Staff Changing Room and Lockers. 20 places	A1	A1 EMERGENCY	1			0.7
1	G-A1-049	Staff Shower: ambulant	A1	A1 EMERGENCY	1			0.6
1	G-A1-050	Consultant Office (6 person)	A1	A1 EMERGENCY	1			75
1	G-A1-051	Corridor	A1	A1 EMERGENCY	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A1-052	Senior Charge Nurse Office	A1	A1 EMERGENCY	1			0.4
1	G-A1-053	Interview/Meeting Room: 6 persons	A1	A1 EMERGENCY	1			0.4
1	G-A1-054	Beverage Bay	A1	A1 EMERGENCY	1			0.4
1	G-A1-055	WC - Staff	A1	A1 EMERGENCY	1			0.6
1	G-A1-056	DSR	A1	A1 EMERGENCY	1			16
1	G-A1-057	Medical Staff / Audit / Secy Office (3 person)	A1	A1 EMERGENCY	1			0.4
1	G-A1-058	WC - Staff	A1	A1 EMERGENCY	1			0.6
1	G-A1-059	Store - Stock & Sterile Supplies	A1	A1 EMERGENCY	1			0.2
1	G-A1-060	Bay 2	A1	A1 EMERGENCY	1			200
1	G-A1-061	Bay 1	A1	A1 EMERGENCY	1			200
1	G-A1-062	Bay 4	A1	A1 EMERGENCY	1			200
1	G-A1-063	Pantry - Staff / Patient	A1	A1 EMERGENCY	1			0.4
1	G-A1-064	Bay 3	A1	A1 EMERGENCY	1			200
1	G-A1-065	Store - Plaster	A1	A1 EMERGENCY	1			0.2
1	G-A1-066	Plaster Suite (2 bays)	A1	A1 EMERGENCY	1			50
1	G-A1-067	WC - Wheelchair accessible	A1	A1 EMERGENCY	1			0.8
1	G-A1-068	Corridor	A1	A1 EMERGENCY	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A1-069	Draught Lobby	A1	A1 EMERGENCY	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A1-070	Switch Cupboard	A1	A1 EMERGENCY	1		Project Co Space	0
1	G-A1-071	Switch Cupboard	A1	A1 EMERGENCY	1		Project Co Space	0
1	G-A1-072	Mobile X-Ray Bay	A1	A1 EMERGENCY	1			0.8
1	G-A2-001	Corridor	A2	A2 PARU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A2-002	Single Room 27	A2	A2 PARU	1		Grouped with G-A2-003	35
1	G-A2-003	Room 27 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-002	0
1	G-A2-004	Single Room 28	A2	A2 PARU	1		Grouped with G-A2-005	35
1	G-A2-005	Room 28 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-004	0

1	G-A2-006	Single Room 26	A2	A2 PARU	1		Grouped with G-A2-007	35
1	G-A2-007	Room 26 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-006	0
1	G-A2-008	Reception	A2	A2 PARU	1			21
1	G-A2-009	Single Room 29	A2	A2 PARU	1		Grouped with G-A2-010	35
1	G-A2-010	Room 29 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-009	0
1	G-A2-011	Touchdown Base 2	A2	A2 PARU	1			21
1	G-A2-012	Single Room 31	A2	A2 PARU	1		Grouped with G-A2-013	35
1	G-A2-013	Room 31 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-012	0
1	G-A2-014	Single Room 30	A2	A2 PARU	1		Grouped with G-A2-015	35
1	G-A2-015	Room 30 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-014	0
1	G-A2-016	Resus Bay	A2	A2 PARU	1			0.1
1	G-A2-017	Single Room 6	A2	A2 PARU	1		Grouped with G-A2-018	35
1	G-A2-018	Room 6 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-017	0
1	G-A2-019	Single Room 5	A2	A2 PARU	1		Grouped with G-A2-020	35
1	G-A2-020	Room 5 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-019	0
1	G-A2-021	Clean Utility	A2	A2 PARU	1			50
1	G-A2-022	Dirty Utility	A2	A2 PARU	1			21
1	G-A2-023	WC - Staff	A2	A2 PARU	1			0.6
1	G-A2-024	WC - Ambulant (Visitors)	A2	A2 PARU	1			0.8
1	G-A2-025	Linen Bay (1 trolley)	A2	A2 PARU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A2-026	Touchdown Base 1	A2	A2 PARU	1			21
1	G-A2-027	Hoist Bay	A2	A2 PARU	1			0.1
1	G-A2-028	Observation Bay	A2	A2 PARU	1		Grouped with G-A2-029	35
1	G-A2-029	Observation Bay - Ensuite	A2	A2 PARU	1		Grouped with G-A2-028	0
1	G-A2-030	Observation Bay - Toilet	A2	A2 PARU	1			0.8
1	G-A2-031	Single Room 1	A2	A2 PARU	1		Grouped with G-A2-032	35
1	G-A2-032	Room 1 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-031	0
1	G-A2-033	Single Room 2	A2	A2 PARU	1		Grouped with G-A2-034	35
1	G-A2-034	Room 2 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-033	0
1	G-A2-035	Single Room 3	A2	A2 PARU	1		Grouped with G-A2-036	35
1	G-A2-036	Room 3 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-035	0
1	G-A2-037	Single Room 4	A2	A2 PARU	1		Grouped with G-A2-038	35
1	G-A2-038	Room 4 Ensuite	A2	A2 PARU	1		Grouped with G-A2-037	0
1	G-A2-039	Treatment Room	A2	A2 PARU	1			21
1	G-A2-040	Dining / Play Room	A2	A2 PARU	1			10
1	G-A2-041	Ward Kitchen	A2	A2 PARU	1			21
1	G-A2-042	Single Room 7	A2	A2 PARU	1		Grouped with G-A2-043	35
1	G-A2-043	Room 7 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-042	0
1	G-A2-044	Single Room 8	A2	A2 PARU	1		Grouped with G-A2-045	35
1	G-A2-045	Room 8 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-044	0
1	G-A2-046	Bay 2	A2	A2 PARU	1		Grouped with G-A2-048	35
1	G-A2-047	Bay 2 - Toilet	A2	A2 PARU	1			0.8
1	G-A2-048	Bay 2 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-046	0
1	G-A2-049	Touchdown Base 3	A2	A2 PARU	1			21

1	G-A2-050	Single Room 9	A2	A2 PARU	1		Grouped with G-A2-051	35
1	G-A2-051	Room 9 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-050	0
1	G-A2-052	Single Room 10	A2	A2 PARU	1		Grouped with G-A2-053	35
1	G-A2-053	Room 10 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-052	0
1	G-A2-054	Bay 1	A2	A2 PARU	1		Grouped with G-A2-055	35
1	G-A2-055	Bay 1 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-054	0
1	G-A2-056	Bay 1 - Toilet	A2	A2 PARU	1			0.8
1	G-A2-057	Corridor	A2	A2 PARU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A2-058	Single Room 11	A2	A2 PARU	1		Grouped with G-A2-059	35
1	G-A2-059	Room 11 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-058	0
1	G-A2-060	Single Room 12	A2	A2 PARU	1		Grouped with G-A2-061	35
1	G-A2-061	Room 12 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-060	0
1	G-A2-062	WC - Staff	A2	A2 PARU	1			0.6
1	G-A2-063	Linen Bay (1 trolley)	A2	A2 PARU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A2-064	Store - Equipment	A2	A2 PARU	1			0.2
1	G-A2-065	Single Room 16	A2	A2 PARU	1		Grouped with G-A2-066	35
1	G-A2-066	Room 16 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-065	0
1	G-A2-067	Single Room 14	A2	A2 PARU	1		Grouped with G-A2-068	35
1	G-A2-068	Room 14 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-067	0
1	G-A2-069	Touchdown Base 4	A2	A2 PARU	1			21
1	G-A2-070	Single Room 15	A2	A2 PARU	1		Grouped with G-A2-071	35
1	G-A2-071	Room 15 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-070	0
1	G-A2-072	Single Room 17	A2	A2 PARU	1		Grouped with G-A2-073	35
1	G-A2-073	Room 17 - Ensuite	A2	A2 PARU	1		Grouped with G-A2-072	0
1	G-A2-074	Room 17 - Lobby	A2	A2 PARU	1			35
1	G-A2-075A	Store - General	A2	A2 PARU	1			0.1
1	G-A2-075B	Store - General	A2	A2 PARU	1			0.1
1	G-A2-076	Patients' Assisted Bathroom	A2	A2 PARU	1			21
1	G-A2-077	Multi-Disciplinary Office	A2	A2 PARU	1			0.8
1	G-A2-078	Senior Charge Nurse Office	A2	A2 PARU	1			0.4
1	G-A2-079	On-Call Consultant Office (2 person)	A2	A2 PARU	1			0.4
1	G-A2-080	DSR	A2	A2 PARU	1			16
1	G-A2-081	Clinical Coordinators Office (2 person)	A2	A2 PARU	1			0.4
1	G-A2-082	Disposal Hold	A2	A2 PARU	1			0.9
1	G-A2-083	Patient Interview Room	A2	A2 PARU	1			10
1	G-A2-084	Dirty Utility	A2	A2 PARU	1			21
1	G-A2-085	Corridor	A2	A2 PARU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A2-086	Switch Cupboard	A2	A2 PARU	1		Project Co Space	0
1	G-A2-088	Switch Cupboard	A2	A2 PARU	1		Project Co Space	0
1	G-A2-089	Switch Cupboard	A2	A2 PARU	1		Project Co Space	0
1	G-A3-001	Staff Room	A3	A3 Shared Support	1			0.4

1	G-A3-002	Seminar & Training Room	A3	A3 Shared Support	1			0.4
1	G-A3-003	Meeting / Case Conference Room	A3	A3 Shared Support	1			10
1	G-A3-004	Lobby	A3	A3 Shared Support	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-A3-005	Switch Cupboard	A3	A3 Shared Support	1		Project Co Space	0
1	1-B1-001	Corridor	B1	B1 PICU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-B1-002	Retrieval Equipment Store	B1	B1 PICU	1			10
1	1-B1-003	Staff Room	B1	B1 PICU	1			10
1	1-B1-004	Senior Charge Nurse Office	B1	B1 PICU	1			0.4
1	1-B1-005	WC - Staff	B1	B1 PICU	1			0.6
1	1-B1-006	WC - Staff	B1	B1 PICU	1			0.6
1	1-B1-007	Equipment Service Room	B1	B1 PICU	1			10
1	1-B1-008	IPS Room	B1	B1 PICU	1			200
1	1-B1-009	Bay 1	B1	B1 PICU	1			200
1	1-B1-010	Gas Cylinder Store	B1	B1 PICU	1			0.8
1	1-B1-011	Multidisciplinary Work Area PICU	B1	B1 PICU	1			50
1	1-B1-012	Staff Base 1	B1	B1 PICU	1			50
1	1-B1-013A	Corridor	B1	B1 PICU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-B1-013B	Corridor	B1	B1 PICU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-B1-013C	Corridor	B1	B1 PICU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-B1-014	Resuscitation Trolley Bay	B1	B1 PICU	1			0.1
1	1-B1-015	Lobby 5	B1	B1 PICU	1		Grouped with 1-B1-016	0
1	1-B1-016	Single Room 5 - Isolation	B1	B1 PICU	1		Grouped with 1-B1-015	200
1	1-B1-017	Single Room 6 - Isolation	B1	B1 PICU	1		Grouped with 1-B1-018	200
1	1-B1-018	Lobby 6	B1	B1 PICU	1		Grouped with 1-B1-017	0
1	1-B1-019	Single Room 8	B1	B1 PICU	1			200
1	1-B1-020	Single Room 7	B1	B1 PICU	1			200
1	1-B1-021	Single Room 9	B1	B1 PICU	1			200
1	1-B1-022	Corridor	B1	B1 PICU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-B1-023	Staff Base 2	B1	B1 PICU	1			50
1	1-B1-024	Resuscitation Trolley Bay	B1	B1 PICU	1			0.1
1	1-B1-025	Lobby 10	B1	B1 PICU	1		Grouped with 1-B1-026	0
1	1-B1-026	Single Room 10 - Isolation	B1	B1 PICU	1		Grouped with 1-B1-025	200
1	1-B1-027	Clean Utility	B1	B1 PICU	1			50
1	1-B1-028	Bed/Patient Chair / Buggy Storage	B1	B1 PICU	1			0.1
1	1-B1-029	Dirty Utility	B1	B1 PICU	1			21
1	1-B1-030	Linen Bay (1 trolley)	B1	B1 PICU	1		Not measurable against availability standards	0
1	1-B1-031	Bay 2	B1	B1 PICU	1			200
1	1-B1-032	Patients' Assisted Bathroom	B1	B1 PICU	1			200

1	1-B1-033	Lobby 16	B1	B1 PICU	1		Grouped with 1-B1-036	0
1	1-B1-034	Linen Bay (1 trolley)	B1	B1 PICU	1		Not measurable against availability standards	0
1	1-B1-035	Hoist Bay	B1	B1 PICU	1			0.1
1	1-B1-036	Single Room 16 - isolation	B1	B1 PICU	1		Grouped with 1-B1-033	200
1	1-B1-037	Single Room 17	B1	B1 PICU	1			200
1	1-B1-038	Staff base 3	B1	B1 PICU	1			50
1	1-B1-039	Resuscitation Trolley Bay	B1	B1 PICU	1			0.1
1	1-B1-040	Corridor	B1	B1 PICU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-B1-041	Clean Utility	B1	B1 PICU	1			50
1	1-B1-042	Multidisciplinary Work Area HDU	B1	B1 PICU	1			50
1	1-B1-043	Laboratory	B1	B1 PICU	1			200
1	1-B1-044	IPS Room	B1	B1 PICU	1			200
1	1-B1-045	Quiet / Interview Room	B1	B1 PICU	1			16
1	1-B1-046	Store - Equipment	B1	B1 PICU	1			10
1	1-B1-047	Family Interview Room	B1	B1 PICU	1			21
1	1-B1-048	On-Call Consultant Office (2 person)	B1	B1 PICU	1			0.4
1	1-B1-049	Retrieval Team Office (2 person)	B1	B1 PICU	1			0.4
1	1-B1-051	Data Manager & Secretarial Office (3 person)	B1	B1 PICU	1			0.4
1	1-B1-052	Corridor	B1	B1 PICU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-B1-055	Waiting Area (Visitors)	B1	B1 PICU	1			10
1	1-B1-056	WC - Wheelchair accessible	B1	B1 PICU	1			0.8
1	1-B1-057	X-Ray Processing	B1	B1 PICU	1			21
1	1-B1-058	Mobile X-Ray / Ultrasound Bay	B1	B1 PICU	1			0.8
1	1-B1-059	Cardiac Echo/ECG Bay	B1	B1 PICU	1			0.4
1	1-B1-060	Seminar Room	B1	B1 PICU	1			0.4
1	1-B1-061	Disposal Hold	B1	B1 PICU	1			0.8
1	1-B1-062	WC - Staff	B1	B1 PICU	1			0.6
1	1-B1-063	Bay 3	B1	B1 PICU	1			200
1	1-B1-064	Dirty Utility	B1	B1 PICU	1			21
1	1-B1-065	Neonatal Bay 4	B1	B1 PICU	1			200
1	1-B1-066	Clean Utility (Neo-Natal)	B1	B1 PICU	1			50
1	1-B1-067	Medical Gas Store	B1	B1 PICU	1			0.8
1	1-B1-068	Baby/Infant Feeding Room	B1	B1 PICU	1			0.8
1	1-B1-069	Staff Base 4	B1	B1 PICU	1			50
1	1-B1-070	Corridor	B1	B1 PICU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-B1-071	Resuscitation Trolley Bay	B1	B1 PICU	1			0.1
1	1-B1-072	Play Specialist Base & Store	B1	B1 PICU	1			0.2
1	1-B1-073	Pantry / Milk Store	B1	B1 PICU	1			21
1	1-B1-074	Neonatal Cot 22 - Ensuite	B1	B1 PICU	1		Grouped with 1-B1-075	0
1	1-B1-075	Neonatal Cot 22	B1	B1 PICU	1		Grouped with 1-B1-074	200

1	1-B1-076	Corridor	B1	B1 PICU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-B1-077	DSR	B1	B1 PICU	1			16
1	1-B1-078	Relatives Overnight Stay Room 1	B1	B1 PICU	1		Grouped with 1-B1-083	21
1	1-B1-079	Relatives Overnight Room 1 - ensuite	B1	B1 PICU	1		Grouped with 1-B1-082	0
1	1-B1-080	WC - Ambulant (Relatives)	B1	B1 PICU	1			0.8
1	1-B1-082	Relatives Overnight Stay Room 2	B1	B1 PICU	1		Grouped with 1-B1-079	21
1	1-B1-083	Relatives Overnight Room 2 - ensuite	B1	B1 PICU	1		Grouped with 1-B1-078	0
1	1-B1-084	Relatives' Sitting Room	B1	B1 PICU	1			10
1	1-B1-086	Corridor	B1	B1 PICU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-B1-087	Corridor	B1	B1 PICU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-B1-088	Corridor	B1	B1 PICU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-B1-089	Switch Cupboard	B1	B1 PICU	1		Project Co Space	0
1	1-B1-090	Equipment Cleaning	B1	B1 PICU	1			50
1	3-C1.1-001	Corridor	C1.1	C1.1 Medical Inpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.1-002	IPS Room	C1.1	C1.1 Medical Inpatients	1			200
1	3-C1.1-003	Senior Charge Nurse Office	C1.1	C1.1 Medical Inpatients	1			0.4
1	3-C1.1-004	Single Room 4 (Transitional Care Bed)	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-005, 3-C1.1-006	35
1	3-C1.1-005	Room 4 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-004, 3-C1.1-006	0
1	3-C1.1-006	Room 4 - Lobby	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-004, 3-C1.1-005	0
1	3-C1.1-007	Hoist Bay	C1.1	C1.1 Medical Inpatients	1			0.1
1	3-C1.1-008	Sitting Room	C1.1	C1.1 Medical Inpatients	1			0.8
1	3-C1.1-009	Single Room 6 (Transitional Care Bed)	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-010	35
1	3-C1.1-010	Room 6 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-009	0
1	3-C1.1-011	Touchdown Base 2	C1.1	C1.1 Medical Inpatients	1			21
1	3-C1.1-012	Resus Bay	C1.1	C1.1 Medical Inpatients	1			0.1
1	3-C1.1-013	Single Room 5 (Transitional Care Bed)	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-014	35
1	3-C1.1-014	Room 5 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-013	0
1	3-C1.1-015	Single Room 7 (Transitional Care Bed)	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-016	35
1	3-C1.1-016	Room 7 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-015	0
1	3-C1.1-017	DSR	C1.1	C1.1 Medical Inpatients	1			16
1	3-C1.1-018	Bay 2 (beds 15-18)	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-019	35
1	3-C1.1-019	Bay 2 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-018	0
1	3-C1.1-020	Bay 2 - Toilet	C1.1	C1.1 Medical Inpatients	1			0.8
1	3-C1.1-021	Dining / Play Room	C1.1	C1.1 Medical Inpatients	1			10
1	3-C1.1-022	Store - Equipment	C1.1	C1.1 Medical Inpatients	1			0.2
1	3-C1.1-023	Ward Kitchen	C1.1	C1.1 Medical Inpatients	1			21

1	3-C1.1-024	Linen Bay (2 trolleys)	C1.1	C1.1 Medical Inpatients	1		Not measurable against availability standards	0
1	3-C1.1-025	Store - General	C1.1	C1.1 Medical Inpatients	1			0.1
1	3-C1.1-026	WC - Staff	C1.1	C1.1 Medical Inpatients	1			0.6
1	3-C1.1-027	WC - Staff	C1.1	C1.1 Medical Inpatients	1			0.6
1	3-C1.1-028	Disposal Hold	C1.1	C1.1 Medical Inpatients	1			0.8
1	3-C1.1-029	Mobile X-Ray / Ultrasound Bay	C1.1	C1.1 Medical Inpatients	1			0.8
1	3-C1.1-030	Multi-Disciplinary Office	C1.1	C1.1 Medical Inpatients	1			0.4
1	3-C1.1-031	Reception (1 person)	C1.1	C1.1 Medical Inpatients	1			0.6
1	3-C1.1-032	Room 21 - Lobby	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-034, 3-C1.1-033	35
1	3-C1.1-033	Single Room 21	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-034, 3-C1.1-032	35
1	3-C1.1-034	Room 21 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-033, 3-C1.1-032	0
1	3-C1.1-035	Room 20 - Lobby	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-036, 3-C1.1-037	35
1	3-C1.1-036	Single Room 20	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-035, 3-C1.1-037	35
1	3-C1.1-037	Room 20 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-035, 3-C1.1-036	0
1	3-C1.1-038	Touchdown Base 1	C1.1	C1.1 Medical Inpatients	1			21
1	3-C1.1-039	Room 19 - Lobby	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-040, 3-C1.1-041	35
1	3-C1.1-040	Single Room 19	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-039, 3-C1.1-041	35
1	3-C1.1-041	Room 19 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-039, 3-C1.1-040	0
1	3-C1.1-042	Clean Utility	C1.1	C1.1 Medical Inpatients	1			50
1	3-C1.1-043	Treatment Room	C1.1	C1.1 Medical Inpatients	1			21
1	3-C1.1-044	Dirty Utility	C1.1	C1.1 Medical Inpatients	1			21
1	3-C1.1-045	Touchdown Base 3	C1.1	C1.1 Medical Inpatients	1			21
1	3-C1.1-046	Bay 1 (beds 10-14 excl13)	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-048	35
1	3-C1.1-047	Bay 1 - Toilet	C1.1	C1.1 Medical Inpatients	1			0.8
1	3-C1.1-048	Bay 1 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-046	0
1	3-C1.1-049	Patients' Assisted Bathroom	C1.1	C1.1 Medical Inpatients	1			21
1	3-C1.1-050	Patient Interview Room	C1.1	C1.1 Medical Inpatients	1			10
1	3-C1.1-051	Touchdown Base 4	C1.1	C1.1 Medical Inpatients	1			21
1	3-C1.1-052	Single Room 9	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-053	35
1	3-C1.1-053	Room 9 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-052	0
1	3-C1.1-054	Single Room 8	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-055	35
1	3-C1.1-055	Room 8 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-054	0
1	3-C1.1-056	Single Room 3	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-057	35
1	3-C1.1-057	Room 3 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-056	0
1	3-C1.1-058	Single Room 1	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-059	35
1	3-C1.1-059	Room 1 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-058	0
1	3-C1.1-060	Single Room 2	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-061	35
1	3-C1.1-061	Room 2 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-060	0
1	3-C1.1-062	Touchdown Base 5	C1.1	C1.1 Medical Inpatients	1			21
1	3-C1.1-063	Single Room 24	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-064	35
1	3-C1.1-064	Room 24 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-063	0
1	3-C1.1-065	Single Room 23	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-066	35
1	3-C1.1-066	Room 23 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-065	0
1	3-C1.1-067	Single Room 22	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-068	35
1	3-C1.1-068	Room 22 - Ensuite	C1.1	C1.1 Medical Inpatients	1		Grouped with 3-C1.1-067	0
1	3-C1.1-070	WC - Ambulant (Visitors)	C1.1	C1.1 Medical Inpatients	1			0.8

1	3-C1.1-071	Corridor	C1.1	C1.1 Medical Inpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.1-072	Switch Cupboard	C1.1	C1.1 Medical Inpatients	1		Project Co Space	0
1	3-C1.1-073	Corridor	C1.1	C1.1 Medical Inpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.2-001	Corridor	C1.2	C1.2 Surgical Long Stay	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.2-002	Single Room 9	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-011	35
1	3-C1.2-003	Room 10 - Ensuite	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-010	0
1	3-C1.2-004	Linen Bay	C1.2	C1.2 Surgical Long Stay	1		Not measurable against availability standards	0
1	3-C1.2-005	Single Room 11	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-006	35
1	3-C1.2-006	Room 11 - Ensuite	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-005	0
1	3-C1.2-007	Single Room 12	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-008	35
1	3-C1.2-008	Room 12 - Ensuite	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-007	0
1	3-C1.2-009	Touchdown Base 1	C1.2	C1.2 Surgical Long Stay	1			21
1	3-C1.2-010	Single Room 10	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-003	35
1	3-C1.2-011	Room 9 - Ensuite	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-002	0
1	3-C1.2-012	Dirty Utility	C1.2	C1.2 Surgical Long Stay	1			21
1	3-C1.2-013	DSR	C1.2	C1.2 Surgical Long Stay	1			16
1	3-C1.2-014	Single Room 14	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-015	35
1	3-C1.2-015	Room 14 - Ensuite	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-014	0
1	3-C1.2-016	Hoist Bay	C1.2	C1.2 Surgical Long Stay	1			0.1
1	3-C1.2-017	Patients' Assisted Bathroom	C1.2	C1.2 Surgical Long Stay	1			21
1	3-C1.2-018	Single Room 15	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-021	35
1	3-C1.2-019	Room 16 - Ensuite	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-020	0
1	3-C1.2-020	Single Room 16	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-019	35
1	3-C1.2-021	Room 15 - Ensuite	C1.2	C1.2 Surgical Long Stay	1		Grouped with 3-C1.2-018	0
1	3-C1.2-022	Touchdown Base 2	C1.2	C1.2 Surgical Long Stay	1			21
1	3-C1.2-023	Bay 2 (beds 5-8)	C1.2	C1.2 Surgical Long Stay	1			35
1	3-C1.2-024	Bay 2 - Toilet	C1.2	C1.2 Surgical Long Stay	1			0.8
1	3-C1.2-025	Bay 1 - Ensuite	C1.2	C1.2 Surgical Long Stay	1			21
1	3-C1.2-026	Bay 1 (beds 1-4)	C1.2	C1.2 Surgical Long Stay	1			35
1	3-C1.2-027	Bay 1 - Toilet	C1.2	C1.2 Surgical Long Stay	1			0.8
1	3-C1.2-028	Senior Charge Nurse Office	C1.2	C1.2 Surgical Long Stay	1			0.4
1	3-C1.2-029	Resuscitation Trolley Bay	C1.2	C1.2 Surgical Long Stay	1			0.1
1	3-C1.2-030	Store - Equipment	C1.2	C1.2 Surgical Long Stay	1			0.2
1	3-C1.2-031	Clean Utility	C1.2	C1.2 Surgical Long Stay	1			50
1	3-C1.2-032	Treatment Room	C1.2	C1.2 Surgical Long Stay	1			21
1	3-C1.2-033	Dining / Play Room	C1.2	C1.2 Surgical Long Stay	1			10
1	3-C1.2-034	Ward Kitchen	C1.2	C1.2 Surgical Long Stay	1			21
1	3-C1.2-035	Patient Interview Room	C1.2	C1.2 Surgical Long Stay	1			10
1	3-C1.2-036	Reception (1 person)	C1.2	C1.2 Surgical Long Stay	1			0.6
1	3-C1.2-037	Discharge Lounge	C1.2	C1.2 Surgical Long Stay	1			21
1	3-C1.2-038	Disposal Hold	C1.2	C1.2 Surgical Long Stay	1			0.5
1	3-C1.2-039	Store - General	C1.2	C1.2 Surgical Long Stay	1			0.1

1	3-C1.2-040	WC - Staff	C1.2	C1.2 Surgical Long Stay	1			0.6
1	3-C1.2-041	WC - Ambulant (Visitors)	C1.2	C1.2 Surgical Long Stay	1			0.8
1	3-C1.2-042	Touchdown Base 3	C1.2	C1.2 Surgical Long Stay	1			21
1	3-C1.2-043	Multi-Disciplinary Office	C1.2	C1.2 Surgical Long Stay	1			0.4
1	3-C1.2-044	WC - Staff	C1.2	C1.2 Surgical Long Stay	1			0.6
1	3-C1.2-045	Corridor	C1.2	C1.2 Surgical Long Stay	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.2-046	Switch Cupboard	C1.2	C1.2 Surgical Long Stay	1		Project Co Space	0
1	3-C1.3-001	Corridor	C1.3	C1.3 Neuroscience	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.3-002	Waiting Area	C1.3	C1.3 Neuroscience	1			0.8
1	3-C1.3-003	Reception (1 person)	C1.3	C1.3 Neuroscience	1			0.6
1	3-C1.3-004	WC - Wheelchair accessible	C1.3	C1.3 Neuroscience	1			0.8
1	3-C1.3-005	Store - Equipment	C1.3	C1.3 Neuroscience	1			0.2
1	3-C1.3-006	Touchdown Base 1	C1.3	C1.3 Neuroscience	1			21
1	3-C1.3-007	Room 1 - Lobby	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-008, 3-C1.3-009	35
1	3-C1.3-008	Single Room 1	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-007, 3-C1.3-009	35
1	3-C1.3-009	Room 1 - Ensuite	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-007, 3-C1.3-008	0
1	3-C1.3-010	Bay 1 - Toilet	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-011, 3-C1.3-12	21
1	3-C1.3-011	Bay 1 (Beds 2-5)	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-010, 3-C1.3-12	35
1	3-C1.3-012	Bay 1 - Ensuite	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-010, 3-C1.3-11	21
1	3-C1.3-013	Bay 2 (beds 6-9)	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-014	35
1	3-C1.3-014	Bay 2 - Toilet	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-013	0
1	3-C1.3-015	Resuscitation Trolley Bay	C1.3	C1.3 Neuroscience	1			0.1
1	3-C1.3-016	Linen Bay (1 trolley)	C1.3	C1.3 Neuroscience	1		Not measurable against availability standards	0
1	3-C1.3-017	Store - General	C1.3	C1.3 Neuroscience	1			0.1
1	3-C1.3-018	Multi-Disciplinary Office	C1.3	C1.3 Neuroscience	1			0.8
1	3-C1.3-019	Patient Interview Room	C1.3	C1.3 Neuroscience	1			10
1	3-C1.3-020	Senior Charge Nurse Office	C1.3	C1.3 Neuroscience	1			0.4
1	3-C1.3-021	WC - Staff	C1.3	C1.3 Neuroscience	1			0.6
1	3-C1.3-022	WC - Staff	C1.3	C1.3 Neuroscience	1			0.6
1	3-C1.3-023	WC - Ambulant (Visitors)	C1.3	C1.3 Neuroscience	1			0.8
1	3-C1.3-024	Snoezelen Room	C1.3	C1.3 Neuroscience	1			21
1	3-C1.3-025	Rehabilitation Room	C1.3	C1.3 Neuroscience	1			21
1	3-C1.3-026	Hoist Bay	C1.3	C1.3 Neuroscience	1			0.1
1	3-C1.3-027	Touchdown Base 2	C1.3	C1.3 Neuroscience	1			21
1	3-C1.3-028	Single Room 10 (VT)	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-029	35
1	3-C1.3-029	Room 10 - Ensuite	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-028	0
1	3-C1.3-030	Single Room 11 (VT)	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-031	35
1	3-C1.3-031	Room 11 - Ensuite	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-030	0
1	3-C1.3-032	Single Room 12	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-033	35
1	3-C1.3-033	Room 12 - Ensuite	C1.3	C1.3 Neuroscience	1		Grouped with 3-C1.3-032	0
1	3-C1.3-034	Ward Kitchen	C1.3	C1.3 Neuroscience	1			21
1	3-C1.3-035	Patients' Assisted Bathroom	C1.3	C1.3 Neuroscience	1			21
1	3-C1.3-036	Dirty Utility	C1.3	C1.3 Neuroscience	1			21

1	3-C1.3-037	Treatment Room	C1.3	C1.3 Neuroscience	1			21
1	3-C1.3-038	Clean Utility	C1.3	C1.3 Neuroscience	1			50
1	3-C1.3-039	Dining / Play Room	C1.3	C1.3 Neuroscience	1			10
1	3-C1.3-040	DSR	C1.3	C1.3 Neuroscience	1			16
1	3-C1.3-041	Disposal Hold	C1.3	C1.3 Neuroscience	1			0.9
1	3-C1.4-001	Corridor	C1.4	C1.4 Haematology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.4-002	Quiet Room / Study	C1.4	C1.4 Haematology	1			10
1	3-C1.4-003	Corridor	C1.4	C1.4 Haematology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.4-004	Disposal Hold	C1.4	C1.4 Haematology	1			0.9
1	3-C1.4-005	DSR	C1.4	C1.4 Haematology	1			16
1	3-C1 4-006	Store - General	C1.4	C1.4 Haematology	1			0.1
1	3-C1.4-007	Patient Interview Room	C1.4	C1.4 Haematology	1			21
1	3-C1.4-008	Complementary Therapy Room	C1.4	C1.4 Haematology	1			21
1	3-C1.4-009	Room 11 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-010	21
1	3-C1.4-010	Single Room 11	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-009	35
1	3-C1.4-011	Assisted Bathroom	C1.4	C1.4 Haematology	1			21
1	3-C1.4-012	Touchdown Base 4	C1.4	C1.4 Haematology	1			21
1	3-C1.4-013	Single Room 12	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-014	35
1	3-C1.4-014	Room 12 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-013	0
1	3-C1.4-015	Social Space	C1.4	C1.4 Haematology	1			10
1	3-C1.4-016	Single Room 14	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-017	35
1	3-C1.4-017	Room 14 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-016	0
1	3-C1.4-018	Single Room 10	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-019	35
1	3-C1.4-019	Room 10 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-018	0
1	3-C1.4-020	Corridor	C1.4	C1.4 Haematology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.4-021	Hoist Bay	C1.4	C1.4 Haematology	1			0.1
1	3-C1.4-022	Dirty Utility	C1.4	C1.4 Haematology	1			21
1	3-C1.4-023	Nursing Staff Office	C1.4	C1.4 Haematology	1			21
1	3-C1.4-024	Multi-Disciplinary Office	C1.4	C1.4 Haematology	1			0.8
1	3-C1.4-025	Medical Staff Office (4 person)	C1.4	C1.4 Haematology	1			0.4
1	3-C1.4-026	Consultant Office (5 person & microscope)	C1.4	C1.4 Haematology	1			0.4
1	3-C1.4-027	Store - Equipment	C1.4	C1.4 Haematology	1			0.2
1	3-C1.4-028	Research Staff Office/Store (2 person)	C1.4	C1.4 Haematology	1			0.4
1	3-C1.4-029	Pharmacy Base	C1.4	C1.4 Haematology	1			0.4
1	3-C1.4-030	Senior Charge Nurse Office	C1.4	C1.4 Haematology	1			0.4
1	3-C1.4-031	Corridor	C1.4	C1.4 Haematology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.4-032	Single Room 9	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-033	35
1	3-C1.4-033	Room 9 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-032	0
1	3-C1.4-034	Touchdown Base 3	C1.4	C1.4 Haematology	1			21

1	3-C1.4-035	Linen Bay (1 trolley)	C1.4	C1.4 Haematology	1		Not measurable against availability standards	0
1	3-C1.4-036	WC - Staff	C1.4	C1.4 Haematology	1			0.6
1	3-C1.4-037	WC - Staff	C1.4	C1.4 Haematology	1			0.6
1	3-C1.4-038	Clean Utility	C1.4	C1.4 Haematology	1			50
1	3-C1.4-039	Room 8 - Lobby	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-040, 3-C1.4-041	35
1	3-C1.4-040	Single Room 8 (Isolation)	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-039, 3-C1.4-041	35
1	3-C1.4-041	Room 8 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-039, 3-C1.4-040	0
1	3-C1.4-042	Room 7 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-043, 3-C1.4-044	21
1	3-C1.4-043	Single Room 7 (Isolation)	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-042, 3-C1.4-044	35
1	3-C1.4-044	Room 7 - Lobby	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-043, 3-C1.4-042	0
1	3-C1.4-045	Touchdown Base 2	C1.4	C1.4 Haematology	1			21
1	3-C1.4-046	Single Room 15	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-047	35
1	3-C1.4-047	Room 15 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-046	0
1	3-C1.4-048	Room 6 - Lobby	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-049, 3-C1.4-050	35
1	3-C1.4-049	Single Room 6 (Isolation)	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-048, 3-C1.4-050	35
1	3-C1.4-050	Room 6 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-049, 3-C1.4-048	0
1	3-C1.4-051	Room 5 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-052, 3-C1.4-053	21
1	3-C1.4-052	Single Room 5 (Isolation)	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-053, 3-C1.4-051	35
1	3-C1.4-053	Room 5 - Lobby	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-052, 3-C1.4-051	0
1	3-C1.4-054	Resuscitation Trolley Bay	C1.4	C1.4 Haematology	1			0.1
1	3-C1.4-055	Single Room 16	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-056	35
1	3-C1.4-056	Room 16 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-055	0
1	3-C1.4-057	Single Room 17	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-058	35
1	3-C1.4-058	Room 17 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-057	0
1	3-C1.4-059	Single Room 18	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-060	35
1	3-C1.4-060	Room 18 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-059	0
1	3-C1.4-061	Bay 1 (Beds 1-6)	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-062	35
1	3-C1.4-062	Bay 1 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-061	0
1	3-C1.4-063	Play Room	C1.4	C1.4 Haematology	1			10
1	3-C1.4-064	Ward Kitchen	C1.4	C1.4 Haematology	1			21
1	3-C1.4-065	Treatment Room	C1.4	C1.4 Haematology	1			21
1	3-C1.4-066	Clean Utility	C1.4	C1.4 Haematology	1			50
1	3-C1.4-067	WC - Ambulant (Visitors)	C1.4	C1.4 Haematology	1			0.8
1	3-C1.4-068	Waiting Area	C1.4	C1.4 Haematology	1			0.8
1	3-C1.4-069	Reception (1 person)	C1.4	C1.4 Haematology	1			0.6
1	3-C1.4-070	Switch Cupboard	C1.4	C1.4 Haematology	1		Project Co Space	0
1	3-C1.4-071	Room 4 - Lobby	C1.4	C1.4 Haematology	1			35
1	3-C1.4-072	Single Room 4 (Isolation)	C1.4	C1.4 Haematology	1			35
1	3-C1.4-073	Room 4 - Ensuite	C1.4	C1.4 Haematology	1			35
1	3-C1.4-074	Single Room 3	C1.4	C1.4 Haematology	1			35
1	3-C1.4-075	Room 3 - Ensuite	C1.4	C1.4 Haematology	1			35
1	3-C1.4-076	Single Room 2	C1.4	C1.4 Haematology	1			35
1	3-C1.4-077	Room 2 - Ensuite	C1.4	C1.4 Haematology	1			35
1	3-C1.4-078	Single Room 1	C1.4	C1.4 Haematology	1			35
1	3-C1.4-079	Room 1 - Ensuite	C1.4	C1.4 Haematology	1			35
1	3-C1.4-080	Reception	C1.4	C1.4 Haematology	1			0.6

1	3-C1.4-081	Touchdown Base 1	C1.4	C1.4 Haematology	1			21
1	3-C1.4-082	Corridor	C1.4	C1.4 Haematology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.4-083	Dirty Utility	C1.4	C1.4 Haematology	1			21
1	3-C1.4-084	Bay 2 (Beds 7-9)	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-085	35
1	3-C1.4-085	Bay 2 - Ensuite	C1.4	C1.4 Haematology	1		Grouped with 3-C1.4-084	0
1	3-C1.4-086	Equipment Bay	C1.4	C1.4 Haematology	1		Not measurable against availability standards	0
1	3-C1.4-087	Consulting Room	C1.4	C1.4 Haematology	1			21
1	3-C1.4-088	Beverage Bay	C1.4	C1.4 Haematology	1		Not measurable against availability standards	0
1	3-C1.4-090	Switch Cupboard	C1.4	C1.4 Haematology	1		Project Co Space	0
1	3-C1.5-001	Corridor	C1.5	C1.5 Shared Support	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.5-002	Store - back up clothing	C1.5	C1.5 Shared Support	1			0.1
1	3-C1.5-003	Family Sitting Room	C1.5	C1.5 Shared Support	1			10
1	3-C1.5-004	Baby Infant / Feeding Room	C1.5	C1.5 Shared Support	1			0.8
1	3-C1.5-005	Nappy Change	C1.5	C1.5 Shared Support	1			0.8
1	3-C1.5-006	Breast Pump Room	C1.5	C1.5 Shared Support	1			0.7
1	3-C1.5-007	WC - Wheelchair Accessible	C1.5	C1.5 Shared Support	1			0.8
1	3-C1.5-008	WC - Wheelchair Accessible	C1.5	C1.5 Shared Support	1			0.8
1	3-C1.6-001	Dining / Recreation Room	C1.6	C1.6 Adolescent	1			21
1	3-C1.6-002	Quiet Room / Study	C1.6	C1.6 Adolescent	1			0.7
1	3-C1.7-001	Corridor	C1.7	C1.7 Neurophysiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.7-002	EEG Review Office	C1.7	C1.7 Neurophysiology	1			10
1	3-C1.7-003	EEG Recording Room 2	C1.7	C1.7 Neurophysiology	1			21
1	3-C1.7-004	EEG Recording Room 1	C1.7	C1.7 Neurophysiology	1			21
1	3-C1.7-005	Evoked Potential Recording Room	C1.7	C1.7 Neurophysiology	1			21
1	3-C1.8-001	Corridor	C1.8	C1.8 Short Stay Inpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.8-002	Disposal Hold	C1.8	C1.8 Short Stay Inpatients	1			0.6
1	3-C1.8-003	Dirty Utility	C1.8	C1.8 Short Stay Inpatients	1			21
1	3-C1.8-004	Corridor	C1.8	C1.8 Short Stay Inpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C1.8-005	Single Room 9	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-006	35
1	3-C1.8-006	Room 9 - Ensuite	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-005	0
1	3-C1.8-007	WC - Staff	C1.8	C1.8 Short Stay Inpatients	1			0.6
1	3-C1.8-008	WC - Ambulant (Visitors)	C1.8	C1.8 Short Stay Inpatients	1			0.8
1	3-C1.8-009	Dining / Play Room	C1.8	C1.8 Short Stay Inpatients	1			10
1	3-C1.8-010	Ward Kitchen	C1.8	C1.8 Short Stay Inpatients	1			21
1	3-C1.8-011	Reception (1 person)	C1.8	C1.8 Short Stay Inpatients	1			0.6
1	3-C1.8-012	DSR	C1.8	C1.8 Short Stay Inpatients	1			16
1	3-C1.8-013	Store - General	C1.8	C1.8 Short Stay Inpatients	1			0.1
1	3-C1.8-014	Clean Utility	C1.8	C1.8 Short Stay Inpatients	1			50
1	3-C1.8-015	Treatment Room	C1.8	C1.8 Short Stay Inpatients	1			21

1	3-C1.8-016	Bay 1 (beds 1-4)	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-017	35
1	3-C1.8-017	Bay 1 - Ensuite	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-016	0
1	3-C1.8-018	Bay 1 - Toilet	C1.8	C1.8 Short Stay Inpatients	1			0.8
1	3-C1.8-019	Touchdown Base 1	C1.8	C1.8 Short Stay Inpatients	1			21
1	3-C1.8-020	Resuscitation Trolley Bay	C1.8	C1.8 Short Stay Inpatients	1			0.1
1	3-C1.8-021	Single Room 10	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-033	35
1	3-C1.8-022	Room 11 - Ensuite	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-032	0
1	3-C1.8-023	Single Room 15	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-024	35
1	3-C1.8-024	Room 15 - Ensuite	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-023	0
1	3-C1.8-025	Single Room 14	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-026	35
1	3-C1.8-026	Room 14 - Ensuite	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-025	0
1	3-C1.8-027	Bay 2 (beds 5-8)	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-029	35
1	3-C1.8-028	Bay 2 - Toilet	C1.8	C1.8 Short Stay Inpatients	1			0.8
1	3-C1.8-029	Bay 2 - Ensuite	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-027	0
1	3-C1.8-030	Single Room 12	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-031	35
1	3-C1.8-031	Room 12 - Ensuite	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-030	0
1	3-C1.8-032	Single Room 11	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-022	35
1	3-C1.8-033	Room 10 - Ensuite	C1.8	C1.8 Short Stay Inpatients	1		Grouped with 3-C1.8-021	0
1	3-C1.8-034	Linen Bay (1 trolley)	C1.8	C1.8 Short Stay Inpatients	1		Not measurable against availability standards	0
1	3-C1.8-035	Patients' Assisted Bathroom	C1.8	C1.8 Short Stay Inpatients	1			21
1	3-C1.8-036	Store - Equipment	C1.8	C1.8 Short Stay Inpatients	1			0.2
1	3-C1.8-037	Senior Charge Nurse Office	C1.8	C1.8 Short Stay Inpatients	1			0.4
1	3-C1.8-038	Switch Cupboard	C1.8	C1.8 Short Stay Inpatients	1		Project Co Space	0
1	3-C1.8-040	Touchdown Base 2	C1.8	C1.8 Short Stay Inpatients	1			21
1	3-C2-001	Corridor	C2	C2 Ward Support	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C2-003	DSR	C2	C2 Ward Support	1			16
1	3-C2-004	Seminar Room	C2	C2 Ward Support	1			0.4
1	3-C2-005	Staff Room	C2	C2 Ward Support	1			0.4
1	3-C2-006	Parent Shower Room	C2	C2 Ward Support	1			0.8
1	3-C3-001	Corridor	C3	C3 Special Feeds	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C3-002	Feed Prep Area	C3	C3 Special Feeds	1			21
1	3-C3-003	Wash Room	C3	C3 Special Feeds	1			21
1	3-C3-004	Office / Ante-Room	C3	C3 Special Feeds	1			0.4
1	3-C3-005	Store - Feeds	C3	C3 Special Feeds	1			21
1	3-C4-001A	Corridor	C4	C4 Sleep Lab	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C4-001B	Corridor	C4	C4 Sleep Lab	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-C4-002	Store	C4	C4 Sleep Lab	1			0.1
1	3-C4-003	Room 1 - Ensuite	C4	C4 Sleep Lab	1		Grouped with 3-C4-005	0
1	3-C4-005	Sleep Room 1	C4	C4 Sleep Lab	1		Grouped with 3-C4-003	21
1	3-C4-006	Parents Room 1	C4	C4 Sleep Lab	1			21

1	3-C4-007	Control Room	C4	C4 Sleep Lab	1	Consequential impact on 3-C4-008, 3-C4-005		21
1	3-C4-008	Sleep Room 2	C4	C4 Sleep Lab	1		Grouped with 3-C4-009	21
1	3-C4-009	Parents Room 2	C4	C4 Sleep Lab	1		Grouped with 3-C4-008	21
1	3-C4-010	Room 2 - Ensuite	C4	C4 Sleep Lab	1		Grouped with 3-C4-008	0
1	4-C5-001	Corridor	C5	C5 Classrooms	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-C5-002	WC - Wheelchair accessible	C5	C5 Classrooms	1			0.8
1	4-C5-003	Store	C5	C5 Classrooms	1			0.1
1	4-C5-004	Primary Classroom	C5	C5 Classrooms	1			0.4
1	4-C5-005	Upper Primary Classroom	C5	C5 Classrooms	1			0.4
1	4-C5-006	Secondary Classroom	C5	C5 Classrooms	1			0.4
1	4-C5-007	Administration Area	C5	C5 Classrooms	1			0.4
1	4-C5-008	Resource Storage	C5	C5 Classrooms	1			0.1
1	4-C5-009	WC - Ambulant	C5	C5 Classrooms	1			0.8
1	1-BD-001	Lift 6 (Patient Bed Lift)	Communication	1st Floor	1		Grouped into G-BD-001	0
1	1-BD-002	Lift 7 (Patient Bed Lift)	Communication	1st Floor	1		Grouped into G-BD-002	0
1	1-BD-003	Lift 12 (Patient Bed Lift)	Communication	1st Floor	1		Grouped into G-BD-003	0
1	1-BD-004	Lift 13 (Patient Bed Lift)	Communication	1st Floor	1		Grouped into G-BD-004	0
1	1-BD-005	Lift 14 (Patient Bed Lift)	Communication	1st Floor	1		Grouped into G-BD-005	0
1	1-COR-001A	Pod Bridge	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-001B	Atrium Bridge	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-001C	Corridor	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-002A	Corridor	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-002B	Corridor	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-003	Corridor	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-004	Corridor	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-005	Corridor	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-006	Corridor	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-007	Corridor	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0

1	1-COR-009	Corridor	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-010	Corridor	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-011	Corridor	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-012	Corridor	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-COR-013	Lift Lobby	Communication	1st Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	1-FM-001	Lift 3	Communication	1st Floor	1		Grouped into G-FM-001	0
1	1-FM-002	Lift 4	Communication	1st Floor	1		Grouped into G-FM-002	0
1	1-FM-003	Lift 5	Communication	1st Floor	1		Grouped into G-FM-003	0
1	1-FM-004	Lift 10	Communication	1st Floor	1		Grouped into G-FM-004	0
1	1-FM-005	Lift 11	Communication	1st Floor	1		Grouped into G-FM-005	0
1	1-PA-001	Lift 1	Communication	1st Floor	1		Grouped into G-PA-001	0
1	1-PA-002	Lift 2	Communication	1st Floor	1		Grouped into G-PA-002	0
1	1-PA-003	Lift 15	Communication	1st Floor	1		Grouped into G-PA-003	0
1	1-PA-004	Lift 16	Communication	1st Floor	1		Grouped into G-PA-004	0
1	1-PA-005	Lift 8	Communication	1st Floor	1		Grouped into G-PA-005	0
1	1-PA-006	Lift 9	Communication	1st Floor	1		Grouped into G-PA-006	0
1	1-Z1-001	Stair 01	Communication	1st Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	1-Z1-002	Stair 02	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-Z1-003	Stair 03	Communication	1st Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	1-Z1-004	Stair 04	Communication	1st Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	1-Z1-005	Stair 05	Communication	1st Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	1-Z1-006	Stair 06	Communication	1st Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	1-Z1-007	Stair 07	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-Z1-008	Stair 08	Communication	1st Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0

1	1-Z1-009	Stair 05 Lobby	Communication	1st Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	1-Z1-010	Stair 06 Lobby	Communication	1st Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	1-Z1-011	Stair 07 Lobby	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-Z1-012	Stair 04 Lobby	Communication	1st Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-BD-001	Lift 6 (Patient Bed Lift)	Communication	2nd Floor	1		Grouped into G-BD-001	0
1	2-BD-002	Lift 7 (Patient Bed Lift)	Communication	2nd Floor	1		Grouped into G-BD-002	0
1	2-BD-003	Lift 12 (Patient Bed Lift)	Communication	2nd Floor	1		Grouped into G-BD-003	0
1	2-BD-004	Lift 13 (Patient Bed Lift)	Communication	2nd Floor	1		Grouped into G-BD-004	0
1	2-BD-005	Lift 14 (Patient Bed Lift)	Communication	2nd Floor	1		Grouped into G-BD-005	0
1	2-COR-001	Corridor	Communication	2nd Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-COR-002	Corridor	Communication	2nd Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-COR-003	Corridor	Communication	2nd Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-COR-004	Corridor	Communication	2nd Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-COR-005	Corridor	Communication	2nd Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-COR-006	Corridor	Communication	2nd Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-COR-007	Corridor	Communication	2nd Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-COR-008	Corridor	Communication	2nd Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-COR-009	Corridor	Communication	2nd Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-COR-010	Corridor	Communication	2nd Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-COR-011	Corridor	Communication	2nd Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-COR-012	Lift Lobby	Communication	2nd Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-FM-001	Lift 3	Communication	2nd Floor	1		Grouped into G-FM-001	0

1	2-FM-002	Lift 4	Communication	2nd Floor	1		Grouped into G-FM-002	0
1	2-FM-003	Lift 5	Communication	2nd Floor	1		Grouped into G-FM-003	0
1	2-FM-004	Lift 10	Communication	2nd Floor	1		Grouped into G-FM-004	0
1	2-FM-005	Lift 11	Communication	2nd Floor	1		Grouped into G-FM-005	0
1	2-PA-001	Lift 1	Communication	2nd Floor	1		Grouped into G-PA-001	0
1	2-PA-002	Lift 2	Communication	2nd Floor	1		Grouped into G-PA-002	0
1	2-PA-003	Lift 15	Communication	2nd Floor	1		Grouped into G-PA-003	0
1	2-PA-004	Lift 16	Communication	2nd Floor	1		Grouped into G-PA-004	0
1	2-PA-005	Lift 8	Communication	2nd Floor	1		Grouped into G-PA-005	0
1	2-PA-006	Lift 9	Communication	2nd Floor	1		Grouped into G-PA-006	0
1	2-Z1-001	Stair 01	Communication	2nd Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	2-Z1-002	Stair 02	Communication	2nd Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	2-Z1-003	Stair 03	Communication	2nd Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	2-Z1-004	Stair 04	Communication	2nd Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	2-Z1-005	Stair 05	Communication	2nd Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	2-Z1-006	Stair 06	Communication	2nd Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	2-Z1-007	Stair 07	Communication	2nd Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	2-Z1-008	Stair 04 Lobby	Communication	2nd Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	2-Z1-009	Stair 05 Lobby	Communication	2nd Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	2-Z1-010	Stair 06 Lobby	Communication	2nd Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	2-Z1-011	Stair 07 Lobby	Communication	2nd Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	3-BD-001	Lift 6 (Patient Bed Lift)	Communication	Third Floor	1		Grouped into G-BD-001	0
1	3-BD-002	Lift 7 (Patient Bed Lift)	Communication	Third Floor	1		Grouped into G-BD-002	0
1	3-BD-003	Lift 12 (Patient Bed Lift)	Communication	Third Floor	1		Grouped into G-BD-003	0
1	3-BD-004	Lift 13 (Patient Bed Lift)	Communication	Third Floor	1		Grouped into G-BD-004	0

1	3-BD-005	Lift 14 (Patient Bed Lift)	Communication	Third Floor	1		Grouped into G-BD-005	0
1	3-COR-001	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-002	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-003A	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-003B	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-004	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-005	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-006	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-008	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-009	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-010	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-011	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-012	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-014	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-015	Lift Lobby	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-COR-017	Corridor	Communication	Third Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-FM-001	Lift 3	Communication	Third Floor	1		Grouped into G-FM-001	0
1	3-FM-002	Lift 4	Communication	Third Floor	1		Grouped into G-FM-002	0
1	3-FM-003	Lift 5	Communication	Third Floor	1		Grouped into G-FM-003	0
1	3-FM-004	Lift 10	Communication	Third Floor	1		Grouped into G-FM-004	0
1	3-FM-005	Lift 11	Communication	Third Floor	1		Grouped into G-FM-005	0
1	3-PA-001	Lift 1	Communication	Third Floor	1		Grouped into G-PA-001	0
1	3-PA-002	Lift 2	Communication	Third Floor	1		Grouped into G-PA-002	0

1	3-PA-003	Lift 15	Communication	Third Floor	1		Grouped into G-PA-003	0
1	3-PA-004	Lift 16	Communication	Third Floor	1		Grouped into G-PA-004	0
1	3-PA-005	Lift 8	Communication	Third Floor	1		Grouped into G-PA-005	0
1	3-PA-006	Lift 9	Communication	Third Floor	1		Grouped into G-PA-006	0
1	3-Z1-001	Stair 01	Communication	Third Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	3-Z1-002	Stair 02	Communication	Third Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	3-Z1-003	Stair 03	Communication	Third Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	3-Z1-004	Stair 04	Communication	Third Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	3-Z1-005	Stair 05	Communication	Third Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	3-Z1-006	Stair 06	Communication	Third Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	3-Z1-007	Stair 07	Communication	Third Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	3-Z1-008	Stair 04 Lobby	Communication	Third Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	3-Z1-009	Stair 05 Lobby	Communication	Third Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	3-Z1-010	Stair 06 Lobby	Communication	Third Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	3-Z1-011	Stair 07 Lobby	Communication	Third Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	4-BD-001	Lift 6 (Patient Bed Lift)	Communication	4th Floor	1		Grouped into G-BD-001	0
1	4-BD-002	Lift 7 (Patient Bed Lift)	Communication	4th Floor	1		Grouped into G-BD-002	0
1	4-BD-003	Lift 12 (Patient Bed Lift)	Communication	4th Floor	1		Grouped into G-BD-003	0
1	4-BD-004	Lift 13 (Patient Bed Lift)	Communication	4th Floor	1		Grouped into G-BD-004	0
1	4-COR-001A	Corridor	Communication	4th Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-COR-001B	Corridor	Communication	4th Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-COR-002	Corridor	Communication	4th Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-COR-003	Corridor	Communication	4th Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0

1	4-COR-004	Corridor	Communication	4th Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-COR-005	Corridor	Communication	4th Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-COR-006	Corridor	Communication	4th Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-COR-007	Corridor	Communication	4th Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-COR-008	Corridor	Communication	4th Floor	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-FM-002	Lift 4	Communication	4th Floor	1		Grouped into G-FM-002	0
1	4-FM-003	Lift 5	Communication	4th Floor	1		Grouped into G-FM-003	0
1	4-FM-004	Lift 10	Communication	4th Floor	1		Grouped into G-FM-004	0
1	4-FM-005	Lift 11	Communication	4th Floor	1		Grouped into G-FM-005	0
1	4-PA-003	Lift 15	Communication	4th Floor	1		Grouped into G-PA-003	0
1	4-PA-004	Lift 16	Communication	4th Floor	1		Grouped into G-PA-004	0
1	4-Z1-001	Stair 01	Communication	4th Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	4-Z1-002	Stair 02	Communication	4th Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	4-Z1-003	Stair 03	Communication	4th Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	4-Z1-004	Stair 04	Communication	4th Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	4-Z1-008	Stair 04 Lobby	Communication	4th Floor	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	B-BD-001	Lift 6 (Patient Bed Lift)	Communication	Basement	1		Grouped into G-BD-001	0
1	B-BD-002	Lift 7 (Patient Bed Lift)	Communication	Basement	1		Grouped into G-BD-002	0
1	B-COR-001	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-COR-002	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-COR-003	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-COR-004	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-COR-005	Corridor	Communication	Basement	1		Project Co Space	0

1	B-COR-006	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-COR-007	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-COR-008	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-COR-009	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-COR-010	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-COR-011	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-COR-012	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-COR-013	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-COR-014	Corridor	Communication	Basement	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-FM-001	Lift 3	Communication	Basement	1		Grouped into G-FM-001	0
1	B-FM-002	Lift 4	Communication	Basement	1		Grouped into G-FM-002	0
1	B-FM-003	Lift 5	Communication	Basement	1		Grouped into G-FM-003	0
1	B-FM-004	Lift 10	Communication	Basement	1		Grouped into G-FM-004	0
1	B-FM-005	Lift 11	Communication	Basement	1		Grouped into G-FM-005	0
1	B-PA-001	Lift 1	Communication	Basement	1		Grouped into G-PA-001	0
1	B-PA-002	Lift 2	Communication	Basement	1		Grouped into G-PA-002	0
1	B-PA-005	Lift 8	Communication	Basement	1		Grouped into G-PA-005	0
1	B-PA-006	Lift 9	Communication	Basement	1		Grouped into G-PA-006	0
1	B-Z1-002	Stair 02	Communication	Basement	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	B-Z1-003A	Stair 03	Communication	Basement	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	B-Z1-003B	Stair 03	Communication	Basement	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	G-BD-001	Lift 6 (Patient Bed Lift)	Communication	Ground Floor Layout	1			200
1	G-BD-002	Lift 7 (Patient Bed Lift)	Communication	Ground Floor Layout	1			200
1	G-BD-003	Lift 12 (Patient Bed Lift)	Communication	Ground Floor Layout	1			200

1	G-BD-004	Lift 13 (Patient Bed Lift)	Communication	Ground Floor Layout	1			200
1	G-BD-005	Lift 14 (Patient Bed Lift)	Communication	Ground Floor Layout	1			200
1	G-COR-001	Atrium	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-002	Corridor	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-003	Corridor	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-005	Corridor	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-006	Corridor	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-007	Corridor	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-008	Corridor	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-009	Corridor	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-010	Corridor	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-011	Corridor	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-012	Corridor	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-013	Corridor	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-016	Corridor	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-COR-017	Lift Lobby	Communication	Ground Floor Layout	1		Availability Standards not applied to Corridor. Deductions accrued based on any subsequent impact on rooms attached to corridor	0
1	G-FM-001	Lift 3	Communication	Ground Floor Layout	1			10
1	G-FM-002	Lift 4	Communication	Ground Floor Layout	1			10
1	G-FM-003	Lift 5	Communication	Ground Floor Layout	1			10
1	G-FM-004	Lift 10	Communication	Ground Floor Layout	1			10
1	G-FM-005	Lift 11	Communication	Ground Floor Layout	1			10
1	G-PA-001	Lift 1	Communication	Ground Floor Layout	1			10
1	G-PA-002	Lift 2	Communication	Ground Floor Layout	1			10

1	G-PA-003	Lift 15	Communication	Ground Floor Layout	1			10
1	G-PA-004	Lift 16	Communication	Ground Floor Layout	1			10
1	G-PA-005	Lift 8	Communication	Ground Floor Layout	1			10
1	G-PA-006	Lift 9	Communication	Ground Floor Layout	1			10
1	G-Z1-001	STAIR 01	Communication	Ground Floor Layout	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	G-Z1-002	Stair 02	Communication	Ground Floor Layout	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	G-Z1-003	Stair 03	Communication	Ground Floor Layout	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	G-Z1-004	STAIR 04	Communication	Ground Floor Layout	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	G-Z1-005	STAIR 05	Communication	Ground Floor Layout	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	G-Z1-006	STAIR 06	Communication	Ground Floor Layout	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	G-Z1-007	STAIR 07	Communication	Ground Floor Layout	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	G-Z1-008	STAIR 08	Communication	Ground Floor Layout	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	G-Z1-009	Stair 05 Lobby	Communication	Ground Floor Layout	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	G-Z1-010	Stair 06 Lobby	Communication	Ground Floor Layout	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	G-Z1-011	Stair 07 Lobby	Communication	Ground Floor Layout	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	1-D1-001	DSR	D1	D1 Outpatients	1			16
1	1-D1-002	Consulting Room 1	D1	D1 Outpatients	1			0.8
1	1-D1-003	Treatment Room 4	D1	D1 Outpatients	1			10
1	1-D1-004	Linen Bay (1 trolley)	D1	D1 Outpatients	1		Not measurable against availability standards	0
1	1-D1-005	Consulting Room 2	D1	D1 Outpatients	1			0.8
1	1-D1-007	Corridor	D1	D1 Outpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-D1-008	Treatment Room 5	D1	D1 Outpatients	1			10
1	1-D1-009	Resuscitation Trolley Bay	D1	D1 Outpatients	1			0.1
1	1-D1-010	Dirty Utility	D1	D1 Outpatients	1			21
1	1-D1-011	WC - Wheelchair accessible	D1	D1 Outpatients	1			0.8
1	1-D1-012	Shower Room	D1	D1 Outpatients	1			0.8
1	1-D1-013	Clean Utility	D1	D1 Outpatients	1			50
1	1-D1-014	Consulting Room 3	D1	D1 Outpatients	1			0.8

1	1-D1-015	Play Room	D1	D1 Outpatients	1			10
1	1-D1-016	Consulting Room 6	D1	D1 Outpatients	1			0.8
1	1-D1-017	Consulting Room 7	D1	D1 Outpatients	1			0.8
1	1-D1-018	Consulting Room 14	D1	D1 Outpatients	1			0.8
1	1-D1-019	Consulting Room 12	D1	D1 Outpatients	1			0.8
1	1-D1-020	Consulting Room 8	D1	D1 Outpatients	1			0.8
1	1-D1-021	Consulting Room 9	D1	D1 Outpatients	1			0.8
1	1-D1-022	Consulting Room 11	D1	D1 Outpatients	1			0.8
1	1-D1-023	Consulting Room 10	D1	D1 Outpatients	1			0.8
1	1-D1-025	Physical Measurement	D1	D1 Outpatients	1			0.8
1	1-D1-026	Infant Measuring Room	D1	D1 Outpatients	1			0.8
1	1-D1-027	Sub Waiting Area (incl supervised play) with Nurse Base	D1	D1 Outpatients	1			0.8
1	1-D1-029	Baby Infant / Feeding Room	D1	D1 Outpatients	1			0.8
1	1-D1-030	Nappy Change	D1	D1 Outpatients	1			0.8
1	1-D1-031	Equipment / General Store	D1	D1 Outpatients	1			0.2
1	1-D1-032	WC - Wheelchair accessible	D1	D1 Outpatients	1			0.8
1	1-D1-033	Phlebotomy Room	D1	D1 Outpatients	1			0.8
1	1-D1-034	Hoist Bay	D1	D1 Outpatients	1			0.1
1	1-D1-035	Disposal Hold	D1	D1 Outpatients	1			0.8
1	1-D1-036	Physical Measurement	D1	D1 Outpatients	1			0.8
1	1-D1-037	Reception (1 person)	D1	D1 Outpatients	1			0.8
1	1-D1-038	WC - Staff	D1	D1 Outpatients	1			0.6
1	1-D1-039	Switch Cupboard	D1	D1 Outpatients	1		Project Co Space	0
1	1-D1-049	Manifold	D1	D1 Outpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-D1-001	Nappy Change	D1	D1 Outpatients	1			0.8
1	G-D1-002	Baby Infant / Feeding Room	D1	D1 Outpatients	1			0.8
1	G-D1-003	WC - Wheelchair accessible	D1	D1 Outpatients	1			0.8
1	G-D1-004	WC - Staff	D1	D1 Outpatients	1			0.6
1	G-D1-005	Store Room	D1	D1 Outpatients	1			0.1
1	G-D1-006	Disposal Hold	D1	D1 Outpatients	1			0.8
1	G-D1-007	DSR	D1	D1 Outpatients	1			16
1	G-D1-008	Plaster Suite (3 bays)	D1	D1 Outpatients	1			10
1	G-D1-009	Store: Plaster	D1	D1 Outpatients	1			0.1
1	G-D1-010	Orthotics Workshop	D1	D1 Outpatients	1			21
1	G-D1-011	Consulting Room 12	D1	D1 Outpatients	1			0.8
1	G-D1-012	Consulting Room 11	D1	D1 Outpatients	1			0.8
1	G-D1-013	Consulting Room 10	D1	D1 Outpatients	1			0.8
1	G-D1-014	Consulting Room 9	D1	D1 Outpatients	1			0.8
1	G-D1-015	Physical Measurement	D1	D1 Outpatients	1			0.8
1	G-D1-016	Acorn Room 1	D1	D1 Outpatients	1			16
1	G-D1-017A	Corridor	D1	D1 Outpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0

1	G-D1-017B	Corridor	D1	D1 Outpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-D1-019	Equipment / General Store	D1	D1 Outpatients	1			0.2
1	G-D1-020	Phlebotomy Room	D1	D1 Outpatients	1			0.8
1	G-D1-021	Acorn Room 2	D1	D1 Outpatients	1			16
1	G-D1-022	Hoist Bay	D1	D1 Outpatients	1			0.1
1	G-D1-023	Dirty Utility	D1	D1 Outpatients	1			21
1	G-D1-024	Beverage Bay	D1	D1 Outpatients	1			0.4
1	G-D1-025	Physical Measurement	D1	D1 Outpatients	1			0.8
1	G-D1-026	WC & handwash: specimen; wheelchair	D1	D1 Outpatients	1			0.8
1	G-D1-027	Resuscitation Trolley Bay	D1	D1 Outpatients	1			0.1
1	G-D1-028	Infant Measuring Room	D1	D1 Outpatients	1			0.8
1	G-D1-029	WC - Staff	D1	D1 Outpatients	1			0.6
1	G-D1-030	Linen Bay (1 trolley)	D1	D1 Outpatients	1		Not measurable against availability standards	0
1	G-D1-031	Clean Utility	D1	D1 Outpatients	1			50
1	G-D1-032	Consulting Room 1	D1	D1 Outpatients	1			0.8
1	G-D1-033	Treatment Room 8	D1	D1 Outpatients	1			10
1	G-D1-034	Consulting Room 2	D1	D1 Outpatients	1			0.8
1	G-D1-035	Consulting Room 3	D1	D1 Outpatients	1			0.8
1	G-D1-036	Consulting Room 4	D1	D1 Outpatients	1			0.8
1	G-D1-037	Meeting Room	D1	D1 Outpatients	1			0.4
1	G-D1-038	Consulting Room 5	D1	D1 Outpatients	1			0.8
1	G-D1-039	Consulting Room 6	D1	D1 Outpatients	1			0.8
1	G-D1-040	Consulting Room 7	D1	D1 Outpatients	1			0.8
1	G-D1-041	Senior Charge Nurse Office	D1	D1 Outpatients	1			0.4
1	G-D1-042	Acorn Room 2 - Ensuite	D1	D1 Outpatients	1			0.8
1	G-D1-043	Corridor	D1	D1 Outpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-D1-044	Switch Cupboard	D1	D1 Outpatients	1		Project Co Space	0
1	G-D10-001	Staff Room	D10	D10 Support	1			0.4
1	G-D2-001	Waiting Area	D2	D2 Cardiology	1			0.8
1	G-D2-002A	Corridor	D2	D2 Cardiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-D2-002B	Corridor	D2	D2 Cardiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-D2-003	Cardiology Admin Office (2 person)	D2	D2 Cardiology	1			0.4
1	G-D2-004	WC - Staff	D2	D2 Cardiology	1			0.6
1	G-D2-005	CardioPulmonary Exercise Lab	D2	D2 Cardiology	1			21
1	G-D2-006	Echocardiograph Lab	D2	D2 Cardiology	1			21
1	G-D2-007	DSR	D2	D2 Cardiology	1			16
1	G-D2-008	Store/ Equipment	D2	D2 Cardiology	1			0.1
1	G-D2-009	ECG Procedure Room	D2	D2 Cardiology	1			21
1	G-D2-010	Respiratory Admin Office (3 person)	D2	D2 Cardiology	1			0.4

1	G-D2-012	pH/Impedance Lab	D2	D2 Cardiology	1			21
1	G-D2-013	Pulmonary Function Lab	D2	D2 Cardiology	1			21
1	G-D2-014	Cardiac Stress Lab	D2	D2 Cardiology	1			21
1	G-D2-015	Physical Measurement	D2	D2 Cardiology	1			0.8
1	1-D3-001	Staff Office (2 person)	D3	D3 Orthoptics	1			0.4
1	1-D3-002	Parking bay:pushchairs/prams	D3	D3 Orthoptics	1		Not measurable against availability standards	0
1	1-D3-003	WC & handwash: specimen; wheelchair	D3	D3 Orthoptics	1			0.8
1	1-D3-004	DSR	D3	D3 Orthoptics	1			16
1	1-D3-005	Examination Room: Fields test	D3	D3 Orthoptics	1			0.8
1	1-D3-006	C/E Orthoptic (6 metre room)	D3	D3 Orthoptics	1			0.8
1	1-D3-007	C/E Orthoptic (6 metre room)	D3	D3 Orthoptics	1			0.8
1	1-D3-008	C/E Orthoptic (6 metre room)	D3	D3 Orthoptics	1			0.8
1	1-D3-009	C/E Orthoptic (6 metre room)	D3	D3 Orthoptics	1			0.8
1	1-D4-001	Waiting Area	D4	D4 Audiology	1			0.8
1	1-D4-002	ABR Room	D4	D4 Audiology	1			0.8
1	1-D4-003	Test Room	D4	D4 Audiology	1			0.8
1	1-D4-004	Staff Office (8 person)	D4	D4 Audiology	1			0.4
1	1-D4-005	Consulting Room 2	D4	D4 Audiology	1			0.8
1	1-D4-006	Control Room 1	D4	D4 Audiology	1			0.8
1	1-D4-007	Consulting Room 1	D4	D4 Audiology	1			0.8
1	1-D4-008	Control Room 2	D4	D4 Audiology	1			0.8
1	1-D4-009	Waiting Area	D4	D4 Audiology	1			0.8
1	1-D4-010	Work Room	D4	D4 Audiology	1			0.8
1	1-D4-011A	Corridor	D4	D4 Audiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-D4-011B	Corridor	D4	D4 Audiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-D4-012	Store	D4	D4 Audiology	1			0.1
1	1-D4-013	Mould Room	D4	D4 Audiology	1			0.8
1	G-D5-001	Corridor	D5	D5 Dentistry	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-D5-002	Dental Lab	D5	D5 Dentistry	1			21
1	G-D5-003	Clean Utility / Dental Store	D5	D5 Dentistry	1			50
1	G-D5-004	Surgery 1	D5	D5 Dentistry	1			0.8
1	G-D5-005	Dirty Utility	D5	D5 Dentistry	1			21
1	G-D5-006	Mobile Inter-oral Storage	D5	D5 Dentistry	1			0.2
1	G-D5-007	Recovery	D5	D5 Dentistry	1			10
1	G-D5-008	Surgery 4	D5	D5 Dentistry	1			0.8
1	G-D5-009	Surgery 3	D5	D5 Dentistry	1			0.8
1	G-D5-010	Surgery 2	D5	D5 Dentistry	1			0.8
1	G-D5-011	Corridor	D5	D5 Dentistry	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-D6-001	Dictation/ 1:1/Phone Booth	D6	D6 Therapies	1			0.2

1	1-D6-002	Staff Office - All specialities (39 person)	D6	D6 Therapies	1			0.4
1	1-D6-003	Meeting Room - 6 person	D6	D6 Therapies	1			0.4
1	1-D6-004	Dictation/ 1:1/Phone Booth	D6	D6 Therapies	1			0.2
1	1-D6-005	Meeting Room - 4 person	D6	D6 Therapies	1			0.4
1	1-D6-006	WC - Staff	D6	D6 Therapies	1			0.6
1	1-D6-007	WC - Staff	D6	D6 Therapies	1			0.6
1	1-D6-009	Dictation/ 1:1/Phone Booth	D6	D6 Therapies	1			0.2
1	1-D6-010	Dictation/ 1:1/Phone Booth	D6	D6 Therapies	1			0.2
1	1-D6-014	Store - Physio	D6	D6 Therapies	1			0.2
1	1-D6-016	Management Office (4 person + pod)	D6	D6 Therapies	1			0.4
1	1-D6-017	A&C Staff Office/Appliance Officer (9 person)	D6	D6 Therapies	1			0.4
1	1-D6-018	DSR	D6	D6 Therapies	1			16
1	1-D6-019	Equipment Decontamination	D6	D6 Therapies	1			0.8
1	1-D6-020	Clinic Room 1	D6	D6 Therapies	1			0.8
1	1-D6-021	Clinic Room 2	D6	D6 Therapies	1			0.8
1	1-D6-022	Waiting / Play Area	D6	D6 Therapies	1			0.8
1	1-D6-023	Reception (2 person)	D6	D6 Therapies	1			0.8
1	1-D6-024	WC - Wheelchair accessible	D6	D6 Therapies	1			0.8
1	1-D6-025	Infant Measuring Room	D6	D6 Therapies	1			0.8
1	1-D6-026	Linen Bay (1 trolley)	D6	D6 Therapies	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-D6-027	Treatment Room 3	D6	D6 Therapies	1			0.8
1	1-D6-028	Treatment Room 4	D6	D6 Therapies	1			0.8
1	1-D6-029	Treatment Room 5	D6	D6 Therapies	1			0.8
1	1-D6-030	Treatment Room 6	D6	D6 Therapies	1			0.8
1	1-D6-031	Store - Dietetic	D6	D6 Therapies	1			0.2
1	1-D6-032	Treatment Room 16	D6	D6 Therapies	1			0.8
1	1-D6-034	Corridor	D6	D6 Therapies	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-D6-035	Treatment Room 7	D6	D6 Therapies	1			0.8
1	1-D6-036	Treatment Room 15	D6	D6 Therapies	1			0.8
1	1-D6-037	Store - Physio	D6	D6 Therapies	1			0.2
1	1-D6-038	Store - OT	D6	D6 Therapies	1			0.2
1	1-D6-039	Rehabilitation Room 9	D6	D6 Therapies	1			0.8
1	1-D6-040	Splinting/Casting Room 14	D6	D6 Therapies	1			10
1	1-D6-041	Store - OT	D6	D6 Therapies	1			0.2
1	1-D6-042	Pantry	D6	D6 Therapies	1			0.4
1	1-D6-043	Store - Physio	D6	D6 Therapies	1			0.2
1	1-D6-044	WC - Staff	D6	D6 Therapies	1			0.6
1	1-D6-046	Rehabilitation Room 10	D6	D6 Therapies	1			0.8
1	1-D6-047	Store - OT	D6	D6 Therapies	1			0.2
1	1-D6-048	Rehabilitation Room 8	D6	D6 Therapies	1			0.8
1	1-D6-049	Changing Cubicle	D6	D6 Therapies	1			0.8
1	1-D6-050	Store - Physio	D6	D6 Therapies	1			0.2

1	1-D6-052	Store - Physio	D6	D6 Therapies	1			0.2
1	1-D6-053	Rehabilitation Room 12	D6	D6 Therapies	1			0.8
1	1-D6-054	Rehabilitation Room 11	D6	D6 Therapies	1			0.8
1	1-D6-055	Corridor	D6	D6 Therapies	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-D6-056	Corridor	D6	D6 Therapies	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-D6-057	WC - Assisted (large+changing)	D6	D6 Therapies	1			0.8
1	1-D6-058	Riser/Switch Cupboard	D6	D6 Therapies	1		Project Co Space	0
1	1-D6-059	Riser/Switch Cupboard	D6	D6 Therapies	1		Project Co Space	0
1	1-D6-060	Resus Bay	D6	D6 Therapies	1		Not measurable against availability standards	0
1	1-D6-061	Hoist Bay	D6	D6 Therapies	1		Not measurable against availability standards	0
1	1-D6-062	Corridor	D6	D6 Therapies	1		Not measurable against availability standards	0
1	1-D7-001	Patients' Assisted Bathroom	D7	D7 Plastics	1			10
1	1-D7-002	Dressings / Doppler Store	D7	D7 Plastics	1			0.2
1	1-D7-003	Clinic Room 1	D7	D7 Plastics	1			10
1	1-D7-004	Dirty Utility	D7	D7 Plastics	1			10
1	1-D7-005	1:1	D7	D7 Plastics	1			0.4
1	1-D7-006	Clinic Room 2	D7	D7 Plastics	1			10
1	1-D7-007	Disposal Hold	D7	D7 Plastics	1			0.9
1	1-D7-008	Corridor	D7	D7 Plastics	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-D8-001	Social Work Office	D8	D8 Social Work	1			0.4
1	G-D8-002	Interview Room	D8	D8 Social Work	1			0.6
1	G-D8-003	Corridor	D8	D8 Social Work	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-D8-005	Switch Cupboard	D8	D8 Social Work	1		Project Co Space	0
1	3-D9-001	Corridor	D9	D9 Medical Day Care	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-D9-002	Waiting Area	D9	D9 Medical Day Care	1			0.8
1	3-D9-003	Reception (1 person)	D9	D9 Medical Day Care	1			0.6
1	3-D9-004	WC - Wheelchair accessible	D9	D9 Medical Day Care	1			0.8
1	3-D9-005	Disposal Hold	D9	D9 Medical Day Care	1			0.9
1	3-D9-006	Interview, Counselling & Quiet Room	D9	D9 Medical Day Care	1			0.8
1	3-D9-007	Office and Storage 2 staff	D9	D9 Medical Day Care	1			0.4
1	3-D9-008	Resuscitation Trolley Bay	D9	D9 Medical Day Care	1			0.1
1	3-D9-009	Physical Measurement	D9	D9 Medical Day Care	1			0.8
1	3-D9-010	Waiting Play Area	D9	D9 Medical Day Care	1			0.8
1	3-D9-011	Consulting Room	D9	D9 Medical Day Care	1			21
1	3-D9-012	Clean Utility	D9	D9 Medical Day Care	1			50
1	3-D9-013	Treatment Room	D9	D9 Medical Day Care	1			21
1	3-D9-014	Pantry	D9	D9 Medical Day Care	1			0.8
1	3-D9-015	Senior Charge Nurse Office	D9	D9 Medical Day Care	1			0.4
1	3-D9-016	Bay 2	D9	D9 Medical Day Care	1			21

1	3-D9-017	Dirty Utility	D9	D9 Medical Day Care	1			21
1	3-D9-018	Touchdown Base 1	D9	D9 Medical Day Care	1			21
1	3-D9-019	Single Room 1	D9	D9 Medical Day Care	1		Grouped with 3-D9-020	35
1	3-D9-020	Room 1 - Ensuite	D9	D9 Medical Day Care	1		Grouped with 3-D9-019	0
1	3-D9-021	Parking Bay: 1 patient trolley/whch	D9	D9 Medical Day Care	1		Not measurable against availability standards	0
1	3-D9-022	Bay 1 (beds 3-5)	D9	D9 Medical Day Care	1		Grouped with 3-D9-023	35
1	3-D9-023	Bay 1 - Ensuite	D9	D9 Medical Day Care	1		Grouped with 3-D9-022	0
1	3-D9-024	Single Room 2	D9	D9 Medical Day Care	1		Grouped with 3-D9-025	35
1	3-D9-025	Room 2 - Ensuite	D9	D9 Medical Day Care	1		Grouped with 3-D9-024	0
1	3-D9-026	Linen Bay (1 trolley)	D9	D9 Medical Day Care	1		Not measurable against availability standards	0
1	3-D9-027	Store - General	D9	D9 Medical Day Care	1			0.1
1	3-D9-028	WC - Staff	D9	D9 Medical Day Care	1			0.6
1	3-D9-029	Corridor	D9	D9 Medical Day Care	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-D9-030	DSR	D9	D9 Medical Day Care	1			16
1	3-D9-031	Switch Cupboard	D9	D9 Medical Day Care	1		Project Co Space	0
1	G-E1-001	Multi-Functional Activity Zone	E1	E1 POD	1			0.8
1	G-E1-002	Reception (2 person)	E1	E1 POD	1			0.8
1	G-E1-003	Pod Support Base	E1	E1 POD	1			0.8
1	G-E1-004	WC - Wheelchair accessible	E1	E1 POD	1			0.8
1	G-E1-005	WC - Wheelchair accessible	E1	E1 POD	1			0.8
1	G-E1-006	WC - Fully accessible changing room	E1	E1 POD	1			0.8
1	G-E1-007	WC - Wheelchair accessible	E1	E1 POD	1			0.8
1	G-E1-008	DSR	E1	E1 POD	1			16
1	G-E1-009	WC - Ambulant	E1	E1 POD	1			0.8
1	G-E1-010	WC - Wheelchair accessible	E1	E1 POD	1			0.8
1	G-E1-012	Switch Cupboard	E1	E1 POD	0		Project Co Space	0
1	G-E1-012A	Switch Cupboard	E1	E1 POD	1		Project Co Space	0
1	G-E1-012B	Manifold	E1	E1 POD	1		Project Co Space	0
1	1-CT-010	Emergency Department Green Roof	External Spaces	External Spaces	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-CT-011	Courtyard Terrace	External Spaces	External Spaces	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-CT-012	DCN Courtyard	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	2-CT-013	Street Courtyard 1	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	2-CT-014	Critical Care Green Roof	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	2-CT-015A	DCN Balcony	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	2-CT-015B	DCN Therapies Balcony	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	2-CT-016	DCN Therapies Terrace	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	3-CT-017	Neurosciences Terrace	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0

1	3-CT-018	Haemotology / Oncology Terrace	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	3-CT-019	Long Stay Surgical Terrace	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	3-CT-020	MDCU Terrace	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	4-CT-021	Restaurant Terrace	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	4-CT-022	Management Suite Terrace	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	4-CT-023	Classroom Terrace	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	4-CT-024	Child Life & Health Terrace	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	G-CT-001	CAHMS Secure Garden	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	G-CT-002	CAHMS Courtyard A	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	G-CT-003	CAHMS Courtyard B	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	G-CT-004	PARU Garden	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	G-CT-005	Spiritual Courtyard	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	G-CT-006	Staff Courtyard	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	G-CT-007	Emergency Dept External Play Area	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	G-CT-008	Bereavement Garden	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	G-CT-009	Drop-In Centre Garden and OPD Play	External Spaces	External Spaces	1		External Spaces excluded from Availability Deductions	0
1	G-F1-001	Corridor	F1	F1 CAMHS	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-F1-002	Consultant Psychiatrist / Psychologist Office (5 person)	F1	F1 CAMHS	1			0.4
1	G-F1-003	Storage (testing)	F1	F1 CAMHS	1			0.2
1	G-F1-004	Senior Charge Nurse Office	F1	F1 CAMHS	1			0.4
1	G-F1-005	Meeting Room 3	F1	F1 CAMHS	1			21
1	G-F1-006	Reception (2 person)	F1	F1 CAMHS	1			0.8
1	G-F1-007	Meeting Room 4	F1	F1 CAMHS	1			21
1	G-F1-008	Meeting Room 1	F1	F1 CAMHS	1			21
1	G-F1-009	Meeting Room 2	F1	F1 CAMHS	1			21
1	G-F1-010	Dictation/ 1:1/Phone Booth	F1	F1 CAMHS	1			0.2
1	G-F1-011	Waiting Area 2	F1	F1 CAMHS	1			0.8
1	G-F1-013	Storage / Photocopy	F1	F1 CAMHS	1			0.4
1	G-F1-014	Secretary/Filing Office (3 person)	F1	F1 CAMHS	1			0.4
1	G-F1-015	Corridor	F1	F1 CAMHS	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-F1-016	Multi-Disciplinary Office (7 person)	F1	F1 CAMHS	1			0.4
1	G-F1-017	Shower / WC / WHB assisted	F1	F1 CAMHS	1			0.8
1	G-F1-018	WC - Wheelchair accessible	F1	F1 CAMHS	1			0.8
1	G-F1-019	Play Room	F1	F1 CAMHS	1			21
1	G-F1-020	Group Room 4	F1	F1 CAMHS	1			21

1	G-F1-021	Screening Room	F1	F1 CAMHS	1			21
1	G-F1-022	Calm Down Zone	F1	F1 CAMHS	1			21
1	G-F1-023	Meeting Room 5	F1	F1 CAMHS	1			21
1	G-F1-024	Group Room 3	F1	F1 CAMHS	1			21
1	G-F1-025	Corridor	F1	F1 CAMHS	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-F1-026	Meeting Room 6	F1	F1 CAMHS	1			21
1	G-F1-027	Sitting Room	F1	F1 CAMHS	1			0.8
1	G-F1-028	EPSS Multi-Disciplinary Office (6 person)	F1	F1 CAMHS	1			0.4
1	G-F1-029	Corridor	F1	F1 CAMHS	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-F1-030	Tipperlinn Multi-Disciplinary Office (7 person)	F1	F1 CAMHS	1			0.4
1	G-F1-031	Tipperlinn Sitting Room	F1	F1 CAMHS	1			0.8
1	G-F1-032	Group Room 2	F1	F1 CAMHS	1			21
1	G-F1-033	Art Room	F1	F1 CAMHS	1			21
1	G-F1-034	Therapy / Play Therapy Room	F1	F1 CAMHS	1			21
1	G-F1-035	Corridor	F1	F1 CAMHS	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-F1-036	Dining Room (Inpatients & Day Prog)	F1	F1 CAMHS	1			21
1	G-F1-037	Therapy Kitchen	F1	F1 CAMHS	1			10
1	G-F1-038	WC - Wheelchair accessible	F1	F1 CAMHS	1			0.8
1	G-F1-039	Ward Kitchen	F1	F1 CAMHS	1			21
1	G-F1-040	WC - Wheelchair accessible	F1	F1 CAMHS	1			0.8
1	G-F1-041	Waiting Area 1	F1	F1 CAMHS	1			0.8
1	G-F1-042	DSR	F1	F1 CAMHS	1			16
1	G-F1-043	WC - Staff	F1	F1 CAMHS	1			0.6
1	G-F1-044	Dictation/ 1:1/Phone Booth	F1	F1 CAMHS	1			0.2
1	G-F1-045	Multi-Disciplinary Office - ITS (6 person)	F1	F1 CAMHS	1			0.4
1	G-F1-046	Corridor	F1	F1 CAMHS	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-F1-047	Recreation Room	F1	F1 CAMHS	1			21
1	G-F1-048	Group Room 1	F1	F1 CAMHS	1			21
1	G-F1-049	Dictation/ 1:1/Phone Booth	F1	F1 CAMHS	1			0.2
1	G-F1-050	Small Treatment Room	F1	F1 CAMHS	1			0.7
1	G-F1-051	Treatment Room	F1	F1 CAMHS	1			21
1	G-F1-052	Treatment Room Store	F1	F1 CAMHS	1			0.8
1	G-F1-053	Multi-Disciplinary Office - Inpatients (7 person)	F1	F1 CAMHS	1			0.4
1	G-F1-054	Laundry Room	F1	F1 CAMHS	1			0.4
1	G-F1-055	Corridor	F1	F1 CAMHS	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-F1-056	Open Space	F1	F1 CAMHS	1			21
1	G-F1-057	Pantry	F1	F1 CAMHS	1			21

1	G-F1-058	WC - Staff	F1	F1 CAMHS	1			0.6
1	G-F1-059	Dirty Utility	F1	F1 CAMHS	1			21
1	G-F1-060	Corridor	F1	F1 CAMHS	1			0.8
1	G-F1-061	Disposal Hold	F1	F1 CAMHS	1			0.9
1	G-F1-062	Staff Base	F1	F1 CAMHS	1			21
1	G-F1-065	Quiet Room	F1	F1 CAMHS	1			21
1	G-F1-066	Corridor	F1	F1 CAMHS	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-F1-067	Bedroom 1	F1	F1 CAMHS	1		Grouped with G-F1-068	35
1	G-F1-068	Room 1 - Ensuite	F1	F1 CAMHS	1		Grouped with G-F1-067	0
1	G-F1-069	Bedroom 8	F1	F1 CAMHS	1		Grouped with G-F1-070	35
1	G-F1-070	Room 8 - Ensuite	F1	F1 CAMHS	1		Grouped with G-F1-069	0
1	G-F1-071	Bedroom 11	F1	F1 CAMHS	1		Grouped with G-F1-072	35
1	G-F1-072	Room 11 - Ensuite	F1	F1 CAMHS	1		Grouped with G-F1-071	0
1	G-F1-073	Bedroom 10	F1	F1 CAMHS	1		Grouped with G-F1-074	35
1	G-F1-074	Room 10 - Ensuite	F1	F1 CAMHS	1		Grouped with G-F1-073	0
1	G-F1-075	Bedroom 9	F1	F1 CAMHS	1		Grouped with G-F1-076	35
1	G-F1-076	Room 9 - Ensuite	F1	F1 CAMHS	1		Grouped with G-F1-075	0
1	G-F1-077	Bedroom 2	F1	F1 CAMHS	1		Grouped with G-F1-078	35
1	G-F1-078	Room 2 - Ensuite	F1	F1 CAMHS	1		Grouped with G-F1-077	0
1	G-F1-079	Bedroom 3	F1	F1 CAMHS	1		Grouped with G-F1-080	35
1	G-F1-080	Room 3 - Ensuite	F1	F1 CAMHS	1		Grouped with G-F1-079	0
1	G-F1-081	Bedroom 4	F1	F1 CAMHS	1		Grouped with G-F1-082	35
1	G-F1-082	Room 4 - Ensuite	F1	F1 CAMHS	1		Grouped with G-F1-081	0
1	G-F1-083	Bedroom 5	F1	F1 CAMHS	1		Grouped with G-F1-084	35
1	G-F1-084	Room 5 - Ensuite	F1	F1 CAMHS	1		Grouped with G-F1-083	0
1	G-F1-085	Bedroom 12	F1	F1 CAMHS	1		Grouped with G-F1-086	35
1	G-F1-086	Room 12 - Ensuite	F1	F1 CAMHS	1		Grouped with G-F1-085	0
1	G-F1-087	Bedroom 6	F1	F1 CAMHS	1		Grouped with G-F1-088	35
1	G-F1-088	Room 6 - Ensuite	F1	F1 CAMHS	1		Grouped with G-F1-087	0
1	G-F1-089	Linen Bay (1 trolley)	F1	F1 CAMHS	1		Not measurable against availability standards	0
1	G-F1-090	Bedroom 7	F1	F1 CAMHS	1		Grouped with G-F1-091	35
1	G-F1-091	Room 7 - Ensuite	F1	F1 CAMHS	1		Grouped with G-F1-090	0
1	G-F1-092	Quiet Room	F1	F1 CAMHS	1			21
1	G-F1-093	Corridor	F1	F1 CAMHS	1			0
1	G-F1-094	Switch Cupboard	F1	F1 CAMHS	1		Project Co Space	0
1	G-F1-095	Switch Cupboard	F1	F1 CAMHS	1		Project Co Space	0
1	G-F1-096	Store	F1	F1 CAMHS	1			0.1
1	G-F1-097	Corridor	F1	F1 CAMHS	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-F1-098	Corridor	F1	F1 CAMHS	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-F1-100	Lobby	F1	F1 CAMHS	1			0.8
1	G-F1-101	Intensive Nursing Room	F1	F1 CAMHS	1			100
1	G-F1-102	E-S Duct 1	F1	F1 CAMHS	1		Project Co Space	0

1	G-F1-103	E-S Duct 2	F1	F1 CAMHS	1		Project Co Space	0
1	G-F1-104	E-S Duct 3	F1	F1 CAMHS	1		Project Co Space	0
1	G-F1-105	E-S Duct 4	F1	F1 CAMHS	1		Project Co Space	0
1	G-F1-106	E-S Duct 5	F1	F1 CAMHS	1		Project Co Space	0
1	G-F1-107	E-S Duct 6	F1	F1 CAMHS	1		Project Co Space	0
1	G-F1-108	E-S Duct 7	F1	F1 CAMHS	1		Project Co Space	0
1	G-F1-109	E-S Duct 8	F1	F1 CAMHS	1		Project Co Space	0
1	2-G2-001	Corridor	G2	G2 Equip Library	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-G2-002	DSR	G2	G2 Equip Library	1			16
1	2-G2-003	Clean Equipment	G2	G2 Equip Library	1			10
1	2-G2-004	Dirty Equipment	G2	G2 Equip Library	1			10
1	2-G2-005	Disposal Hold	G2	G2 Equip Library	1			0.9
1	1-G3-001	Corridor	G3	G3 On-Call	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-G3-002	On-Call Bedroom 1	G3	G3 On-Call	1		Grouped with 1-G3-003	0.7
1	1-G3-003	En-suite Shower / WC / WHB Bedroom 1	G3	G3 On-Call	1		Grouped with 1-G3-002	0
1	1-G3-004	On-Call Bedroom 2	G3	G3 On-Call	1		Grouped with 1-G3-005	0.7
1	1-G3-005	En-suite Shower / WC / WHB Bedroom 2	G3	G3 On-Call	1		Grouped with 1-G3-004	0
1	1-G3-006	On-Call Bedroom 3	G3	G3 On-Call	1		Grouped with 1-G3-007	0.7
1	1-G3-007	En-suite Shower / WC / WHB Bedroom 3	G3	G3 On-Call	1		Grouped with 1-G3-006	0
1	1-G3-008	Mini Kitchen	G3	G3 On-Call	1			21
1	1-G3-009	DSR	G3	G3 On-Call	1			16
1	4-H1-001	Corridor	H1	H1 Child Life	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-H1-002	Conference / Meeting Room	H1	H1 Child Life	1			0.6
1	4-H1-003	Seminar / Tutorial Room	H1	H1 Child Life	1			0.6
1	4-H1-004	Seminar / Tutorial Room	H1	H1 Child Life	1			0.6
1	4-H1-005	WC - Wheelchair accessible	H1	H1 Child Life	1			0.8
1	4-H1-006	Disposal Hold	H1	H1 Child Life	1			0.9
1	4-H1-007	Waiting Area	H1	H1 Child Life	1			0.8
1	4-H1-008	Lockers	H1	H1 Child Life	1			0.4
1	4-H1-009	WC - Ambulant	H1	H1 Child Life	1			0.8
1	4-H1-010	WC - Ambulant	H1	H1 Child Life	1			0.8
1	4-H1-011	DSR	H1	H1 Child Life	1			16
1	4-H1-012	Staff Office (16 person)	H1	H1 Child Life	1			0.4
1	4-H1-013	Admin Office	H1	H1 Child Life	1			0.4
1	4-H1-014	Beverage Bay	H1	H1 Child Life	1			0.4
1	4-H1-015	Stationery / Photocopying	H1	H1 Child Life	1			0.4
1	4-H1-016	Tissue Culture Store	H1	H1 Child Life	1			21
1	4-H1-017	Meeting Room - 4 person	H1	H1 Child Life	1			0.4
1	4-H1-018	Molecular Biology Laboratory	H1	H1 Child Life	1			50
1	4-H1-019	WC - Ambulant	H1	H1 Child Life	1			0.8

1	4-H1-020	WC - Ambulant	H1	H1 Child Life	1			0.8
1	4-H1-021	Student Records Store	H1	H1 Child Life	1			0.1
1	4-H1-022	Laboratory / Finance Manager's Office	H1	H1 Child Life	1			0.4
1	4-H1-023	Corridor	H1	H1 Child Life	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-H1-024	Senior Academic Staff Office 6	H1	H1 Child Life	1			0.4
1	4-H1-025	Senior Academic Staff Office 5	H1	H1 Child Life	1			0.4
1	4-H1-026	Freezer Store	H1	H1 Child Life	1			21
1	4-H1-027	Physiological Laboratory	H1	H1 Child Life	1			21
1	4-H1-028	Senior Academic Staff Office 4	H1	H1 Child Life	1			0.4
1	4-H1-029	Head of Department Office	H1	H1 Child Life	1			0.4
1	4-H1-030	Senior Academic Staff Office 3	H1	H1 Child Life	1			0.4
1	4-H1-031	Senior Academic Staff Office 2	H1	H1 Child Life	1			0.4
1	4-H1-032	Senior Academic Staff Office 1	H1	H1 Child Life	1			0.4
1	4-H1-033	WC - Wheelchair accessible	H1	H1 Child Life	1			0.8
1	4-H1-034	Switch Cupboard	H1	H1 Child Life	1		Project Co Space	0
1	4-H1-035	Stationery / Photocoping	H1	H1 Child Life	1			0.1
1	4-H1-036	Gas Store	H1	H1 Child Life	1			0.8
1	1-H2-001	Disposal Hold	H2	H2 Clinical Research	1			0.6
1	1-H2-002	Waiting Play Area	H2	H2 Clinical Research	1			0.8
1	1-H2-004	Reception (1 person)	H2	H2 Clinical Research	1			0.6
1	1-H2-005	WC - Wheelchair accessible (Patient)	H2	H2 Clinical Research	1			0.8
1	1-H2-006	DSR	H2	H2 Clinical Research	1			16
1	1-H2-007	Office - 4 person	H2	H2 Clinical Research	1			0.4
1	1-H2-008	Linen Bay (1 trolley)	H2	H2 Clinical Research	1		Not measurable against availability standards	0
1	1-H2-009	Consulting Room 2	H2	H2 Clinical Research	1			0.8
1	1-H2-010	Consulting Room 1	H2	H2 Clinical Research	1			0.8
1	1-H2-011	WC - Staff	H2	H2 Clinical Research	1			0.6
1	1-H2-012	Pantry	H2	H2 Clinical Research	1			0.8
1	1-H2-013	Store - Equipment	H2	H2 Clinical Research	1			0.2
1	1-H2-014	Bay 1	H2	H2 Clinical Research	1		Grouped with 1-H2-015	21
1	1-H2-015	Bay 1 - Ensuite	H2	H2 Clinical Research	1		Grouped with 1-H2-014	0
1	1-H2-016	Sample Processing	H2	H2 Clinical Research	1			21
1	1-H2-017	Dirty Utility	H2	H2 Clinical Research	1			21
1	1-H2-018	Room 4 - Ensuite	H2	H2 Clinical Research	1		Grouped with 1-H2-021	35
1	1-H2-019	Corridor	H2	H2 Clinical Research	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-H2-020	Clean Utility	H2	H2 Clinical Research	1			50
1	1-H2-021	Single Room 4	H2	H2 Clinical Research	1		Grouped with 1-H2-023	0.8
1	1-H2-022	Room 5 - Ensuite	H2	H2 Clinical Research	1		Grouped with 1-H2-024	35
1	1-H2-023	Room 4 - Lobby	H2	H2 Clinical Research	1		Grouped with 1-H2-018	0
1	1-H2-024	Single Room 5	H2	H2 Clinical Research	1		Grouped with 1-H2-022	0.8
1	1-H2-026	Corridor	H2	H2 Clinical Research	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0

1	1-H2-027	Switch Cupboard	H2	H2 Clinical Research	1		Project Co Space	0
1	1-H2-028	Touch Down Base	H2	H2 Clinical Research	1			21
1	1-H2-029	Corridor	H2	H2 Clinical Research	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-H3-001	Scenario Room 1	H3	H3 Clinical Education	1			0.4
1	3-H3-002	Control Room	H3	H3 Clinical Education	1			0.6
1	3-H3-003	Storage	H3	H3 Clinical Education	1			0.1
1	3-H3-004	Teaching Room 1	H3	H3 Clinical Education	1			0.4
1	3-H3-005	Scenario Room 2	H3	H3 Clinical Education	1			0.6
1	3-H3-006	WC - Wheelchair accessible	H3	H3 Clinical Education	1			0.6
1	3-H3-007	WC - Ambulant	H3	H3 Clinical Education	1			0.6
1	3-H3-008	WC - Ambulant	H3	H3 Clinical Education	1			0.6
1	3-H3-009	Corridor	H3	H3 Clinical Education	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-H3-010	Teaching Room 2	H3	H3 Clinical Education	1			0.4
1	3-H3-011	Beverage Bay	H3	H3 Clinical Education	1			0.4
1	3-H3-012	DSR	H3	H3 Clinical Education	1			16
1	3-H3-013	Manual Handling, Health & Safety (3 person)	H3	H3 Clinical Education	1			0.4
1	3-H3-014	Practice Based Educators Office (4 person)	H3	H3 Clinical Education	1			0.4
1	3-H3-015	Meeting Room	H3	H3 Clinical Education	1			0.4
1	3-H3-016	Seminar Room	H3	H3 Clinical Education	1			0.4
1	3-H3-018	Management/Admin Office (3 person)	H3	H3 Clinical Education	1			0.4
1	3-H3-019	Computer Carrels	H3	H3 Clinical Education	1			0.4
1	3-H3-020	Lockers	H3	H3 Clinical Education	1			0.4
1	3-H3-021	Corridor	H3	H3 Clinical Education	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-I1-001	Draught Lobby	I1	I1 RHSC Entrance	1			21
1	G-I1-002	Wheelchair Bay	I1	I1 RHSC Entrance	1		Not measurable against availability standards	0
1	G-I1-003	Security Office	I1	I1 RHSC Entrance	1			16
1	G-I1-004	Vending Machine	I1	I1 RHSC Entrance	1			0.6
1	G-I1-005	Enquiry / Information Desk (2 person)	I1	I1 RHSC Entrance	1			21
1	G-I1-006	Retail Shop	I1	I1 RHSC Entrance	1			0.8
1	G-I1-007	Catering Shop	I1	I1 RHSC Entrance	1			0.8
1	G-I1-008	Waiting Area	I1	I1 RHSC Entrance	1			21
1	G-I1-009	Public Telephone Booth	I1	I1 RHSC Entrance	1			0.6
1	G-I1-010	WC - Ambulant (Visitors)	I1	I1 RHSC Entrance	1			0.8
1	G-I1-011	WC - Wheelchair accessible	I1	I1 RHSC Entrance	1			0.8
1	G-I1-012	Assisted Change/Nappy Change	I1	I1 RHSC Entrance	1			0.8
1	G-I1-013	DSR	I1	I1 RHSC Entrance	1			16
1	G-I1-014	Fire Control Room	I1	I1 RHSC Entrance	1			200
1	B-I2-002	DSR	I2	I2 Stores	1			16
1	B-I2-004	Store - Beds	I2	I2 Stores	1			0.6
1	B-I2-005	Store - Toys	I2	I2 Stores	1			0.2

1	B-I2-006	Vending & Cafe Store	I2	I2 Stores	1			0.8
1	B-I2-007	Store	I2	I2 Stores	1			0.8
1	B-I2-008	Store	I2	I2 Stores	1			0.8
1	1-J1-001	Lobby	J1	J1 Bereavement Suite	1			21
1	1-J1-002	WC - Wheelchair accessible	J1	J1 Bereavement Suite	1			0.8
1	1-J1-003	Viewing Room	J1	J1 Bereavement Suite	1			21
1	1-J1-004	Sitting Room with Beverage Bay	J1	J1 Bereavement Suite	1			0.8
1	G-J2-001	Corridor	JS	JS Spiritual Care	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-J2-002	Interview Room	JS	JS Spiritual Care	1			10
1	G-J2-003	Sanctuary	JS	JS Spiritual Care	1			10
1	G-J2-004	WC - Wheelchair accessible / Ritual Washing Area	JS	JS Spiritual Care	1			0.8
1	G-J2-005	Store	JS	JS Spiritual Care	1			0.1
1	G-J2-006	Office	JS	JS Spiritual Care	1			0.4
1	G-J2-007	Switch Cupboard	JS	JS Spiritual Care	1		Project Co Space	0
1	G-K1-001	Meeting Room (family size)	K1	K1 Family Support	1			0.7
1	G-K1-002	Meeting Room (family size)	K1	K1 Family Support	1			0.7
1	G-K1-003	Office 1	K1	K1 Family Support	1			0.4
1	G-K1-004	Office 2	K1	K1 Family Support	1			0.4
1	G-K1-005	Office 3	K1	K1 Family Support	1			0.4
1	G-K1-006	Waiting Area	K1	K1 Family Support	1			0.6
1	G-K1-007	Nappy Change	K1	K1 Family Support	1			0.8
1	G-K1-008	WC - Wheelchair accessible	K1	K1 Family Support	1			0.8
1	G-K1-009	Corridor	K1	K1 Family Support	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-K1-010	Interview Room	K1	K1 Family Support	1			10
1	G-K1-011	Office 4	K1	K1 Family Support	1			0.4
1	G-K1-012	Office 5	K1	K1 Family Support	1			0.4
1	G-K1-013	Store	K1	K1 Family Support	1			0.1
1	G-K1-015	Interview Room	K1	K1 Family Support	1			10
1	G-K1-016	Drop-In Lounge / Beverage Bay	K1	K1 Family Support	1			10
1	G-K1-017	Drop-In Multi-Purpose Room	K1	K1 Family Support	1			10
1	G-K1-018	WC - Staff	K1	K1 Family Support	1			0.6
1	G-K1-019	Beverage Bay	K1	K1 Family Support	1			0.8
1	G-K1-021	Complementary Therapy Room	K1	K1 Family Support	1			10
1	G-K1-022	Radio Lollipop Broadcasting Studio, Lobby	K1	K1 Family Support	1			0.8
1	G-K1-023	Wheelchair Bay	K1	K1 Family Support	1		Not measurable against availability standards	0
1	G-K1-024	Office 6	K1	K1 Family Support	1			0.4
1	G-K1-025	WC - Wheelchair accessible	K1	K1 Family Support	1			0.8
1	G-K1-026	DSR	K1	K1 Family Support	1			16
1	G-K1-027	Switch Cupboard	K1	K1 Family Support	1		Project Co Space	0
1	G-K1-029	Disposal Hold	K1	K1 Family Support	1			0.8
1	G-K1-030	Corridor	K1	K1 Family Support	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0

1	3-K2-001	Corridor	K2	K2 Hotel	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-K2-002	Reception	K2	K2 Hotel	1			0.6
1	3-K2-004	WC - Ambulant (Female)	K2	K2 Hotel	1			0.8
1	3-K2-005	WC - Ambulant (Male)	K2	K2 Hotel	1			0.8
1	3-K2-006	Lounge - non residents	K2	K2 Hotel	1			0.8
1	3-K2-007	WC - Wheelchair accessible	K2	K2 Hotel	1			0.8
1	3-K2-008	Family Room for 4 persons 1	K2	K2 Hotel	1		Grouped with 3-K2-009	0.8
1	3-K2-009	En-suite wheelchair-accessible WC, Shower & wash Room 1	K2	K2 Hotel	1		Grouped with 3-K2-008	0
1	3-K2-010	Family Room for 4 persons 3	K2	K2 Hotel	1		Grouped with 3-K2-011	0.8
1	3-K2-011	En-suite wheelchair-accessible WC, Shower & wash Room 3	K2	K2 Hotel	1		Grouped with 3-K2-010	0
1	3-K2-012	Family Room for 4 persons 2	K2	K2 Hotel	1		Grouped with 3-K2-013	0.8
1	3-K2-013	En-suite wheelchair-accessible WC, Shower & wash Room 2	K2	K2 Hotel	1		Grouped with 3-K2-012	0
1	3-K2-014	Family Room for 4 persons 4	K2	K2 Hotel	1		Grouped with 3-K2-015	0.8
1	3-K2-015	En-suite wheelchair-accessible WC, Shower & wash Room 4	K2	K2 Hotel	1		Grouped with 3-K2-014	0
1	3-K2-016	Family Room for 4 persons 5	K2	K2 Hotel	1		Grouped with 3-K2-017	0.8
1	3-K2-017	En-suite wheelchair-accessible WC, Shower & wash Room 5	K2	K2 Hotel	1		Grouped with 3-K2-016	0
1	3-K2-018	Corridor	K2	K2 Hotel	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-K2-019	Family Room accessible for 4 persons 1	K2	K2 Hotel	1		Grouped with 3-K2-020	0.8
1	3-K2-020	En-suite wheelchair-accessible WC, Shower & wash Acc Room 1	K2	K2 Hotel	1		Grouped with 3-K2-019	0
1	3-K2-021	Family Room for 4 persons 6	K2	K2 Hotel	1		Grouped with 3-K2-022	0.8
1	3-K2-022	En-suite wheelchair-accessible WC, Shower & wash Room 6	K2	K2 Hotel	1		Grouped with 3-K2-021	0
1	3-K2-023	Family Room for 4 persons 7	K2	K2 Hotel	1		Grouped with 3-K2-024	0.8
1	3-K2-024	En-suite wheelchair-accessible WC, Shower & wash Room 7	K2	K2 Hotel	1		Grouped with 3-K2-023	0
1	3-K2-025	Family Room for 4 persons 8	K2	K2 Hotel	1		Grouped with 3-K2-026	0.8
1	3-K2-026	En-suite wheelchair-accessible WC, Shower & wash Room 8	K2	K2 Hotel	1		Grouped with 3-K2-025	0
1	3-K2-027	Family Room for 4 persons 9	K2	K2 Hotel	1		Grouped with 3-K2-028	0.8
1	3-K2-028	En-suite wheelchair-accessible WC, Shower & wash Room 9	K2	K2 Hotel	1		Grouped with 3-K2-027	0
1	3-K2-029	Family Room for 4 persons 10	K2	K2 Hotel	1		Grouped with 3-K2-030	0.8
1	3-K2-030	En-suite wheelchair-accessible WC, Shower & wash Room 10	K2	K2 Hotel	1		Grouped with 3-K2-029	0
1	3-K2-032	Family Room for 4 persons 11	K2	K2 Hotel	1		Grouped with 3-K2-033	0.8
1	3-K2-033	En-suite wheelchair-accessible WC, Shower & wash Room 11	K2	K2 Hotel	1		Grouped with 3-K2-032	0
1	3-K2-035	Family Room for 4 persons 12	K2	K2 Hotel	1		Grouped with 3-K2-036	0.8
1	3-K2-036	En-suite wheelchair-accessible WC, Shower & wash Room 12	K2	K2 Hotel	1		Grouped with 3-K2-035	0
1	3-K2-037	Family Room for 4 persons 13	K2	K2 Hotel	1		Grouped with 3-K2-038	0.8
1	3-K2-038	En-suite wheelchair-accessible WC, Shower & wash Room 13	K2	K2 Hotel	1		Grouped with 3-K2-037	0
1	3-K2-039	Store	K2	K2 Hotel	1			0.1

1	3-K2-040	Family Room for 4 persons 14	K2	K2 Hotel	1		Grouped with 3-K2-041	0.9
1	3-K2-041	En-suite wheelchair-accessible WC, Shower & wash Room 14	K2	K2 Hotel	1		Grouped with 3-K2-040	0
1	3-K2-042	Laundry	K2	K2 Hotel	1			0.8
1	3-K2-043	En-suite wheelchair-accessible WC, Shower & wash Room 15	K2	K2 Hotel	1		Grouped with 3-K2-044	0.8
1	3-K2-044	Family Room for 4 persons 15	K2	K2 Hotel	1		Grouped with 3-K2-043	0.9
1	3-K2-045	Family Room for 4 persons 16	K2	K2 Hotel	1		Grouped with 3-K2-046	0.9
1	3-K2-046	En-suite wheelchair-accessible WC, Shower & wash Room 16	K2	K2 Hotel	1		Grouped with 3-K2-045	0
1	3-K2-047	DSR	K2	K2 Hotel	1			16
1	3-K2-048	WC - Wheelchair accessible	K2	K2 Hotel	1			0.8
1	3-K2-049	Corridor	K2	K2 Hotel	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-K2-050	Kitchens / Dining Rooms	K2	K2 Hotel	1			0.8
1	3-K2-051	Residents Day Room	K2	K2 Hotel	1			0.8
1	3-K2-052	Corridor	K2	K2 Hotel	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-K2-053	Residents Play Room	K2	K2 Hotel	1			0.8
1	3-K2-054	Switch/Meter Cupboard	K2	K2 Hotel	1		Project Co Space	0
1	3-K2-056	Corridor	K2	K2 Hotel	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	3-K2-057	Store	K2	K2 Hotel	1			0.1
1	3-K2-058	En-suite wheelchair-accessible WC, Shower & wash Room 17	K2	K2 Hotel	1		Grouped with 3-K2-059	0.8
1	3-K2-059	Family Room for 4 persons 17	K2	K2 Hotel	1		Grouped with 3-K2-058	0.9
1	3-K2-060	Family Room accessible for 4 persons 2	K2	K2 Hotel	1		Grouped with 3-K2-061	0.9
1	3-K2-061	En-suite wheelchair-accessible WC, Shower & wash Acc Room 2	K2	K2 Hotel	1		Grouped with 3-K2-060	0
1	3-K2-062	Family Room for 4 persons 18	K2	K2 Hotel	1			0.9
1	3-K2-063	En-suite wheelchair-accessible WC, Shower & wash Room 18	K2	K2 Hotel	1		Grouped with 3-K2-065	0
1	3-K2-064	En-suite wheelchair-accessible WC, Shower & wash Room 19	K2	K2 Hotel	1			0.8
1	3-K2-065	Family Room for 4 persons 19	K2	K2 Hotel	1		Grouped with 3-K2-063	0.9
1	3-K2-066	Family Room for 4 persons 20	K2	K2 Hotel	1		Grouped with 3-K2-067	0.9
1	3-K2-067	En-suite wheelchair-accessible WC, Shower & wash Room 20	K2	K2 Hotel	1		Grouped with 3-K2-066	0
1	3-K2-068	En-suite wheelchair-accessible WC, Shower & wash Room 21	K2	K2 Hotel	1		Grouped with 3-K2-069	0.8
1	3-K2-069	Family Room for 4 persons 21	K2	K2 Hotel	1		Grouped with 3-K2-068	0.9
1	3-K2-071	En-suite wheelchair-accessible WC, Shower & wash Room 22	K2	K2 Hotel	1		Grouped with 3-K2-072	0.8
1	3-K2-072	Family Room for 4 persons 22	K2	K2 Hotel	1		Grouped with 3-K2-071	0.9
1	3-K2-073	Family Room for 4 persons 23	K2	K2 Hotel	1		Grouped with 3-K2-074	0.9
1	3-K2-074	En-suite wheelchair-accessible WC, Shower & wash Room 23	K2	K2 Hotel	1		Grouped with 3-K2-073	0
1	3-K2-075	Family Room for 4 persons 24	K2	K2 Hotel	1		Grouped with 3-K2-076	0.9
1	3-K2-076	En-suite wheelchair-accessible WC, Shower & wash Room 24	K2	K2 Hotel	1		Grouped with 3-K2-075	0

1	3-K2-078	Laundry	K2	K2 Hotel	1			0.8
1	3-K2-080	Storage - refuse	K2	K2 Hotel	1			0.1
1	3-K2-082	Switch Cup	K2	K2 Hotel	1		Project Co Space	0
1	3-K2-083	Switch Cup	K2	K2 Hotel	1		Project Co Space	0
1	3-K2-084	Switch Cup	K2	K2 Hotel	1		Project Co Space	0
1	3-K2-086	Office - 4 person	K2	K2 Hotel	1			0.4
1	1-L1-001	Corridor	L1	L1 DCN Acute	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-L1-002	Single Room 1	L1	L1 DCN Acute	1		Grouped with 1-L1-003	35
1	1-L1-003	Room 1 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-002	0
1	1-L1-004	Disposal Hold	L1	L1 DCN Acute	1			[illegible]
1	1-L1-005	Intensive Treatment Room	L1	L1 DCN Acute	1			21
1	1-L1-006	Single Room 2	L1	L1 DCN Acute	1		Grouped with 1-L1-007	35
1	1-L1-007	Room 2 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-006	0
1	1-L1-008	Touchdown Base 1	L1	L1 DCN Acute	1			21
1	1-L1-010	Single Room 3	L1	L1 DCN Acute	1		Grouped with 1-L1-011	35
1	1-L1-011	Room 3 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-010	0
1	1-L1-012	Waiting Area, relatives	L1	L1 DCN Acute	1			0.8
1	1-L1-014	WC - Wheelchair accessible (Visitors)	L1	L1 DCN Acute	1			0.8
1	1-L1-015	Single Room 4	L1	L1 DCN Acute	1		Grouped with 1-L1-016	35
1	1-L1-016	Room 4 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-015	0
1	1-L1-017	Single Room 5	L1	L1 DCN Acute	1		Grouped with 1-L1-018	35
1	1-L1-018	Room 5 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-017	0
1	1-L1-019	Linen Bay (1 trolley)	L1	L1 DCN Acute	1		Not measurable against availability standards	0
1	1-L1-021	Single Room 6	L1	L1 DCN Acute	1		Grouped with 1-L1-022	35
1	1-L1-022	Room 6 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-021	0
1	1-L1-023	Staff Base 1	L1	L1 DCN Acute	1			21
1	1-L1-024	Single Room 22	L1	L1 DCN Acute	1		Grouped with 1-L1-025	35
1	1-L1-025	Room 22 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-024	0
1	1-L1-026	WC - Wheelchair accessible (Visitors)	L1	L1 DCN Acute	1			0.8
1	1-L1-027	Patient Waiting Area	L1	L1 DCN Acute	1			0.8
1	1-L1-028	Multi-Disciplinary Office / Reception	L1	L1 DCN Acute	1			0.8
1	1-L1-029	Consulting Room 1	L1	L1 DCN Acute	1			21
1	1-L1-030	Consulting Room 2	L1	L1 DCN Acute	1			21
1	1-L1-031	Consulting Room 3	L1	L1 DCN Acute	1			21
1	1-L1-032	Consulting Room 4	L1	L1 DCN Acute	1			21
1	1-L1-033	Dirty Utility	L1	L1 DCN Acute	1			21
1	1-L1-034	Single Room 23	L1	L1 DCN Acute	1		Grouped with 1-L1-035	35
1	1-L1-035	Room 23 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-034	0
1	1-L1-036	Touchdown Base 2	L1	L1 DCN Acute	1			21
1	1-L1-037	Interview/Relatives Quiet Room	L1	L1 DCN Acute	1			0.8
1	1-L1-038	Single Room 24	L1	L1 DCN Acute	1		Grouped with 1-L1-039	35
1	1-L1-039	Room 24 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-038	0
1	1-L1-040	Room 25 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-044	0

1	1-L1-044	Single Room 25	L1	L1 DCN Acute	1		Grouped with 1-L1-040	35
1	1-L1-046	Senior Charge Nurse Office	L1	L1 DCN Acute	1			0.4
1	1-L1-047	Clean Utility	L1	L1 DCN Acute	1			50
1	1-L1-052	Staff Room	L1	L1 DCN Acute	1			0.4
1	1-L1-053	Multi-Disciplinary Office	L1	L1 DCN Acute	1			0.8
1	1-L1-054	Ward Kitchen	L1	L1 DCN Acute	1			0.4
1	1-L1-055	Touchdown Base 3	L1	L1 DCN Acute	1			21
1	1-L1-060	Teaching Room	L1	L1 DCN Acute	1			0.4
1	1-L1-061	Dirty Utility	L1	L1 DCN Acute	1			21
1	1-L1-066	Single Room 7	L1	L1 DCN Acute	1		Grouped with 1-L1-067	35
1	1-L1-067	Room 7 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-066	0
1	1-L1-068	Single Room 8	L1	L1 DCN Acute	1		Grouped with 1-L1-069	35
1	1-L1-069	Room 8 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-068	0
1	1-L1-070	Interview/Relatives Quiet Room	L1	L1 DCN Acute	1			0.8
1	1-L1-071	Linen Bay (1 trolley)	L1	L1 DCN Acute	1		Not measurable against availability standards	0
1	1-L1-072	WC - Staff	L1	L1 DCN Acute	1			0.6
1	1-L1-073	WC - Staff	L1	L1 DCN Acute	1			0.6
1	1-L1-074	Resuscitation Trolley Bay	L1	L1 DCN Acute	1			0.1
1	1-L1-075	Staff Base 2	L1	L1 DCN Acute	1			21
1	1-L1-076	Storage Consumables	L1	L1 DCN Acute	1			0.2
1	1-L1-077	Relatives Room - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-082	0
1	1-L1-078	Hoist Bay	L1	L1 DCN Acute	1			0.1
1	1-L1-079	WC - Staff	L1	L1 DCN Acute	1			0.6
1	1-L1-080	WC - Wheelchair accessible	L1	L1 DCN Acute	1			0.8
1	1-L1-082	Relatives Overnight Stay Room	L1	L1 DCN Acute	1		Grouped with 1-L1-077	21
1	1-L1-083	Single Room 21	L1	L1 DCN Acute	1		Grouped with 1-L1-084	35
1	1-L1-084	Room 21 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-083	0
1	1-L1-085	Mobile X-Ray Bay	L1	L1 DCN Acute	1			0.8
1	1-L1-086A	Storage Equipment	L1	L1 DCN Acute	1			0.2
1	1-L1-086B	Storage Equipment	L1	L1 DCN Acute	1			0.2
1	1-L1-087	Room 20 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-088	35
1	1-L1-088	Single Room 20	L1	L1 DCN Acute	1		Grouped with 1-L1-087	35
1	1-L1-089	Touchdown Base 5	L1	L1 DCN Acute	1			21
1	1-L1-090	Storage Stationery	L1	L1 DCN Acute	1			0.1
1	1-L1-091	Single Room 19	L1	L1 DCN Acute	1		Grouped with 1-L1-092	35
1	1-L1-092	Room 19 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-091	0
1	1-L1-093	Single Room 18	L1	L1 DCN Acute	1		Grouped with 1-L1-094	35
1	1-L1-094	Room 18 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-093	0
1	1-L1-095	DSR	L1	L1 DCN Acute	1			16
1	1-L1-096	Disposal Hold	L1	L1 DCN Acute	1			0.6
1	1-L1-097	Bay 1	L1	L1 DCN Acute	1		Grouped with1-L1-099	35
1	1-L1-099	Bay 1 - Ensuite	L1	L1 DCN Acute	1		Grouped with1-L1-097	0
1	1-L1-100	Bay 2	L1	L1 DCN Acute	1		Grouped with 1-L1-101	35
1	1-L1-101	Bay 2 - Ensuite	L1	L1 DCN Acute	1		Grouped with 1-L1-100	0
1	1-L1-103	Treatment Room	L1	L1 DCN Acute	1			21
1	1-L1-104	Room 8 - Lobby	L1	L1 DCN Acute	1			200

1	1-L1-105	Corridor	L1	L1 DCN Acute	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-L1-106	Switch Cupboard	L1	L1 DCN Acute	1		Project Co Space	0
1	1-L1-107	Switch Cupboard	L1	L1 DCN Acute	1		Project Co Space	0
1	1-L1-108	Physical Measure	L1	L1 DCN Acute	1			0.8
1	1-L1-109	Touchdown Base 4	L1	L1 DCN Acute	1			21
1	2-L2-001	Corridor	L2	L2 DCN Inpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-L2-002	Disposal Hold	L2	L2 DCN Inpatients	1			0.9
1	2-L2-003	Linen Bay (1 trolley)	L2	L2 DCN Inpatients	1		Not measurable against availability standards	0
1	2-L2-004	Single Room 7	L2	L2 DCN Inpatients	1		Grouped with 2-L2-005	35
1	2-L2-005	Room 7 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-004	0
1	2-L2-006	Single Room 8	L2	L2 DCN Inpatients	1		Grouped with 2-L2-007	35
1	2-L2-007	Room 8 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-006	0
1	2-L2-008	Hoist Bay	L2	L2 DCN Inpatients	1			0.1
1	2-L2-009	Touchdown Base 4	L2	L2 DCN Inpatients	1			21
1	2-L2-010	Single Room 9	L2	L2 DCN Inpatients	1		Grouped with 2-L2-011	35
1	2-L2-011	Room 9 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-010	0
1	2-L2-012	Store	L2	L2 DCN Inpatients	1			0.1
1	2-L2-013	Single Room 10	L2	L2 DCN Inpatients	1		Grouped with 2-L2-014	35
1	2-L2-014	Room 10 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-013	0
1	2-L2-015	Single Room 11	L2	L2 DCN Inpatients	1		Grouped with 2-L2-016	35
1	2-L2-016	Room 11 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-015	0
1	2-L2-017	Touchdown Base 3	L2	L2 DCN Inpatients	1			21
1	2-L2-018	Single Room 6	L2	L2 DCN Inpatients	1		Grouped with 2-L2-019	35
1	2-L2-019	Room 6 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-018	0
1	2-L2-020	Resuscitation Trolley Bay	L2	L2 DCN Inpatients	1			0.1
1	2-L2-021	Single Room 12	L2	L2 DCN Inpatients	1		Grouped with 2-L2-022	35
1	2-L2-022	Room 12 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-021	0
1	2-L2-023	Single Room 5	L2	L2 DCN Inpatients	1		Grouped with 2-L2-024	35
1	2-L2-024	Room 5 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-023	0
1	2-L2-025	Touchdown Base 2	L2	L2 DCN Inpatients	1			21
1	2-L2-026	Single Room 14	L2	L2 DCN Inpatients	1		Grouped with 2-L2-027	35
1	2-L2-027	Room 14 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-026	0
1	2-L2-028	Single Room 4	L2	L2 DCN Inpatients	1		Grouped with 2-L2-029	35
1	2-L2-029	Room 4 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-028	0
1	2-L2-030	Dirty Utility	L2	L2 DCN Inpatients	1			21
1	2-L2-031	DSR	L2	L2 DCN Inpatients	1			16
1	2-L2-032	Single Room 15	L2	L2 DCN Inpatients	1		Grouped with 2-L2-033	35
1	2-L2-033	Room 15 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-032	0
1	2-L2-034	Single Room 16	L2	L2 DCN Inpatients	1		Grouped with 2-L2-035	35
1	2-L2-035	Room 16 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-034	0
1	2-L2-036	Single Room 17	L2	L2 DCN Inpatients	1		Grouped with 2-L2-037	35
1	2-L2-037	Room 17 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-036	0
1	2-L2-038	Room 20 - Lobby	L2	L2 DCN Inpatients	1		Grouped with 2-L2-039	35

1	2-L2-039	Single Room 20	L2	L2 DCN Inpatients	1		Grouped with 2-L2-040	35
1	2-L2-040	Room 20 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-039	0
1	2-L2-041	Single Room 2	L2	L2 DCN Inpatients	1		Grouped with 2-L2-042	35
1	2-L2-042	Room 2 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-041	0
1	2-L2-043	Single Room 1	L2	L2 DCN Inpatients	1		Grouped with 2-L2-044	35
1	2-L2-044	Room 1 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-043	0
1	2-L2-045	Touchdown Base 1	L2	L2 DCN Inpatients	1			21
1	2-L2-046	Single Room 18	L2	L2 DCN Inpatients	1		Grouped with 2-L2-047	35
1	2-L2-047	Room 18 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-046	0
1	2-L2-048	Single Room 19	L2	L2 DCN Inpatients	1		Grouped with 2-L2-049	35
1	2-L2-049	Room 19 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-048	0
1	2-L2-050	Single Room 3	L2	L2 DCN Inpatients	1		Grouped with 2-L2-051	35
1	2-L2-051	Room 3 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-050	0
1	2-L2-052	Clean Utility	L2	L2 DCN Inpatients	1			50
1	2-L2-053	Patient Interview Room	L2	L2 DCN Inpatients	1			0.8
1	2-L2-054	Dirty Utility	L2	L2 DCN Inpatients	1			21
1	2-L2-055	Sitting Room	L2	L2 DCN Inpatients	1			10
1	2-L2-056	Senior Charge Nurse Office	L2	L2 DCN Inpatients	1			0.4
1	2-L2-057	Multi-Disciplinary Office	L2	L2 DCN Inpatients	1			0.8
1	2-L2-058	Store	L2	L2 DCN Inpatients	1			0.1
1	2-L2-059	Hoist Bay	L2	L2 DCN Inpatients	1			0.1
1	2-L2-060	WC - Ambulant	L2	L2 DCN Inpatients	1			0.6
1	2-L2-061	WC - Staff	L2	L2 DCN Inpatients	1			0.6
1	2-L2-062	Ward Kitchen	L2	L2 DCN Inpatients	1			21
1	2-L2-063	Touchdown Base 6	L2	L2 DCN Inpatients	1			21
1	2-L2-064	Mobile X-Ray Bay	L2	L2 DCN Inpatients	1			0.8
1	2-L2-065	WC - Staff	L2	L2 DCN Inpatients	1			0.6
1	2-L2-066	WC - Staff	L2	L2 DCN Inpatients	1			0.6
1	2-L2-067	Clinical Supplies Store	L2	L2 DCN Inpatients	1			0.2
1	2-L2-068	WC - Wheelchair Accessible	L2	L2 DCN Inpatients	1			0.8
1	2-L2-069	Teaching Room	L2	L2 DCN Inpatients	1			0.4
1	2-L2-070	Disposal Hold	L2	L2 DCN Inpatients	1			0.9
1	2-L2-071	WC - Ambulant	L2	L2 DCN Inpatients	1			0.8
1	2-L2-072	WC - Staff	L2	L2 DCN Inpatients	1			0.8
1	2-L2-073	Reception (1 person)	L2	L2 DCN Inpatients	1			0.6
1	2-L2-074	Waiting Area	L2	L2 DCN Inpatients	1			0.8
1	2-L2-075	Multi-Disciplinary Office	L2	L2 DCN Inpatients	1			0.8
1	2-L2-076	Senior Charge Nurse Office	L2	L2 DCN Inpatients	1			0.4
1	2-L2-077	Patient Interview Room	L2	L2 DCN Inpatients	1			0.8
1	2-L2-078	Ward Kitchen	L2	L2 DCN Inpatients	1			21
1	2-L2-079	Clean Utility	L2	L2 DCN Inpatients	1			50
1	2-L2-080	Patients' Assisted Bathroom	L2	L2 DCN Inpatients	1			21
1	2-L2-081	Sitting Room	L2	L2 DCN Inpatients	1			10
1	2-L2-082	Single Room 14	L2	L2 DCN Inpatients	1		Grouped with 2-L2-083	35
1	2-L2-083	Room 14 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-082	0
1	2-L2-084	Single Room 12	L2	L2 DCN Inpatients	1		Grouped with 2-L2-085	35

1	2-L2-085	Room 12 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-084	0
1	2-L2-086	Touchdown Base 7	L2	L2 DCN Inpatients	1			21
1	2-L2-087	Single Room 25	L2	L2 DCN Inpatients	1		Grouped with 2-L2-088	35
1	2-L2-088	Room 25 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-087	0
1	2-L2-089	Hoist Bay	L2	L2 DCN Inpatients	1			0.1
1	2-L2-090	Single Room 24	L2	L2 DCN Inpatients	1		Grouped with 2-L2-091	35
1	2-L2-091	Room 24 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-090	0
1	2-L2-092	Single Room 11	L2	L2 DCN Inpatients	1		Grouped with 2-L2-093	35
1	2-L2-093	Room 11 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-092	0
1	2-L2-094	Single Room 10	L2	L2 DCN Inpatients	1		Grouped with 2-L2-095	35
1	2-L2-095	Room 10 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-094	0
1	2-L2-096	Room 23 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-097	35
1	2-L2-097	Single Room 23	L2	L2 DCN Inpatients	1		Grouped with 2-L2-096	35
1	2-L2-098	Hoist Bay	L2	L2 DCN Inpatients	1			0.1
1	2-L2-099	Resuscitation Trolley Bay	L2	L2 DCN Inpatients	1			0.1
1	2-L2-100	Touchdown Base 5	L2	L2 DCN Inpatients	1			21
1	2-L2-101	Touchdown Base 4	L2	L2 DCN Inpatients	1			21
1	2-L2-102	Single Room 22	L2	L2 DCN Inpatients	1		Grouped with 2-L2-103	35
1	2-L2-103	Room 22 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-102	0
1	2-L2-104	Single Room 21	L2	L2 DCN Inpatients	1		Grouped with 2-L2-105	35
1	2-L2-105	Room 21 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-104	0
1	2-L2-106	Single Room 9	L2	L2 DCN Inpatients	1		Grouped with 2-L2-107	35
1	2-L2-107	Room 9 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-106	0
1	2-L2-108	Single Room 8	L2	L2 DCN Inpatients	1		Grouped with 2-L2-109	35
1	2-L2-109	Room 8 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-108	0
1	2-L2-110	Room 20 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-111	35
1	2-L2-111	Single Room 20	L2	L2 DCN Inpatients	1		Grouped with 2-L2-110	35
1	2-L2-112	Hoist Bay	L2	L2 DCN Inpatients	1			0.1
1	2-L2-113	Single Room 19	L2	L2 DCN Inpatients	1		Grouped with 2-L2-114	35
1	2-L2-114	Room 19 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-113	0
1	2-L2-115	Touchdown Base 3	L2	L2 DCN Inpatients	1			21
1	2-L2-117	Single Room 7	L2	L2 DCN Inpatients	1		Grouped with 2-L2-118	35
1	2-L2-118	Room 7 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-117	0
1	2-L2-119	Single Room 6	L2	L2 DCN Inpatients	1		Grouped with 2-L2-120	35
1	2-L2-120	Room 6 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-119	0
1	2-L2-121	Single Room 18	L2	L2 DCN Inpatients	1		Grouped with 2-L2-122	35
1	2-L2-122	Room 18 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-121	0
1	2-L2-123	Single Room 5	L2	L2 DCN Inpatients	1		Grouped with 2-L2-124	35
1	2-L2-124	Room 5 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-123	0
1	2-L2-125	Single Room 4	L2	L2 DCN Inpatients	1		Grouped with 2-L2-126	35
1	2-L2-126	Room 4 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-125	0
1	2-L2-127	Dirty Utility	L2	L2 DCN Inpatients	1			21
1	2-L2-128	DSR	L2	L2 DCN Inpatients	1			16
1	2-L2-129	Touchdown Base 2	L2	L2 DCN Inpatients	1			21
1	2-L2-130	Single Room 3	L2	L2 DCN Inpatients	1		Grouped with 2-L2-131	35
1	2-L2-131	Room 3 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-130	0

1	2-L2-132	Single Room 2	L2	L2 DCN Inpatients	1		Grouped with 2-L2-133	35
1	2-L2-133	Room 2 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-132	0
1	2-L2-134	Room 1 - Lobby	L2	L2 DCN Inpatients	1		Grouped with 2-L2-135	35
1	2-L2-135	Single Room 1	L2	L2 DCN Inpatients	1		Grouped with 2-L2-136	35
1	2-L2-136	Room 1 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-135	0
1	2-L2-137	Touchdown Base 1	L2	L2 DCN Inpatients	1			21
1	2-L2-138	Room 16 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-139	35
1	2-L2-139	Single Room 16	L2	L2 DCN Inpatients	1		Grouped with 2-L2-138	35
1	2-L2-140	Single Room 15	L2	L2 DCN Inpatients	1		Grouped with 2-L2-141	35
1	2-L2-141	Room 15 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-140	0
1	2-L2-142	Single Room 17	L2	L2 DCN Inpatients	1		Grouped with 2-L2-143	35
1	2-L2-143	Room 17 - Ensuite	L2	L2 DCN Inpatients	1		Grouped with 2-L2-142	0
1	2-L2-144	Linen Bay (1 trolley)	L2	L2 DCN Inpatients	1		Not measurable against availability standards	0
1	2-L2-145	Corridor	L2	L2 DCN Inpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-L2-146	Corridor	L2	L2 DCN Inpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-L2-147	Corridor	L2	L2 DCN Inpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-L2-148	Corridor	L2	L2 DCN Inpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-L2-149	Switch Cup	L2	L2 DCN Inpatients	1		Project Co Space	0
1	2-L2-150	Switch Cup	L2	L2 DCN Inpatients	1		Project Co Space	0
1	2-L2-151	Corridor	L2	L2 DCN Inpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-L2-152	Physical Measure	L2	L2 DCN Inpatients	1			0.8
1	2-L2-153	Store	L2	L2 DCN Inpatients	1			21
1	2-L2-154	Switch Cup	L2	L2 DCN Inpatients	1		Project Co Space	0
1	G-M1-001	Corridor	M1	M1 DCN Outpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-M1-002	Consulting Room 1 (PreAssessment)	M1	M1 DCN Outpatients	1			0.8
1	G-M1-003	Consulting Room 2 (PreAssessment)	M1	M1 DCN Outpatients	1			0.8
1	G-M1-004	Staff Base	M1	M1 DCN Outpatients	1			0.8
1	G-M1-005	WC - Wheelchair accessible	M1	M1 DCN Outpatients	1			0.8
1	G-M1-006	Linen Bay (1 trolley)	M1	M1 DCN Outpatients	1		Not measurable against availability standards	0
1	G-M1-007	Consulting Room 3 (PreAssessment)	M1	M1 DCN Outpatients	1			0.8
1	G-M1-008	Physical Measurement	M1	M1 DCN Outpatients	1			0.8
1	G-M1-009	Consulting Room 4 (PreAssessment)	M1	M1 DCN Outpatients	1			0.8
1	G-M1-010	Pre Op Clinic Team Office (3 person)	M1	M1 DCN Outpatients	1			0.4
1	G-M1-011	Consulting Room 1	M1	M1 DCN Outpatients	1			0.8
1	G-M1-012	Consulting Room 16	M1	M1 DCN Outpatients	1			0.8

1	G-M1-013	Consulting Room 2	M1	M1 DCN Outpatients	1			0.8
1	G-M1-014	Treatment Room 15	M1	M1 DCN Outpatients	1			0.8
1	G-M1-015	Consulting Room 3	M1	M1 DCN Outpatients	1			0.8
1	G-M1-016	Clean Utility	M1	M1 DCN Outpatients	1			50
1	G-M1-017	Consulting Room 4	M1	M1 DCN Outpatients	1			0.8
1	G-M1-018	Consulting Room 5	M1	M1 DCN Outpatients	1			0.8
1	G-M1-019	Consulting Room 6	M1	M1 DCN Outpatients	1			0.8
1	G-M1-020	Consulting Room 7	M1	M1 DCN Outpatients	1			0.8
1	G-M1-021	Consulting Room 8	M1	M1 DCN Outpatients	1			0.8
1	G-M1-022	Consulting Room 9	M1	M1 DCN Outpatients	1			0.8
1	G-M1-023	Consulting Room 10	M1	M1 DCN Outpatients	1			0.8
1	G-M1-024	Consulting Room 11	M1	M1 DCN Outpatients	1			0.8
1	G-M1-025	Consulting Room 12	M1	M1 DCN Outpatients	1			0.8
1	G-M1-026	Corridor	M1	M1 DCN Outpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-M1-027	Consulting Room 14	M1	M1 DCN Outpatients	1			0.8
1	G-M1-028	Senior Charge Nurse Office	M1	M1 DCN Outpatients	1			21
1	G-M1-029	Outpatient Management Office	M1	M1 DCN Outpatients	1			0.4
1	G-M1-030	Corridor	M1	M1 DCN Outpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-M1-031	Staff Base	M1	M1 DCN Outpatients	1			0.8
1	G-M1-032	Main Waiting	M1	M1 DCN Outpatients	1			0.8
1	G-M1-034	WC - Staff	M1	M1 DCN Outpatients	1			0.6
1	G-M1-035	WC - Staff	M1	M1 DCN Outpatients	1			0.6
1	G-M1-036	Staff Room	M1	M1 DCN Outpatients	1			0.4
1	G-M1-037	Store: Clinical Supplies, Equipment & Stationery	M1	M1 DCN Outpatients	1			0.1
1	G-M1-038	Disposal Hold	M1	M1 DCN Outpatients	1			0.8
1	G-M1-039	WC - Fully accessible changing room	M1	M1 DCN Outpatients	1			0.8
1	G-M1-040	Physical Measurement	M1	M1 DCN Outpatients	1			0.8
1	G-M1-041	Store - Equipment / General	M1	M1 DCN Outpatients	1			0.2
1	G-M1-042	Phlebotomy Room	M1	M1 DCN Outpatients	1			0.8
1	G-M1-043	Public Telephone: Single Booth	M1	M1 DCN Outpatients	1			0.1
1	G-M1-045	WC - Wheelchair Accessible	M1	M1 DCN Outpatients	1			0.8
1	G-M1-046	Medical Records Store	M1	M1 DCN Outpatients	1			0.4
1	G-M1-047	Reception (2 person)	M1	M1 DCN Outpatients	1			0.8
1	G-M1-048	Corridor	M1	M1 DCN Outpatients	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-M1-049	Patient Interview Room	M1	M1 DCN Outpatients	1			0.8
1	G-M1-050	DSR	M1	M1 DCN Outpatients	1			16
1	G-M1-051	Sub Waiting Area	M1	M1 DCN Outpatients	1			0.8
1	G-M1-052	Switch Cup	M1	M1 DCN Outpatients	1		Project Co Space	0
1	2-M2-001	Corridor	M2	M2 DCN Therapies	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0

1	2-M2-002	Staff Office	M2	M2 DCN Therapies	1			0.4
1	2-M2-003	Reception	M2	M2 DCN Therapies	1			0.8
1	2-M2-004	Interview Room 1	M2	M2 DCN Therapies	1			0.8
1	2-M2-005	Interview Room 2	M2	M2 DCN Therapies	1			0.8
1	2-M2-006	Waiting Area	M2	M2 DCN Therapies	1			0.8
1	2-M2-007	ADL Bathroom, Shower, WC with hoists	M2	M2 DCN Therapies	1			0.6
1	2-M2-008	Treatment Room 1	M2	M2 DCN Therapies	1			0.8
1	2-M2-009	ADL Kitchen	M2	M2 DCN Therapies	1			0.6
1	2-M2-010	Consulting Room 2	M2	M2 DCN Therapies	1			0.8
1	2-M2-011	Treatment Room 3	M2	M2 DCN Therapies	1			0.8
1	2-M2-012	Treatment Room 4	M2	M2 DCN Therapies	1			0.8
1	2-M2-013	Staff Lockers	M2	M2 DCN Therapies	1			0.6
1	2-M2-014	WC - Accessible	M2	M2 DCN Therapies	1			0.8
1	2-M2-015	WC - Staff	M2	M2 DCN Therapies	1			0.6
1	2-M2-016	WC - Staff	M2	M2 DCN Therapies	1			0.6
1	2-M2-017	Changing Cubicle 1	M2	M2 DCN Therapies	1			0.6
1	2-M2-018	Changing Cubicle 2	M2	M2 DCN Therapies	1			0.6
1	2-M2-019	Changing Cubicle 3	M2	M2 DCN Therapies	1			0.6
1	2-M2-020	Changing Cubicle 4	M2	M2 DCN Therapies	1			0.6
1	2-M2-021	Store: General/Equipment	M2	M2 DCN Therapies	1			0.1
1	2-M2-022	WC - Accessible (Patients)	M2	M2 DCN Therapies	1			0.8
1	2-M2-023	Rehabilitiation Room 5	M2	M2 DCN Therapies	1			0.8
1	2-M2-024	Store: General/Equipment	M2	M2 DCN Therapies	1			0.1
1	2-M2-025	Store: General/Equipment	M2	M2 DCN Therapies	1			0.1
1	2-M2-026	Switch Cupboard	M2	M2 DCN Therapies	1		Project Co Space	0
1	2-M3-001	Corridor	M3	M3 PIU	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-M3-002	Treatment Room	M3	M3 PIU	1			10
1	2-M3-003	Treatment Bays 1-4	M3	M3 PIU	1			10
1	2-M3-004	Waiting Area; 4 & 2 wheelchairs	M3	M3 PIU	1			0.8
1	2-M4-001	Corridor	M4	M4 DCN Neurophsyiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-M4-002	Waiting Area	M4	M4 DCN Neurophsyiology	1			0.8
1	2-M4-003	Secretarial Office	M4	M4 DCN Neurophsyiology	1			0.4
1	2-M4-004	Reporting Room	M4	M4 DCN Neurophsyiology	1			10
1	2-M4-005	Office	M4	M4 DCN Neurophsyiology	1			0.4
1	2-M4-006	WC - Wheelchair accessible	M4	M4 DCN Neurophsyiology	1			0.8
1	2-M4-007	Quiet Room	M4	M4 DCN Neurophsyiology	1			0.8
1	2-M4-008	EMG/Nerve Conduction Room 3	M4	M4 DCN Neurophsyiology	1			10
1	2-M4-009	EMG/Nerve Conduction Room 1	M4	M4 DCN Neurophsyiology	1			10
1	2-M4-011	EMG/Nerve Conduction Room 2	M4	M4 DCN Neurophsyiology	1			10
1	2-M4-012	VTEM/Ambulatory Review Room	M4	M4 DCN Neurophsyiology	1			10
1	2-M4-013	Clinical Physiologist Office (6 person)	M4	M4 DCN Neurophsyiology	1			0.4
1	2-M4-014	WC - Staff	M4	M4 DCN Neurophsyiology	1			0.8

1	2-M4-016	Store / Records	M4	M4 DCN Neurophsyiology	1			0.1
1	2-M4-017	EEG Recording Room 5	M4	M4 DCN Neurophsyiology	1			10
1	2-M4-018	EEG Recording Room 4	M4	M4 DCN Neurophsyiology	1			10
1	2-M4-019	EEG Recording Room 6	M4	M4 DCN Neurophsyiology	1			10
1	2-M4-020	Corridor	M4	M4 DCN Neurophsyiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-M4-021	Switch Cupboard	M4	M4 DCN Neurophsyiology	1		Project Co Space	0
1	2-M4-022	Switch Cupboard	M4	M4 DCN Neurophsyiology	1		Project Co Space	0
1	G-N1-001	DCN Reception	N1	N1 DCN Entrance	1			21
1	G-N1-002	DCN Entrance Draught Lobby	N1	N1 DCN Entrance	1			0.8
1	G-N1-003	WC - Wheelchair accessible	N1	N1 DCN Entrance	1			0.8
1	G-N1-004	WC - Ambulant (Visitors)	N1	N1 DCN Entrance	1			0.8
1	G-N1-005	Wheelchair Bay	N1	N1 DCN Entrance	1		Not measurable against availability standards	0
1	G-N1-006	Vending Machine	N1	N1 DCN Entrance	1			0.6
1	G-N1-007	Waiting Area	N1	N1 DCN Entrance	1			21
1	G-N1-008	Manifold	N1	N1 DCN Entrance	1		Project Co Space	0
1	2-N2-001	Corridor	N2	N2 DCN Support	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-N2-002	Staff Room	N2	N2 DCN Support	1			0.4
1	2-N2-003	Coffee Bar	N2	N2 DCN Support	1			0.4
1	2-N2-004	Disposal Hold (small)	N2	N2 DCN Support	1			0.8
1	2-N2-005	DSR	N2	N2 DCN Support	1			16
1	1-P1-001	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-002	Physical Measurement	P1	P1 Theatres	1			0.8
1	1-P1-003	Single Room 1	P1	P1 Theatres	1		Grouped with 1-P1-004	35
1	1-P1-004	Room 1 - Ensuite	P1	P1 Theatres	1		Grouped with 1-P1-003	0
1	1-P1-005	Single Room 2	P1	P1 Theatres	1		Grouped with 1-P1-006	35
1	1-P1-006	Room 2 - Ensuite	P1	P1 Theatres	1		Grouped with 1-P1-005	0
1	1-P1-007	Consulting Room 5	P1	P1 Theatres	1			10
1	1-P1-008	Consulting Room 4	P1	P1 Theatres	1			10
1	1-P1-009	Patient Interview Room	P1	P1 Theatres	1			0.8
1	1-P1-010	Single Room 3 - Ensuite	P1	P1 Theatres	1		Grouped with 1-P1-011	35
1	1-P1-011	Room 3 - Ensuite	P1	P1 Theatres	1		Grouped with 1-P1-010	0
1	1-P1-012	Discharge Lounge	P1	P1 Theatres	1			200
1	1-P1-013	WC - Wheelchair accessible	P1	P1 Theatres	1			0.8
1	1-P1-014	Patient Interview Room	P1	P1 Theatres	1			0.8
1	1-P1-015	Clean Utility (Dispensary)	P1	P1 Theatres	1			200
1	1-P1-016	Pantry (DCU)	P1	P1 Theatres	1			21
1	1-P1-017	Wheelchair Parking Bay	P1	P1 Theatres	1		Not measurable against availability standards	0
1	1-P1-018	Linen Bay (1 trolley) - RHSC	P1	P1 Theatres	1		Not measurable against availability standards	0
1	1-P1-019	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-020	WC - Ambulant (Patients)	P1	P1 Theatres	1			0.8

1	1-P1-021	Staff Base - Recovery	P1	P1 Theatres	1			21
1	1-P1-022	Clean Utility (Recovery)	P1	P1 Theatres	1			50
1	1-P1-023	Dirty Utility (Recovery)	P1	P1 Theatres	1			21
1	1-P1-024	Recovery	P1	P1 Theatres	1			200
1	1-P1-025	Recovery Bay 6	P1	P1 Theatres	1			200
1	1-P1-026	Recovery Bay 10	P1	P1 Theatres	1			200
1	1-P1-027	Linen Bay (1 trolley) - RHSC	P1	P1 Theatres	1		Not measurable against availability standards	0
1	1-P1-028	Recovery Staff Base	P1	P1 Theatres	1			200
1	1-P1-029	Post-Op Recovery	P1	P1 Theatres	1			200
1	1-P1-030	Bay 5	P1	P1 Theatres	1			200
1	1-P1-031	Bay 6	P1	P1 Theatres	1			200
1	1-P1-032	Theatre 30	P1	P1 Theatres	1		Grouped with 1-P1-039, 1-P1-034, 1-P1-033	200
1	1-P1-033	Anaesthetic Room 30	P1	P1 Theatres	1		Grouped with 1-P1-032	0
1	1-P1-034	Scrub Room 30	P1	P1 Theatres	1		Grouped with 1-P1-032	0
1	1-P1-035	Dictation/ 1:1/Phone Booth (RHSC)	P1	P1 Theatres	1			0.2
1	1-P1-036	Image Intensifier Bay (RHSC)	P1	P1 Theatres	1			0.8
1	1-P1-037	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-038	Satellite Pharmacy Store	P1	P1 Theatres	1			21
1	1-P1-039	Prep Room 30	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-040	Exit Bay 1 (RHSC)	P1	P1 Theatres	1			200
1	1-P1-041	Utility Room 1 (RHSC)	P1	P1 Theatres	1	Consequential impact on 1-P1-032, 1-P1-044		75
1	1-P1-042	Bronchoscope Parking Bay	P1	P1 Theatres	1		Grouped with 1-P1-037	0
1	1-P1-043	Mobile X-Ray / Ultrasound Bay	P1	P1 Theatres	1			0.8
1	1-P1-044	Theatre 31	P1	P1 Theatres	1		Grouped with 1-P1-047, 1-P1-046, 1-P1-045, 1-P1-041	200
1	1-P1-045	Prep Room 31	P1	P1 Theatres	1		Grouped with 1-P1-044	0
1	1-P1-046	Scrub Room 31	P1	P1 Theatres	1		Grouped with 1-P1-044	0
1	1-P1-047	Anaesthetic Room 31	P1	P1 Theatres	1		Grouped with 1-P1-044	0
1	1-P1-048	DSR	P1	P1 Theatres	1			16
1	1-P1-049	Clean Scopes Store	P1	P1 Theatres	1			0.8
1	1-P1-050	Theatre 35	P1	P1 Theatres	1		Grouped with 1-P1-152, 1-P1-196, 1-P1-154, 1-P1-156	200
1	1-P1-051	MRI Reporting	P1	P1 Theatres	1		Grouped with 1-P1-064	200
1	1-P1-052	WC - Staff	P1	P1 Theatres	1			0.6
1	1-P1-053	Staff Room	P1	P1 Theatres	1			0.8
1	1-P1-054	Sub Waiting (3 person)	P1	P1 Theatres	1			0.8
1	1-P1-055	Holding Bay 2	P1	P1 Theatres	1			200
1	1-P1-056	Holding Bay 1	P1	P1 Theatres	1			200
1	1-P1-057	Trolley Bay	P1	P1 Theatres	1		Not measurable against availability standards	0
1	1-P1-058	Angiography Procedures Machine Room	P1	P1 Theatres	1		Grouped with 1-P1-093	0
1	1-P1-059	Angio Preparation Room	P1	P1 Theatres	1		Grouped with 1-P1-093	0
1	1-P1-060	Trolley Bay	P1	P1 Theatres	1		Not measurable against availability standards	0
1	1-P1-061	WC - Wheelchair accessible	P1	P1 Theatres	1			0.8

1	1-P1-062	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-063	MRI 5 Preparation Room	P1	P1 Theatres	1		Grouped with 1-P1-064	200
1	1-P1-064	MRI 5	P1	P1 Theatres	1		Grouped with 1-P1-063, 1-P1-051, 1-P1-065, 1-P1-068	200
1	1-P1-065	MRI 5 Control Room	P1	P1 Theatres	1		Grouped with 1-P1-064	0
1	1-P1-066	Angio Anaesthetic Room	P1	P1 Theatres	1		Grouped with 1-P1-093	0
1	1-P1-067	Exit Bay 6	P1	P1 Theatres	1			200
1	1-P1-068	Equipment Room - MRI	P1	P1 Theatres	1		Grouped with 1-P1-064	0
1	1-P1-069	Anaesthetic Room 37	P1	P1 Theatres	1		Grouped with 1-P1-070	0
1	1-P1-070	Theatre 37	P1	P1 Theatres	1		Grouped with 1-P1-077, 1-P1-075, 1-P1-071, 1-P1-069	200
1	1-P1-071	Scrub Room 37	P1	P1 Theatres	1		Grouped with 1-P1-070	0
1	1-P1-072	Prep Room 39	P1	P1 Theatres	1		Grouped with 1-P1-091	0
1	1-P1-073	Scrub Room 39	P1	P1 Theatres	1		Grouped with 1-P1-091	0
1	1-P1-074	Anaesthetic Room 39	P1	P1 Theatres	1		Grouped with 1-P1-091	0
1	1-P1-075	Prep Room 37	P1	P1 Theatres	1		Grouped with 1-P1-070	0
1	1-P1-076	Exit Bay 5	P1	P1 Theatres	1			200
1	1-P1-077	Utility Room 5	P1	P1 Theatres	1	Consequential impact on 1-P1-070, 1-P1-078		75
1	1-P1-078	Theatre 38	P1	P1 Theatres	1		Grouped with 1-P1-080, 1-P1-184, 1-P1-079,	200
1	1-P1-079	Prep Room 38	P1	P1 Theatres	1		Grouped with 1-P1-078	0
1	1-P1-080	Scrub Room 38	P1	P1 Theatres	1		Grouped with 1-P1-078	0
1	1-P1-082A	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-082B	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-083	Dictation/ 1:1/Phone Booth (DCN)	P1	P1 Theatres	1			0.2
1	1-P1-084	Image Intensifier Bay (DCN)	P1	P1 Theatres	1			0.8
1	1-P1-085	Dictation/ 1:1/Phone Booth (DCN)	P1	P1 Theatres	1			0.2
1	1-P1-086	Medical Gas Cylinder Store	P1	P1 Theatres	1			0.8
1	1-P1-087	Clinical Equipment Store	P1	P1 Theatres	1			0.4
1	1-P1-088	IPS Room	P1	P1 Theatres	1			200
1	1-P1-089	DCN Management Office	P1	P1 Theatres	1			0.4
1	1-P1-090	Dirty Utility: bedpan disposal & urine test	P1	P1 Theatres	1			35
1	1-P1-091	Theatre 39	P1	P1 Theatres	1		Grouped with 1-P1-074, 1-P1-073, 1-P1-072,	200
1	1-P1-092	Utility Room 6	P1	P1 Theatres	1	Consequential impact on 1-P1-093, 1-P1-091		75
1	1-P1-093	Angiography Procedures Room	P1	P1 Theatres	1		Grouped with 1-P1-059, 1-P1-066, 1-P1-058, 1-P1-094	200
1	1-P1-094	Angiography Procedures Control Room	P1	P1 Theatres	1		Grouped with 1-P1-093	0
1	1-P1-095	Sterile Supplies Store	P1	P1 Theatres	1			0.8
1	1-P1-097	Image Trolley Bay	P1	P1 Theatres	1			50
1	1-P1-098	WC - Staff	P1	P1 Theatres	1			0.6
1	1-P1-099	Sterile Supplies Store	P1	P1 Theatres	1			0.8
1	1-P1-100	Female Staff Changing and Lockers	P1	P1 Theatres	1			0.7
1	1-P1-101	Clean Trays	P1	P1 Theatres	1			0.6
1	1-P1-102	Male Staff Changing and Lockers	P1	P1 Theatres	1			0.7
1	1-P1-103	Footwear Machine Washing Area	P1	P1 Theatres	1			0.8

1	1-P1-104	Dirty Trays (DCN)	P1	P1 Theatres	1			0.6
1	1-P1-105	Disposal Hold (DCN)	P1	P1 Theatres	1			0.8
1	1-P1-106	Clean Utility	P1	P1 Theatres	1			50
1	1-P1-107	Resuscitation Trolley Bay	P1	P1 Theatres	1			0.1
1	1-P1-108	Linen Bay (1 trolley) - DCN	P1	P1 Theatres	1		Not measurable against availability standards	0
1	1-P1-109	Recovery (8 bays)	P1	P1 Theatres	1			200
1	1-P1-110	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-113	Staff Base	P1	P1 Theatres	1			50
1	1-P1-114	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-115	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-116	Consulting Room 2	P1	P1 Theatres	1			16
1	1-P1-117	IPS Room	P1	P1 Theatres	1			200
1	1-P1-118	Consulting Room 3	P1	P1 Theatres	1			16
1	1-P1-119	Reception	P1	P1 Theatres	1			0.8
1	1-P1-120	Consulting Room 1	P1	P1 Theatres	1			16
1	1-P1-121	Interview, Counselling & Quiet Room	P1	P1 Theatres	1			10
1	1-P1-122	WC - Wheelchair accessible	P1	P1 Theatres	1			0.8
1	1-P1-123	WC - Wheelchair accessible	P1	P1 Theatres	1			0.8
1	1-P1-124	Store	P1	P1 Theatres	1			0.4
1	1-P1-125	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-126	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-127	Changing Cubicle	P1	P1 Theatres	1			16
1	1-P1-128	Admissions Lounge	P1	P1 Theatres	1			100
1	1-P1-129	Theatre 33	P1	P1 Theatres	1		Grouped with 1-P1-138, 1-P1-136, 1-P1-137	200
1	1-P1-130	Utility Room 2 (RHSC)	P1	P1 Theatres	1	Consequential impact on 1-P1-129, 1-P1-131		75
1	1-P1-131	Theatre 32	P1	P1 Theatres	1		Grouped with 1-P1-132, 1-P1-133, 1-P1-134	200
1	1-P1-132	Anaesthetic Room 32	P1	P1 Theatres	1		Grouped with 1-P1-131	0
1	1-P1-133	Scrub Room 32	P1	P1 Theatres	1		Grouped with 1-P1-131	0
1	1-P1-134	Prep Room 32	P1	P1 Theatres	1		Grouped with 1-P1-131	0
1	1-P1-135	Exit Bay 2 (RHSC)	P1	P1 Theatres	1			200
1	1-P1-136	Prep Room 33	P1	P1 Theatres	1		Grouped with 1-P1-129	0
1	1-P1-137	Scrub Room 33	P1	P1 Theatres	1		Grouped with 1-P1-129	0
1	1-P1-138	Anaesthetic Room 33	P1	P1 Theatres	1		Grouped with 1-P1-129	0
1	1-P1-140	Theatre 34	P1	P1 Theatres	1		Grouped with 1-P1-148, 1-P1-141, 1-P1-149,	200
1	1-P1-141	Anaesthetic Room 34	P1	P1 Theatres	1		Grouped with 1-P1-140	0
1	1-P1-142	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-143	RHCYP Management Office	P1	P1 Theatres	1			0.4
1	1-P1-144	Image Intensifier Bay (RHSC)	P1	P1 Theatres	1			0.8

1	1-P1-145	Dictation/ 1:1/Phone Booth (RHSC)	P1	P1 Theatres	1			0.2
1	1-P1-146	Clinical Equipment Store	P1	P1 Theatres	1			0.4
1	1-P1-147	Staff Office (4 person)	P1	P1 Theatres	1			0.4
1	1-P1-148	Scrub Room 34	P1	P1 Theatres	1		Grouped with 1-P1-140	0
1	1-P1-149	Prep Room 34	P1	P1 Theatres	1		Grouped with 1-P1-140	0
1	1-P1-150	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor, Deductions accrued based on any subsequent impact on rooms attached to corridor	0
1	1-P1-151	Exit Bay 3 (RHSC)	P1	P1 Theatres	1			200
1	1-P1-152	Utility Room 3 (RHSC)	P1	P1 Theatres	1	Consequential impact on 1-P1-050, 1-P1-140		75
1	1-P1-153	Prep Room 36	P1	P1 Theatres	1		Grouped with 1-P1-155	0
1	1-P1-154	Scrub Room 35	P1	P1 Theatres	1		Grouped with 1-P1-050	0
1	1-P1-155	Theatre 36	P1	P1 Theatres	1		Grouped with 1-P1-185, 1-P1-153, 1-P1-187, 1-P1-183	200
1	1-P1-156	Anaesthetic Room 35	P1	P1 Theatres	1		Grouped with 1-P1-050	0
1	1-P1-158	Dirty Scopes Store	P1	P1 Theatres	1			21
1	1-P1-159	Store - Plaster	P1	P1 Theatres	1			0.2
1	1-P1-161	Disposal Hold (RHSC)	P1	P1 Theatres	1			0.9
1	1-P1-162	Staff Reception / Office / Control Base	P1	P1 Theatres	1			0.8
1	1-P1-163	DSR	P1	P1 Theatres	1			16
1	1-P1-164	Changing Cubicle 2	P1	P1 Theatres	1			16
1	1-P1-165	Changing Cubicle 1	P1	P1 Theatres	1			16
1	1-P1-166A	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-166B	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-167	Changing Cubicle 3	P1	P1 Theatres	1			16
1	1-P1-168	WC - Wheelchair accessible	P1	P1 Theatres	1			0.8
1	1-P1-169	WC - Wheelchair accessible	P1	P1 Theatres	1			0.8
1	1-P1-170	Immediate Pre Theatre Wait	P1	P1 Theatres	1			200
1	1-P1-171	WC - Staff	P1	P1 Theatres	1			0.8
1	1-P1-172	Senior Charge Nurse Office	P1	P1 Theatres	1			0.4
1	1-P1-173	Locker Bay	P1	P1 Theatres	1			0.8
1	1-P1-174	General Office (2 person)	P1	P1 Theatres	1			0.4
1	1-P1-175	Reception (2 person)	P1	P1 Theatres	1			0.8
1	1-P1-176	Consulting Room 6	P1	P1 Theatres	1			10
1	1-P1-177	Consulting Room 7	P1	P1 Theatres	1			10
1	1-P1-178	Main Waiting/Play Area	P1	P1 Theatres	1			0.8
1	1-P1-179	WC - Wheelchair accessible	P1	P1 Theatres	1			0.8
1	1-P1-180	WC - Wheelchair accessible	P1	P1 Theatres	1			0.8
1	1-P1-182A	Switch Cupboard	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-182B	Switch Cupboard	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-183	Anaesthetic Room 36	P1	P1 Theatres	1		Grouped with 1-P1-155	0
1	1-P1-184	Anaesthetic Room 38	P1	P1 Theatres	1		Grouped with 1-P1-078	0

1	1-P1-185	Scrub Room 36	P1	P1 Theatres	1		Grouped with 1-P1-155	0
1	1-P1-186	Exit Bay 4	P1	P1 Theatres	1			200
1	1-P1-187	Utility (interoperative)	P1	P1 Theatres	1		Grouped with 1-P1-155	75
1	1-P1-189	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-190	Corridor	P1	P1 Theatres	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	1-P1-191	Switch Cupboard	P1	P1 Theatres	1		Project Co Space	0
1	1-P1-192	Switch Cupboard	P1	P1 Theatres	1		Project Co Space	0
1	1-P1-193	Toy Wash Store	P1	P1 Theatres	1			0.8
1	1-P1-194	Cleaner Cupboard	P1	P1 Theatres	1			0.8
1	1-P1-195	Store (RHSC)	P1	P1 Theatres	1			0.8
1	1-P1-196	Prep Room 35	P1	P1 Theatres	1		Grouped with 1-P1-050	0
1	1-P1-197	IV Store	P1	P1 Theatres	1			21
1	1-P1-199	Corridor	P1	P1 Theatres	1		Project Co Space	0
1	1-T2-001: V1	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-002: V4	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-003: V2	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-004:KEF	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-005: E1	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-006: E2	Riser Plant	Plant	1st Floor	1		Project Co Space	0
1	1-T2-007: M2	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-008: V5	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-009: V10	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-010: E3	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-011: V3	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-012	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-013: V13	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-014: V6	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-015: E4	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-016: M3	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-017:V	Riser Plant	Plant	1st Floor	1		Project Co Space	0
1	1-T2-018: QP	Riser Plant	Plant	1st Floor	1		Project Co Space	0
1	1-T2-019: V12	Riser	Plant	1st Floor	1		Project Co Space	0
1	1-T2-020	Riser Plant	Plant	1st Floor	1		Project Co Space	0
1	1-T2-021	Spare	Plant	1st Floor	1		Project Co Space	0
1	2-PLANT-001	AHU Plant	Plant	2nd Floor	1		Project Co Space	0
1	2-PLANT-001A	Theatre Plant Room 01	Plant	2nd Floor	1		Project Co Space	0
1	2-PLANT-001B	Theatre Plant Room 02	Plant	2nd Floor	1		Project Co Space	0
1	2-PLANT-001C	Theatre Plant Room 03	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-001:V1	Riser	Plant	2nd Floor	1		Project Co Space	0

1	2-T2-002:V4	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-003:V2	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-004:KEF	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-005:E1	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-006:E2	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-007:M2	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-008:V5	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-009:V10	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-010:E3	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-011:V3	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-012	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-013:V13	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-014:M3	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-016:E4	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-017:V12	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-018:QP	Riser	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-019	Riser Plant	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-021	Spare	Plant	2nd Floor	1		Project Co Space	0
1	2-T2-022	Riser	Plant	2nd Floor	1		Project Co Space	0
1	3-T2-001:V1	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-002:V4	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-003:V2	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-004:KEF	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-005:E1	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-006:E2	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-007:M2	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-008:M3	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-009:V10	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-010:E3	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-011:V3	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-012	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-013:V13	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-014:E4	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-015:V12	Riser	Plant	Third Floor	1		Project Co Space	0
1	3-T2-018:QP	Riser Plant	Plant	Third Floor	1		Project Co Space	0
1	3-T2-019	Riser Plant	Plant	Third Floor	1		Project Co Space	0
1	3-T2-020	Riser	Plant	Third Floor	1		Project Co Space	0
1	4-PLANT-001	Central AHU Plant Room 01	Plant	4th Floor	1		Project Co Space	0
1	4-PLANT-002	Central AHU Plant Room 02	Plant	4th Floor	1		Project Co Space	0

1	4-PLANT-004	AHU Plant Room East	Plant	4th Floor	1		Project Co Space	0
1	4-PLANT-005	AHU Plant Room West	Plant	4th Floor	1		Project Co Space	0
1	4-PLANT-006	Water Tank Room	Plant	4th Floor	1		Project Co Space	0
1	4-PLANT-007	Medical Gas Plant Room	Plant	4th Floor	1		Project Co Space	0
1	4-PLANT-008	Medical Gas Bottle St	Plant	4th Floor	1			0.8
1	4-T2-001:V1	Riser	Plant	4th Floor	1		Project Co Space	0
1	4-T2-002:V4	Riser	Plant	4th Floor	1		Project Co Space	0
1	4-T2-003:V2	Riser	Plant	4th Floor	1		Project Co Space	0
1	4-T2-004:KEF	Riser	Plant	4th Floor	1		Project Co Space	0
1	4-T2-005:E1	Riser	Plant	4th Floor	1		Project Co Space	0
1	4-T2-006:E2	Riser	Plant	4th Floor	1		Project Co Space	0
1	4-T2-007:M2	Riser	Plant	4th Floor	1		Project Co Space	0
1	4-T2-009:V10	Riser	Plant	4th Floor	1		Project Co Space	0
1	4-T2-010:E3	Riser	Plant	4th Floor	1		Project Co Space	0
1	4-T2-011:M3	Riser	Plant	4th Floor	1		Project Co Space	0
1	4-T2-017	Riser	Plant	4th Floor	1		Project Co Space	0
1	4-T2-018:QP	Riser Plant	Plant	4th Floor	1		Project Co Space	0
1	B-PLANT-001A	HV Plant Room 01	Plant	Basement	1		Project Co Space	0
1	B-PLANT-001B	HV Plant Room 02	Plant	Basement	1		Project Co Space	0
1	B-PLANT-001C	HV Plant Room Lobby	Plant	Basement	1		Project Co Space	0
1	B-PLANT-002	Heat Station 04	Plant	Basement	1		Project Co Space	0
1	B-PLANT-003	Heat Station 01	Plant	Basement	1		Project Co Space	0
1	B-PLANT-004	Water Tank Room	Plant	Basement	1		Project Co Space	0
1	B-PLANT-005	UPS Plant Room	Plant	Basement	1		Project Co Space	0
1	B-PLANT-006	Heat Station 02	Plant	Basement	1		Project Co Space	0
1	B-PLANT-007A	HV Plant Room 03	Plant	Basement	1		Project Co Space	0
1	B-PLANT-007B	HV Plant Room 04	Plant	Basement	1		Project Co Space	0
1	B-PLANT-008	Rainwater Tank Room	Plant	Basement	1		Project Co Space	0
1	B-PLANT-009	Sprinkler Plant Room	Plant	Basement	1		Project Co Space	0
1	B-PLANT-010	Heat Station 03	Plant	Basement	1		Project Co Space	0
1	B-PLANT-011	PTS Plant Room	Plant	Basement	1		Project Co Space	0
1	B-PLANT-015	Plant Room	Plant	Basement	1		Project Co Space	0
1	B-T2-001:E3	Riser Plant	Plant	Basement	1		Project Co Space	0
1	B-T2-002:M3	Riser Plant	Plant	Basement	1		Project Co Space	0
1	B-T2-003:V10	Riser Plant	Plant	Basement	1		Project Co Space	0
1	B-T2-004:V3	Riser Plant	Plant	Basement	1		Project Co Space	0
1	B-T2-005: E2	Riser Plant	Plant	Basement	1		Project Co Space	0
1	B-T2-006: E1	Riser Plant	Plant	Basement	1		Project Co Space	0
1	B-T2-007:KEF	Riser Access	Plant	Basement	1		Project Co Space	0
1	B-T2-008	Lift Control	Plant	Basement	1		Project Co Space	0

1	B-T2-009	[illegible]	Plant	Basement	1		Project Co Space	0
1	B-T2-011: V	Riser Plant	Plant	Basement	1		Project Co Space	0
1	G-T2-002:V10	Riser Plant	Plant	Basement	1		Project Co Space	0
1	G-T2-003: E3	Riser Plant	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-003: V3	Riser Plant	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-004: M3	Riser Plant	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-005: V5	Riser Plant	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-006: M2	Riser Plant	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-008: E1	Riser Plant	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-009:KEF	Riser Plant	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-010A:E4	Riser	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-011	Riser Plant	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-012	Manifold	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-013	Manifold	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-014	Plant Room	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-015	Riser	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-016:V	Riser Plant	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-T2-017	Riser	Plant	Ground Floor Layout	1		Project Co Space	0
1	G-Q1-001A	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-001B	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-002	IPS Room	Q1	Q1 Radiology	1			200
1	G-Q1-003	Nappy Change	Q1	Q1 Radiology	1			0.8
1	G-Q1-004	General X-Ray Room 1	Q1	Q1 Radiology	1			200
1	G-Q1-005	Changing Cubicle 1 (X-Ray Room 1)	Q1	Q1 Radiology	1			16
1	G-Q1-006	Changing Cubicle 2 (X-Ray Room 1)	Q1	Q1 Radiology	1			16
1	G-Q1-007	Trolley Bay	Q1	Q1 Radiology	1		Not measurable against availability standards	0
1	G-Q1-008	Processing Area	Q1	Q1 Radiology	1	Consequential impact on G-Q1-012, G-Q1-004		200
1	G-Q1-009	Acute Reporting	Q1	Q1 Radiology	1			200
1	G-Q1-010	Utrasound Room 1	Q1	Q1 Radiology	1			200
1	G-Q1-011	Changing Cubicle 3	Q1	Q1 Radiology	1			16
1	G-Q1-012	General X-Ray Room 2	Q1	Q1 Radiology	1			200
1	G-Q1-013	Changing Cubicle 4	Q1	Q1 Radiology	1			16
1	G-Q1-014	Ultrasound Room 2	Q1	Q1 Radiology	1			200
1	G-Q1-015	Changing Cubicle 5	Q1	Q1 Radiology	1		Grouped with G-Q1-016	16
1	G-Q1-016	Fluroscopy Screening Room	Q1	Q1 Radiology	1		Grouped with G-Q1-015, G-Q1-017	200
1	G-Q1-017	Fluroscopy Prep Room	Q1	Q1 Radiology	1		Grouped with G-Q1-016	0
1	G-Q1-018	Ultrasound Waiting Area	Q1	Q1 Radiology	1			0.8
1	G-Q1-019	WC - Wheelchair accessible	Q1	Q1 Radiology	1			0.8
1	G-Q1-020	Patient Interview Room	Q1	Q1 Radiology	1			0.8
1	G-Q1-021	Baby/Infant Feeding Room	Q1	Q1 Radiology	1			0.8
1	G-Q1-022	WC - Wheelchair accessible	Q1	Q1 Radiology	1			0.8
1	G-Q1-023	Registrars Office (5 desks)	Q1	Q1 Radiology	1			0.4
1	G-Q1-024	Dirty Utility	Q1	Q1 Radiology	1			21

1	G-Q1-025	Radioactive Waste Store	Q1	Q1 Radiology	1			200
1	G-Q1-026	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-027	Cold Waiting Area Room 1	Q1	Q1 Radiology	1			0
1	G-Q1-028	Radioisotope Preparation Room	Q1	Q1 Radiology	1			35
1	G-Q1-029	WC - Wheelchair accessible (Hot) Room 1	Q1	Q1 Radiology	1			16
1	G-Q1-030	Gamma Camera Admin Office (2 person)	Q1	Q1 Radiology	1			0.4
1	G-Q1-031	Medical Physics Office (2 person)	Q1	Q1 Radiology	1			0.4
1	G-Q1-032	Radio Nuclide Imaging Reporting	Q1	Q1 Radiology	1			200
1	G-Q1-033	Emergency Shower	Q1	Q1 Radiology	1			200
1	G-Q1-034	Hot Waiting Area Room 1	Q1	Q1 Radiology	1			16
1	G-Q1-035	Radioisotope Injection Room 1	Q1	Q1 Radiology	1		Grouped with G-Q1-039	0
1	G-Q1-036	Recovery Area 1	Q1	Q1 Radiology	1			200
1	G-Q1-037	Changing Cubicle Room 1	Q1	Q1 Radiology	1			16
1	G-Q1-038	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-039	Radio Nuclide Imaging 1	Q1	Q1 Radiology	1		Grouped with G-Q1-035	200
1	G-Q1-040	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-042	Control Room	Q1	Q1 Radiology	1	Consequential impact on G-Q1-044, G-Q1-039		200
1	G-Q1-043	Changing Room 2	Q1	Q1 Radiology	1			16
1	G-Q1-044	Radio Nuclide Imaging 2	Q1	Q1 Radiology	1		Grouped with G-Q1-045	200
1	G-Q1-045	Radioisotope Injection Room 2	Q1	Q1 Radiology	1		Grouped with G-Q1-044	0
1	G-Q1-046	Stress Room	Q1	Q1 Radiology	1			16
1	G-Q1-047	Hot Waiting Area Room 2	Q1	Q1 Radiology	1			16
1	G-Q1-048	WC - Wheelchair accessible (Hot) Room 2	Q1	Q1 Radiology	1			16
1	G-Q1-049	WC - Wheelchair accessible (Cold)	Q1	Q1 Radiology	1			0.8
1	G-Q1-050	Cold Waiting Area Room 2	Q1	Q1 Radiology	1			0
1	G-Q1-051	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-052	Radioisotope Counting Laboratory	Q1	Q1 Radiology	1			200
1	G-Q1-053	DSR	Q1	Q1 Radiology	1			16
1	G-Q1-054	Meeting Room 1	Q1	Q1 Radiology	1			0.4
1	G-Q1-055	Meeting Room 2	Q1	Q1 Radiology	1			0.4
1	G-Q1-056	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-057	Other Clinical Staff Office (7 person)	Q1	Q1 Radiology	1			0.4
1	G-Q1-058	Acute Reporting	Q1	Q1 Radiology	1			200
1	G-Q1-059	CT Room 1	Q1	Q1 Radiology	1		Grouped with G-Q1-066	200
1	G-Q1-061	WC - Wheelchair accessible	Q1	Q1 Radiology	1			0.8
1	G-Q1-062	WC - Ambulant (Patients)	Q1	Q1 Radiology	1			0.8
1	G-Q1-063	Linen Bay (1 trolley)	Q1	Q1 Radiology	1		Not measurable against availability standards	0

1	G-Q1-064	Resuscitation Trolley Bay	Q1	Q1 Radiology	1			0.1
1	G-Q1-065	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-065A	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-065B	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-066	Preparation Room	Q1	Q1 Radiology	1		Grouped with G-Q1-059	0
1	G-Q1-067	WC - Wheelchair accessible	Q1	Q1 Radiology	1			0.8
1	G-Q1-069	CT - Changing Cubicle 1	Q1	Q1 Radiology	1			0.8
1	G-Q1-070	CT - Changing Cubicle 2	Q1	Q1 Radiology	1			16
1	G-Q1-071	Control Room - CT	Q1	Q1 Radiology	1			16
1	G-Q1-072	Imaging Reporting	Q1	Q1 Radiology	1	Consequential impact on G-Q1-059		0
1	G-Q1-073	Quiet Reporting	Q1	Q1 Radiology	1			200
1	G-Q1-074	DCN Consultant Office (5 person)	Q1	Q1 Radiology	1			200
1	G-Q1-075	DCN Consultant Office (5 person)	Q1	Q1 Radiology	1			0.4
1	G-Q1-076	Ultrasound Admin Office (3 person)	Q1	Q1 Radiology	1			0.4
1	G-Q1-077	Admin Office (7 person)	Q1	Q1 Radiology	1			0.4
1	G-Q1-078	Waiting Area - Main Dept	Q1	Q1 Radiology	1			0.4
1	G-Q1-079	Reception (2 person)	Q1	Q1 Radiology	1			0.8
1	G-Q1-080	Waiting Area	Q1	Q1 Radiology	1			0.8
1	G-Q1-081	Doppler Ultrasound	Q1	Q1 Radiology	1			0.8
1	G-Q1-082	Meeting Room 3	Q1	Q1 Radiology	1			200
1	G-Q1-083	Photocopy Room	Q1	Q1 Radiology	1			0.4
1	G-Q1-084	Disposal Hold	Q1	Q1 Radiology	1			0.4
1	G-Q1-085	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-086	MRI 4 Control Room (Shelled Space)	Q1	Q1 Radiology	1			0.8
1	G-Q1-087	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-089	Inpatient Holding Bay	Q1	Q1 Radiology	1	Consequential impact on G-Q1-092		50
1	G-Q1-092	MRI 4 (Shelled Space)	Q1	Q1 Radiology	1			10
1	G-Q1-094	Waiting Area	Q1	Q1 Radiology	1		Grouped with G-Q1-099	200
1	G-Q1-095	Cubicle 1	Q1	Q1 Radiology	1			0.8
1	G-Q1-096	Cubicle 2	Q1	Q1 Radiology	1			0.8
1	G-Q1-097	WC - Wheelchair accessible	Q1	Q1 Radiology	1			0.8
1	G-Q1-098	Recovery Bay	Q1	Q1 Radiology	1			0.8
1	G-Q1-098	Recovery Bay	Q1	Q1 Radiology	1			200
1	G-Q1-099	Equipment Room 1 (Shelled Space)	Q1	Q1 Radiology	1		Grouped with G-Q1-092	0.2
1	G-Q1-100	Equipment Room 2	Q1	Q1 Radiology	1		Grouped with G-Q1-110	0
1	G-Q1-102	DSR	Q1	Q1 Radiology	1			16
1	G-Q1-103	Cubicle 3	Q1	Q1 Radiology	1			0.8
1	G-Q1-104	Cubicle 4	Q1	Q1 Radiology	1			0.8
1	G-Q1-105	Cubicle 5	Q1	Q1 Radiology	1			0.8

1	G-Q1-106	Cubicle 6	Q1	Q1 Radiology	1			0.8
1	G-Q1-107	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-108	Adult Injection Room 1	Q1	Q1 Radiology	1			200
1	G-Q1-109	WC - Ambulant	Q1	Q1 Radiology	1			0.8
1	G-Q1-110	MRI 3	Q1	Q1 Radiology	1		Grouped with G-Q1-100	200
1	G-Q1-111	MRI 3/4 Control Room	Q1	Q1 Radiology	1	Consequential impact on G-Q1-110, G-Q1-123		200
1	G-Q1-112	Clean Utility	Q1	Q1 Radiology	1			50
1	G-Q1-113	Dirty Utility	Q1	Q1 Radiology	1			21
1	G-Q1-114	Store Room	Q1	Q1 Radiology	1			0.1
1	G-Q1-115	Adult Waiting Area	Q1	Q1 Radiology	1			0.6
1	G-Q1-116	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-119	Waiting Area	Q1	Q1 Radiology	1			0.8
1	G-Q1-120	MRI Reporting	Q1	Q1 Radiology	1			200
1	G-Q1-121	Baby/Infant Feeding Room	Q1	Q1 Radiology	1			0.8
1	G-Q1-122	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Q1-123	MRI 2	Q1	Q1 Radiology	1		Grouped with G-Q1-124	200
1	G-Q1-124	Equipment Room 3	Q1	Q1 Radiology	1		Grouped with G-Q1-123	0
1	G-Q1-125	Recovery Area - 1 place	Q1	Q1 Radiology	1			200
1	G-Q1-126	WC - Wheelchair accessible	Q1	Q1 Radiology	1			0.8
1	G-Q1-127	WC - Fully accessible changing room	Q1	Q1 Radiology	1			0.8
1	G-Q1-128	Cubicle 7 - Accessible	Q1	Q1 Radiology	1			16
1	G-Q1-129	Cubicle 8 - Accessible	Q1	Q1 Radiology	1			16
1	G-Q1-130	Induction Area - 1 place	Q1	Q1 Radiology	1			200
1	G-Q1-131	WC - Staff	Q1	Q1 Radiology	1			0.6
1	G-Q1-132	WC - Wheelchair accessible	Q1	Q1 Radiology	1			0.8
1	G-Q1-133	Equipment Room - MRI	Q1	Q1 Radiology	1		Grouped with G-Q1-134	0
1	G-Q1-134	MRI Room	Q1	Q1 Radiology	1		Grouped with G-Q1-133	200
1	G-Q1-135	Control Room - CT/MRI	Q1	Q1 Radiology	1	Consequential impact on G-Q1-134, G-Q1-136		200
1	G-Q1-136	CT Room	Q1	Q1 Radiology	1			200
1	G-Q1-137	Main Reporting	Q1	Q1 Radiology	1			200
1	G-Q1-138	Resuscitation Trolley Bay	Q1	Q1 Radiology	1			0.1
1	G-Q1-139	Linen Bay (1 trolley)	Q1	Q1 Radiology	1		Grouped with G-Q1-100	0
1	G-Q1-140	IPS Room	Q1	Q1 Radiology	1			200
1	G-Q1-141	Dental Room	Q1	Q1 Radiology	1			200
1	G-Q1-142	Disposal Hold	Q1	Q1 Radiology	1			0.6
1	G-Q1-143	WC - Staff	Q1	Q1 Radiology	1			0.6
1	G-Q1-144	Female Staff Changing and Lockers	Q1	Q1 Radiology	1			0.7
1	G-Q1-145	Trolley Bay	Q1	Q1 Radiology	1		Grouped with G-Q1-100	0
1	G-Q1-146	WC - Staff	Q1	Q1 Radiology	1			0.6
1	G-Q1-147	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0

1	G-Q1-148	Store Room	Q1	Q1 Radiology	1			0.1
1	G-Q1-149	Resource Room/Library	Q1	Q1 Radiology	1			0.7
1	G-Q1-150	Male Staff Changing and Lockers	Q1	Q1 Radiology	1			0.7
1	G-Q1-151	RHSC Consultant Office (5 person)	Q1	Q1 Radiology	1			0.4
1	G-Q1-152	Admin Office (4 person)	Q1	Q1 Radiology	1			0.4
1	G-Q1-153	Reception (2 person)	Q1	Q1 Radiology	1			0.8
1	G-Q1-155	Switch Cupboard	Q1	Q1 Radiology	1		Project Co Space	0
1	G-Q1-156	Switch Cupboard	Q1	Q1 Radiology	1		Project Co Space	0
1	G-Q1-157	Switch Cupboard	Q1	Q1 Radiology	1		Project Co Space	0
1	G-Q1-158	Switch Cupboard	Q1	Q1 Radiology	1		Project Co Space	0
1	G-Q1-160	Shelled Space	Q1	Q1 Radiology	1			0.8
1	G-Q1-161	Trolley Bay	Q1	Q1 Radiology	1		Not measurable against availability standards	0
1	G-Q1-162	Corridor	Q1	Q1 Radiology	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-R1-001	Staff Room (2nd floor)	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-002	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-003	Meeting Room - 4 person	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-004	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-005	Beverage Bay	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-006	Meeting Room - 6 person	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-007	DSR	R1	R1 Clinical Management Suite	1			16
1	2-R1-008	Store (Clinical)	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-009	Printer/Photocopier Room	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-010	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-011	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-012	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-013	WC - Staff (Female)	R1	R1 Clinical Management Suite	1			0.6
1	2-R1-014	WC - Staff (Male)	R1	R1 Clinical Management Suite	1			0.6
1	2-R1-015	Meeting Room - 6 person	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-016	WC - Wheelchair Accessible	R1	R1 Clinical Management Suite	1			0.6
1	2-R1-017	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-018	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-019	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-020	Printer/Photocopier Room	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-021	Beverage Bay	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-022	Disposal Hold (small)	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-023	Meeting Room - 4 person	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-024	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-025	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-026	Beverage Bay	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-027	Meeting Room - 4 person	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-028	Meeting Room - 4 person	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-029	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-030	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-031	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2

1	2-R1-032	WC - Wheelchair Accessible	R1	R1 Clinical Management Suite	1			0.6
1	2-R1-033	WC - Staff (Male)	R1	R1 Clinical Management Suite	1			0.6
1	2-R1-034	DSR	R1	R1 Clinical Management Suite	1			16
1	2-R1-035	Printer/Photocopier Room	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-036	Meeting Room - 4 person	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-037	Store (Clinical)	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-038	WC - Staff (Female)	R1	R1 Clinical Management Suite	1			0.6
1	2-R1-039	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-040	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-041	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-042	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-043	Store (Clinical)	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-044	Printer/Photocopier Room	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-045	Meeting Room - 4 person	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-046	Meeting Room - 4 person	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-047	Store (Clinical)	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-048	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	2-R1-049A	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1		grouped with 2-R1-049B	0.4
1	2-R1-049B	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1		grouped with 2-R1-049A	0
1	2-R1-050	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-051A	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1		grouped with 2-R1-051B	0.4
1	2-R1-051B	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1		grouped with 2-R1-051A	0
1	2-R1-051C	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1		grouped with 2-R1-051A	0
1	2-R1-052A	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1		grouped with 2-R1-052B	0.4
1	2-R1-052B	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1		grouped with 2-R1-052A	0
1	2-R1-052C	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1		grouped with 2-R1-052A	0
1	2-R1-053	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-054	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-055A	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-055B	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-055C	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-055D	2nd Floor Open Plan Desks	R1	R1 Clinical Management Suite	1			0.4
1	2-R1-056	Switch Cupboard	R1	R1 Clinical Management Suite	1		Project Co Space	0
1	2-R1-057	Corridor	R1	R1 Clinical Management Suite	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-R1-058	Corridor	R1	R1 Clinical Management Suite	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-R1-059	Corridor	R1	R1 Clinical Management Suite	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-R1-060	Corridor	R1	R1 Clinical Management Suite	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-R1-061	Corridor	R1	R1 Clinical Management Suite	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0

1	2-R1-062	Corridor	R1	R1 Clinical Management Suite	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-R1-063	Corridor	R1	R1 Clinical Management Suite	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-R1-064	Switch Cupboard	R1	R1 Clinical Management Suite	1		Project Co Space	0
1	2-R1-065	Switch Cupboard	R1	R1 Clinical Management Suite	1		Project Co Space	0
1	2-R1-066	Switch Cupboard	R1	R1 Clinical Management Suite	1		Project Co Space	0
1	2-R1-067	Switch Cupboard	R1	R1 Clinical Management Suite	1		Project Co Space	0
1	4-R1-001	Management/Conference Room	R1	R1 Clinical Management Suite	1			0.6
1	4-R1-002	Management/Conference Room	R1	R1 Clinical Management Suite	1			0.6
1	4-R1-003	Meeting Room - 6 person	R1	R1 Clinical Management Suite	1			0.4
1	4-R1-004	Beverage Bay	R1	R1 Clinical Management Suite	1			0.2
1	4-R1-005	WC - Staff (Male)	R1	R1 Clinical Management Suite	1			0.6
1	4-R1-006	WC - Wheelchair Accessible	R1	R1 Clinical Management Suite	1			0.6
1	4-R1-007	Meeting Room - 4 person	R1	R1 Clinical Management Suite	1			0.4
1	4-R1-008	WC - Staff (Female)	R1	R1 Clinical Management Suite	1			0.6
1	4-R1-009	Staff Room (4th floor)	R1	R1 Clinical Management Suite	1			0.4
1	4-R1-010	4th Floor Open Plan Desks	R1	R1 Clinical Management Suite	1			0.4
1	4-R1-011	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	4-R1-012	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	4-R1-013	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	4-R1-014	Dictation/ 1:1/Phone Booth	R1	R1 Clinical Management Suite	1			0.2
1	4-R1-015	Store(Management)	R1	R1 Clinical Management Suite	1			0.1
1	4-R1-016	Store(Management)	R1	R1 Clinical Management Suite	1			0.1
1	4-R1-017	DSR	R1	R1 Clinical Management Suite	1			16
1	4-R1-018	Disposal Hold (small)	R1	R1 Clinical Management Suite	1			0.9
1	4-R1-019	Printer/Photocopier Room	R1	R1 Clinical Management Suite	1			0.2
1	4-R1-020	Corridor	R1	R1 Clinical Management Suite	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-R1-021	Corridor	R1	R1 Clinical Management Suite	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-R1-022	Switch Cupboard	R1	R1 Clinical Management Suite	1		Project Co Space	0
1	4-R1-023	Switch Cupboard	R1	R1 Clinical Management Suite	1		Project Co Space	0
1	4-R2-001	Corridor	R2	R2 Health Records	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-R2-002	Office	R2	R2 Health Records	1			0.4
1	4-R2-003	Assistant Health Records Manager / Supervisors (4 person)	R2	R2 Health Records	1			0.4
1	4-R2-004	RHSC / DCN Office (17 Person)	R2	R2 Health Records	1			0.4
1	4-R2-005	WC - Staff	R2	R2 Health Records	1			0.8
1	4-R2-006	Receipt / Dispatch Counter	R2	R2 Health Records	1		Grouped with 4-R2-008	0
1	4-R2-007	Trolley Area	R2	R2 Health Records	1			0.8
1	4-R2-008	RHSC & DCN Records Library (160,000 records)	R2	R2 Health Records	1		Grouped with 4-R2-006	150
1	4-R2-009	Switch Cupboard	R2	R2 Health Records	1		Project Co Space	0

1	4-R2-010	WC - Staff	R2	R2 Health Records	1			0.8
1	4-R2-011	Dictation/ 1:1/Phone Booth	R2	R2 Health Records	1			0.2
1	B-S1-001	Preparation/Cooking Area	S1	S1 Kitchen	1		Grouped with B-S1-030	16
1	B-S1-005	Temperature Controlled Sandwich Prep	S1	S1 Kitchen	1			16
1	B-S1-006	Bakery Preparation Area	S1	S1 Kitchen	1			16
1	B-S1-007	Staff Room	S1	S1 Kitchen	1			0.4
1	B-S1-008	Office (5 person)	S1	S1 Kitchen	1			0.4
1	B-S1-009	Female Staff Changing inc Shower	S1	S1 Kitchen	1			0.7
1	B-S1-010	Male Staff Changing inc Shower	S1	S1 Kitchen	1			0.7
1	B-S1-012	Pan Wash	S1	S1 Kitchen	1			10
1	B-S1-013	Returned Trolleys	S1	S1 Kitchen	1			0.8
1	B-S1-015	Refuse	S1	S1 Kitchen	1			0.8
1	B-S1-016	DSR	S1	S1 Kitchen	1			16
1	B-S1-017	Clean Trolley Park	S1	S1 Kitchen	1			0.8
1	B-S1-018	Disposables / Detergent	S1	S1 Kitchen	1			0.8
1	B-S1-021	Freezer	S1	S1 Kitchen	1			16
1	B-S1-022	Freezer	S1	S1 Kitchen	1			16
1	B-S1-023	Receipt Bay	S1	S1 Kitchen	1			0.8
1	B-S1-024	Corridor	S1	S1 Kitchen	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-S1-025	Dairy Store	S1	S1 Kitchen	1			0.8
1	B-S1-027	Dry Goods	S1	S1 Kitchen	1			0.8
1	B-S1-028	Switch Cupboard	S1	S1 Kitchen	1		Project Co Space	0
1	B-S1-029	Switch Cupboard	S1	S1 Kitchen	1		Project Co Space	0
1	B-S1-030	Lobby	S1	S1 Kitchen	1		Grouped with B-S1-001	0
1	B-S1-031	Pick and Pack	S1	S1 Kitchen	1			16
1	2-S2-001	2-N01 - Core Server Room	S2	S2 E Health	1			16
1	B-S3-001	Corridor	S3	S3 Domestic Services	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-S3-002	Linen Pool (clean)	S3	S3 Domestic Services	1			16
1	B-S3-003	Supplies Store	S3	S3 Domestic Services	1			0.8
1	B-S3-004	Laundry (microfibre)	S3	S3 Domestic Services	1			16
1	B-S3-005	Linen Pool (dirty)	S3	S3 Domestic Services	1			16
1	B-S3-006	Corridor	S3	S3 Domestic Services	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-S3-007	Cleaning Equipment Store	S3	S3 Domestic Services	1			0.8
1	B-S3-008	Sanitary Bins Store	S3	S3 Domestic Services	1			0.8
1	B-S3-009	DSR	S3	S3 Domestic Services	1			16
1	B-S3-010	Bulk Equipment Store	S3	S3 Domestic Services	1			0.8
1	B-S3-011	Dictation/ 1:1/Phone Booth	S3	S3 Domestic Services	1			0.2
1	B-S3-012	Domestic Services Office (5 person)	S3	S3 Domestic Services	1			0.4
1	B-S3-013	Curtain Store	S3	S3 Domestic Services	1			0.4
1	B-S3-030	Switch Cupboard	S3	S3 Domestic Services	1		Project Co Space	0
1	B-S4-001	Storage/Holding Area	S4	S4 Materials	1			0.8

1	B-S4-002	Lobby	S4	S4 Materials	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	B-S4-003	Mailroom	S4	S4 Materials	1			0.8
1	B-S4-004	Office (2 person)	S4	S4 Materials	1			0.4
1	B-S4-005	Porters Office	S4	S4 Materials	1			0.4
1	B-S4-050	Clocking In	S4	S4 Materials	1		Not measurable against availability standards	0
1	2-S5-001	Corridor	S5	S5 Staff Changing	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	2-S5-002	Bay for Token Machine	S5	S5 Staff Changing	1			0.4
1	2-S5-003	DSR	S5	S5 Staff Changing	1			16
1	2-S5-004	Male Staff Changing , Shower, WC & Lockers	S5	S5 Staff Changing	1			0.7
1	2-S5-005	Female Staff Changing , Shower, WC & Lockers	S5	S5 Staff Changing	1			0.7
1	2-S5-006	Corridor	S5	S5 Staff Changing	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-S6-003	BMS Room	S6	S6 Estates	1			16
1	B-S6-004	Workshop (NPD)	S6	S6 Estates	1		Project Co Space	0
1	B-S6-006	Staff Change	S6	S6 Estates	1			0.7
1	B-S6-007	Shower	S6	S6 Estates	1			0.6
1	B-S6-008	Shower	S6	S6 Estates	1			0.6
1	B-S6-009	Workshop (NHSL)	S6	S6 Estates	1			10
1	B-S6-010	WC - Staff	S6	S6 Estates	1			0.6
1	B-S6-011	Supervisors	S6	S6 Estates	1			0.4
1	B-S6-012	Estates Library	S6	S6 Estates	1			0.4
1	B-S6-013	Office	S6	S6 Estates	1			0.4
1	B-S6-014	Store	S6	S6 Estates	1			0.8
1	B-S6-015	Contract Manager	S6	S6 Estates	1			0.4
1	B-S6-017	Corridor	S6	S6 Estates	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-S6-019	WC - Staff	S6	S6 Estates	1			0.8
1	B-S6-021	WC - Staff	S6	S6 Estates	1			0.8
1	B-S6-050	Staff Welfare	S6	S6 Estates	1			35
1	G-S6-020	Atrium Cleaning Equipment	S6	S6 Estates	1			0.8
1	4-S7-001	Corridor	S7	S7 Restaurant	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-S7-002	WC - Ambulant (Male)	S7	S7 Restaurant	1			0.8
1	4-S7-003	WC - Ambulant (Female)	S7	S7 Restaurant	1			0.8
1	4-S7-004	WC - Ambulant (Male)	S7	S7 Restaurant	1			0.8
1	4-S7-005	Corridor	S7	S7 Restaurant	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-S7-007	Disposal Hold	S7	S7 Restaurant	1			0.8
1	4-S7-008	Storage/Dishwashing	S7	S7 Restaurant	1			0.8
1	4-S7-009	DSR	S7	S7 Restaurant	1			16
1	4-S7-010	Restaurant	S7	S7 Restaurant	1			0.8

1	4-S7-011	WC Accessible	S7	S7 Restaurant	1			0.8
1	4-S7-012	Switch Cupboard	S7	S7 Restaurant	1		Project Co Space	0
1	4-S7-013	Corridor	S7	S7 Restaurant	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	4-S8-001	Trolley Holding Bay	S8	S8 Sterile Supplies	1			0
1	4-S9-001	WC - Ambulant	S9	S9 Helipad Support	1			0.8
1	4-S9-002A	RFFS Support	S9	S9 Helipad Support	1			21
1	4-S9-002B	RFFS Changing	S9	S9 Helipad Support	1			21
1	4-S9-003B	Lobby	S9	S9 Helipad Support	0			0.8
1	4-S9-004A	RFFS/Medical Equipment Store	S9	S9 Helipad Support	1			21
1	4-S9-005	Trolley Bay Equip St	S9	S9 Helipad Support	1			10
1	4-S9-006	Cleaner	S9	S9 Helipad Support	1			21
1	1-T1-001	1-N14	T1	T1 Combined Plant	1			16
1	1-T1-002	1-N12	T1	T1 Combined Plant	1			16
1	1-T1-003	1-N11	T1	T1 Combined Plant	1			16
1	1-T1-004	1-N10	T1	T1 Combined Plant	1			16
1	1-T1-005	1-N13	T1	T1 Combined Plant	1			16
1	2-T1-001	2-N20	T1	T1 Combined Plant	1			16
1	2-T1-002	2-N19	T1	T1 Combined Plant	1			16
1	2-T1-003	2-N17	T1	T1 Combined Plant	1			16
1	2-T1-004	2-N18	T1	T1 Combined Plant	1			16
1	2-T1-005	2-N16	T1	T1 Combined Plant	1			16
1	2-T1-006	2-N15	T1	T1 Combined Plant	1			16
1	3-T1-001	3-N25	T1	T1 Combined Plant	1			16
1	3-T1-002	3-N24	T1	T1 Combined Plant	1			16
1	3-T1-003	3-N23	T1	T1 Combined Plant	1			16
1	3-T1-004	3-N22	T1	T1 Combined Plant	1			16
1	3-T1-005	3-N21	T1	T1 Combined Plant	1			16
1	4-T1-001	4-N26	T1	T1 Combined Plant	1			16
1	4-T1-002	4-N27	T1	T1 Combined Plant	1			16
1	4-T1-003	4-N28	T1	T1 Combined Plant	1			16
1	B-T1-001	B-N02	T1	T1 Combined Plant	1			16
1	B-T1-002	B-N04	T1	T1 Combined Plant	1			16
1	B-T1-003	B-N03	T1	T1 Combined Plant	1			16
1	G-T1-003	G-N09	T1	T1 Combined Plant	1			16
1	G-T1-004	G-N08	T1	T1 Combined Plant	1			16
1	G-T1-005	G-N07	T1	T1 Combined Plant	1			16
1	G-T1-006	G-N06	T1	T1 Combined Plant	1			16
1	G-T1-007	G-N05	T1	T1 Combined Plant	1			16
1	G-T2-013	Manifold	T2	0	1		Project Co Space	0
1	B-V1-001	Confidential Waste	V1	Basement	1			35
1	B-V1-002	Store	V1	Basement	1			35
1	B-COR-014	Corridor	X1	Energy Centre	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	B-FM-006	Lift 17	X1	Energy Centre	1		Grouped with G-FM-006	16

1	B-FM-007	Lift 18	X1	Energy Centre	1		Grouped with G-FM-007	16
1	B-S6-025	Trolley Holding Bay	X1	Energy Centre	1		Not measurable against availability standards	0
1	B-Z1-009	Stair 9	X1	Energy Centre	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	G-FM-006	Lift 17	X1	Energy Centre	1		Grouped with B-FM-006	0
1	G-FM-007	Lift 18	X1	Energy Centre	1		Grouped with B-FM-007	0
1	G-S6-016	Office / Reception	X1	Energy Centre	1			0.8
1	G-S6-022	WC - Staff	X1	Energy Centre	1			0.8
1	G-S6-023	Chemical Store	X1	Energy Centre	1			0.4
1	G-S6-024	Trolley Holding Bay	X1	Energy Centre	1			0.1
1	G-T2-001	Riser	X1	Energy Centre	1		Project Co Space	0
1	G-X1-001	EC Plant Room 1	X1	Energy Centre	1		Project Co Space	0
1	G-X1-002	EC Plant Room 2	X1	Energy Centre	1		Project Co Space	0
1	G-X1-003	Scottish Power Switch Room	X1	Energy Centre	1		Project Co Space	0
1	G-X1-004	CHP Enclosure Room	X1	Energy Centre	1		Project Co Space	0
1	G-X1-005	Generator HV Switch Room	X1	Energy Centre	1		Project Co Space	0
1	G-X1-006	Main HV Switch Room	X1	Energy Centre	1		Project Co Space	0
1	G-X1-007	Corridor	X1	Energy Centre	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-X1-008	Corridor	X1	Energy Centre	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Z1-012	Stair 9	X1	Energy Centre	1		Availability Standards not applied to Circulation. Deductions accrued based on any subsequent impact on rooms attached to Circulation	0
1	M-X1-001	Mezz Plant 1	X1	Energy Centre	1		Project Co Space	0
1	G-Y1-001	Clinical Waste - Dirty	Y1	FM Support (Enc)	1			21
1	G-Y1-002	General Waste	Y1	FM Support (Enc)	1			35
1	G-Y1-003	Gas Manifold	Y1	FM Support (Enc)	1		Project Co Space	0
1	G-Y1-004	Kitchen Waste	Y1	FM Support (Enc)	1			50
1	G-Y1-005	Clinical Waste - Clean	Y1	FM Support (Enc)	1			35
1	G-Y1-006	Wash Area	Y1	FM Support (Enc)	1			0.8
1	G-Y1-007	Circulation	Y1	FM Support (Enc)	1		Availability Standards not applied to Corridor. Deductions accrued based onany subsequent impact on rooms attached to corridor	0
1	G-Y1-008	Medical Gas Cylinder Store	Y1	FM Support (Enc)	1			0.2
1	G-Y1-009	Recyclying	Y1	FM Support (Enc)	1			35
1	G-Y1-010	Holding Area	Y1	FM Support (Enc)	1			35
1	G-Y1-011	Fork Lift Charging	Y1	FM Support (Enc)	1			0

PART E – CLINICAL ASSESSMENT BASEMENT GSU

Part E of Schedule Part 3 Clinical Assessment Basement GSU is in the Agreed Form identified and executed as Part E of Schedule Part 3 Clinical Assessment Basement GSU Table of this SA1, referred to in and forming part of this SA1

Schedule Part 14 (Payment Mechanism)

Appendix 3 - Clinical Assessment Basement GSU

Pump Group	Room Name	Room No	Department	GSU
Basement Pump Additional Functional Areas	Corridor	G-A2-001	A2 PARU	0
Basement Pump Functional Areas	Single Room 27	G-A2-002	A2 PARU	35
Basement Pump Functional Areas	Room 27 - Ensuite	G-A2-003	A2 PARU	0
Basement Pump Functional Areas	Single Room 28	G-A2-004	A2 PARU	35
Basement Pump Functional Areas	Room 28 - Ensuite	G-A2-005	A2 PARU	0
Basement Pump Functional Areas	Single Room 26	G-A2-006	A2 PARU	35
Basement Pump Functional Areas	Room 26 - Ensuite	G-A2-007	A2 PARU	0
Basement Pump Additional Functional Areas	Reception	G-A2-008	A2 PARU	21
Basement Pump Functional Areas	Single Room 29	G-A2-009	A2 PARU	35
Basement Pump Functional Areas	Room 29 - Ensuite	G-A2-010	A2 PARU	0
Basement Pump Additional Functional Areas	Touchdown Base 2	G-A2-011	A2 PARU	21
Basement Pump Functional Areas	Single Room 31	G-A2-012	A2 PARU	35
Basement Pump Functional Areas	Room 31 - Ensuite	G-A2-013	A2 PARU	0
Basement Pump Functional Areas	Single Room 30	G-A2-014	A2 PARU	35
Basement Pump Functional Areas	Room 30 - Ensuite	G-A2-015	A2 PARU	0
Basement Pump Additional Functional Areas	Resus Bay	G-A2-016	A2 PARU	0.1
Basement Pump Additional Functional Areas	Single Room 6	G-A2-017	A2 PARU	35
Basement Pump Additional Functional Areas	Room 6 - Ensuite	G-A2-018	A2 PARU	0
Basement Pump Additional Functional Areas	Single Room 5	G-A2-019	A2 PARU	35
Basement Pump Additional Functional Areas	Room 5 - Ensuite	G-A2-020	A2 PARU	0
Basement Pump Functional Areas	Clean Utility	G-A2-021	A2 PARU	50

Basement Pump Functional Areas	Dirty Utility	G-A2-022	A2 PARU	21
Basement Pump Functional Areas	WC - Staff	G-A2-023	A2 PARU	0.6
Basement Pump Functional Areas	WC - Ambulant (Visitors)	G-A2-024	A2 PARU	0.8
Basement Pump Additional Functional Areas	Linen Bay (1 trolley)	G-A2-025	A2 PARU	0
Basement Pump Additional Functional Areas	Touchdown Base 1	G-A2-026	A2 PARU	21
Basement Pump Additional Functional Areas	Hoist Bay	G-A2-027	A2 PARU	0.1
Basement Pump Functional Areas	Observation Bay	G-A2-028	A2 PARU	35
Basement Pump Functional Areas	Observation Bay - Ensuite	G-A2-029	A2 PARU	0
Basement Pump Additional Functional Areas	Observation Bay - Toilet	G-A2-030	A2 PARU	0.8
Basement Pump Additional Functional Areas	Single Room 1	G-A2-031	A2 PARU	35
Basement Pump Additional Functional Areas	Room 1 - Ensuite	G-A2-032	A2 PARU	0
Basement Pump Additional Functional Areas	Single Room 2	G-A2-033	A2 PARU	35
Basement Pump Additional Functional Areas	Room 2 - Ensuite	G-A2-034	A2 PARU	0
Basement Pump Additional Functional Areas	Single Room 3	G-A2-035	A2 PARU	35
Basement Pump Additional Functional Areas	Room 3 - Ensuite	G-A2-036	A2 PARU	0
Basement Pump Additional Functional Areas	Single Room 4	G-A2-037	A2 PARU	35
Basement Pump Additional Functional Areas	Room 4 Ensuite	G-A2-038	A2 PARU	0
Basement Pump Functional Areas	Treatment Room	G-A2-039	A2 PARU	21
Basement Pump Additional Functional Areas	Dining / Play Room	G-A2-040	A2 PARU	10
Basement Pump Additional Functional Areas	Ward Kitchen	G-A2-041	A2 PARU	21
Basement Pump Additional Functional Areas	Single Room 7	G-A2-042	A2 PARU	35
Basement Pump Additional Functional Areas	Room 7 - Ensuite	G-A2-043	A2 PARU	0
Basement Pump Functional Areas	Single Room 8	G-A2-044	A2 PARU	35
Basement Pump Additional Functional Areas	Room 8 - Ensuite	G-A2-045	A2 PARU	0
Basement Pump Functional Areas	Bay 2	G-A2-046	A2 PARU	35
Basement Pump Additional Functional Areas	Bay 2 - Toilet	G-A2-047	A2 PARU	0.8
Basement Pump Functional Areas	Bay 2 - Ensuite	G-A2-048	A2 PARU	0
Basement Pump Additional Functional Areas	Touchdown Base 3	G-A2-049	A2 PARU	21
Basement Pump Additional Functional Areas	Single Room 9	G-A2-050	A2 PARU	35
Basement Pump Additional Functional Areas	Room 9 - Ensuite	G-A2-051	A2 PARU	0
Basement Pump Additional Functional Areas	Single Room 10	G-A2-052	A2 PARU	35
Basement Pump Additional Functional Areas	Room 10 - Ensuite	G-A2-053	A2 PARU	0

Basement Pump Functional Areas	Bay 1	G-A2-054	A2 PARU	35
Basement Pump Functional Areas	Bay 1 - Ensuite	G-A2-055	A2 PARU	0
Basement Pump Additional Functional Areas	Bay 1 - Toilet	G-A2-056	A2 PARU	0.8
Basement Pump Functional Areas	Corridor	G-A2-057	A2 PARU	0
Basement Pump Additional Functional Areas	Single Room 11	G-A2-058	A2 PARU	35
Basement Pump Additional Functional Areas	Room 11 - Ensuite	G-A2-059	A2 PARU	0
Basement Pump Additional Functional Areas	Single Room 12	G-A2-060	A2 PARU	35
Basement Pump Additional Functional Areas	Room 12 - Ensuite	G-A2-061	A2 PARU	0
Basement Pump Additional Functional Areas	WC - Staff	G-A2-062	A2 PARU	0.6
Basement Pump Additional Functional Areas	Linen Bay (1 trolley)	G-A2-063	A2 PARU	0
Basement Pump Additional Functional Areas	Store - Equipment	G-A2-064	A2 PARU	0.2
Basement Pump Functional Areas	Single Room 16	G-A2-065	A2 PARU	35
Basement Pump Functional Areas	Room 16 - Ensuite	G-A2-066	A2 PARU	0
Basement Pump Additional Functional Areas	Single Room 14	G-A2-067	A2 PARU	35
Basement Pump Additional Functional Areas	Room 14 - Ensuite	G-A2-068	A2 PARU	0
Basement Pump Additional Functional Areas	Touchdown Base 4	G-A2-069	A2 PARU	21
Basement Pump Functional Areas	Single Room 15	G-A2-070	A2 PARU	35
Basement Pump Functional Areas	Room 15 - Ensuite	G-A2-071	A2 PARU	0
Basement Pump Functional Areas	Single Room 17	G-A2-072	A2 PARU	35
Basement Pump Functional Areas	Room 17 - Ensuite	G-A2-073	A2 PARU	0
Basement Pump Additional Functional Areas	Room 17 - Lobby	G-A2-074	A2 PARU	35
Basement Pump Additional Functional Areas	Store - General	G-A2-075A	A2 PARU	0.1
Basement Pump Additional Functional Areas	Store - General	G-A2-075B	A2 PARU	0.1
Basement Pump Functional Areas	Patients' Assisted Bathroom	G-A2-076	A2 PARU	21
Basement Pump Additional Functional Areas	Multi-Disciplinary Office	G-A2-077	A2 PARU	0.8
Basement Pump Additional Functional Areas	Senior Charge Nurse Office	G-A2-078	A2 PARU	0.4
Basement Pump Additional Functional Areas	On-Call Consultant Office (2 person)	G-A2-079	A2 PARU	0.4
Basement Pump Functional Areas	DSR	G-A2-080	A2 PARU	16
Basement Pump Additional Functional Areas	Clinical Coordinators Office (2 person)	G-A2-081	A2 PARU	0.4
Basement Pump Additional Functional Areas	Disposal Hold	G-A2-082	A2 PARU	0.9
Basement Pump Additional Functional Areas	Patient Interview Room	G-A2-083	A2 PARU	10
Basement Pump Functional Areas	Dirty Utility	G-A2-084	A2 PARU	21

Basement Pump Additional Functional Areas	Corridor	G-A2-085	A2 PARU	0
Basement Pump Additional Functional Areas	Switch Cupboard	G-A2-086	A2 PARU	0
Basement Pump Additional Functional Areas	Switch Cupboard	G-A2-088	A2 PARU	0
Basement Pump Additional Functional Areas	Switch Cupboard	G-A2-089	A2 PARU	0
Basement Pump Functional Areas	LOBBY 10	1-B1-025	B1 PICU	0
Basement Pump Functional Areas	SINGLE ISOLATION ROOM	1-B1-026	B1 PICU	200
Basement Pump Functional Areas	SINGLE ROOM	1-B1-037	B1 PICU	200
Basement Pump Functional Areas	BAY 2	1-B1-031	B1 PICU	200
Basement Pump Functional Areas	DIRTY UTILITY	1-B1-029	B1 PICU	21
Basement Pump Functional Areas	WC STAFF	1-B1-062	B1 PICU	0.6
Basement Pump Functional Areas	PATIENTS ASSISTED SHOWER	1-B1-032	B1 PICU	200
Basement Pump Functional Areas	CLEAN UTILITY	1-B1-041	B1 PICU	50
Basement Pump Functional Areas	EQUIP CLEANING	1-B1-090	B1 PICU	50
Basement Pump Functional Areas	DIRTY UTILITY	1-B1-064	B1 PICU	21
Basement Pump Functional Areas	CORRIDOR WHB	1-B1-001	B1 PICU	0
Basement Pump Functional Areas	BAY 3	1-B1-063	B1 PICU	200
Basement Pump Functional Areas	LOBBY	1-B1-015	B1 PICU	0
Basement Pump Functional Areas	WC – WCH	1-B1-056	B1 PICU	0.8
Basement Pump Functional Areas	WAITING AREA	1-B1-055	B1 PICU	10
Basement Pump Functional Areas	EQUIPMENT SERVICE ROOM	1-B1-007	B1 PICU	10
Basement Pump Functional Areas	CORRIDOR WHB	1-B1-040	B1 PICU	0
Basement Pump Functional Areas	BAY 1	1-B1-009	B1 PICU	200
Basement Pump Functional Areas	RESUS BAY	1-B1-014	B1 PICU	0.1
Basement Pump Functional Areas	Single Room 5 - Isolation	1-B1-016	B1 PICU	200
Basement Pump Functional Areas	ENSUITE	3-C1.1-066	C1.1 Medical Inpatients	0
Basement Pump Functional Areas	ENSUITE	3-C1.1-064	C1.1 Medical Inpatients	0
Basement Pump Functional Areas	SINGLE	3-C1.1-063	C1.1 Medical Inpatients	35
Basement Pump Functional Areas	DIRTY UTILITY	3-C1.1-044	C1.1 Medical Inpatients	21
Basement Pump Functional Areas	TREATMENT ROOM	3-C1.1-043	C1.1 Medical Inpatients	21
Basement Pump Functional Areas	CLEAN UTILITY	3-C1.1-042	C1.1 Medical Inpatients	50
Basement Pump Functional Areas	WC (A) (VISITORS)	3-C1.1-070	C1.1 Medical Inpatients	0.8
Basement Pump Functional Areas	WC (ST)	3-C1.1-026	C1.1 Medical Inpatients	0.6

Basement Pump Functional Areas	ENSUITE	3-C1.1-037	C1.1 Medical Inpatients	0
Basement Pump Functional Areas	ENSUITE	3-C1.1-041	C1.1 Medical Inpatients	0
Basement Pump Functional Areas	SINGLE ROOM	3-C1.1-036	C1.1 Medical Inpatients	35
Basement Pump Functional Areas	ENSUITE	3-C1.1-059	C1.1 Medical Inpatients	0
Basement Pump Functional Areas	ENSUITE	3-C1.1-010	C1.1 Medical Inpatients	0
Basement Pump Functional Areas	ENSUITE	3-C1.1-057	C1.1 Medical Inpatients	0
Basement Pump Functional Areas	ENSUITE	3-C1.1-061	C1.1 Medical Inpatients	35
Basement Pump Functional Areas	Single Room 23	3-C1.1-065	C1.1 Medical Inpatients	35
Basement Pump Functional Areas	Room 20 - Lobby	3-C1.1-035	C1.1 Medical Inpatients	35
Basement Pump Functional Areas	Single Room 4 (Transitional Care Bed)	3-C1.1-004	C1.1 Medical Inpatients	35
Basement Pump Functional Areas	Single Room 1	3-C1.1-058	C1.1 Medical Inpatients	35
Basement Pump Functional Areas	Single Room 6 (Transitional Care Bed)	3-C1.1-009	C1.1 Medical Inpatients	35
Basement Pump Functional Areas	Single Room 3	3-C1.1-056	C1.1 Medical Inpatients	35
Basement Pump Functional Areas	Room 4 - Lobby	3-C1.1-006	C1.1 Medical Inpatients	0
Basement Pump Additional Functional Areas	Corridor	3-C1.2-001	C1.2 Surgical Long Stay	0
Basement Pump Functional Areas	Single Room 9	3-C1.2-002	C1.2 Surgical Long Stay	35
Basement Pump Additional Functional Areas	Room 10 - Ensuite	3-C1.2-003	C1.2 Surgical Long Stay	0
Basement Pump Additional Functional Areas	Linen Bay	3-C1.2-004	C1.2 Surgical Long Stay	0
Basement Pump Functional Areas	Single Room 11	3-C1.2-005	C1.2 Surgical Long Stay	35
Basement Pump Functional Areas	Room 11 - Ensuite	3-C1.2-006	C1.2 Surgical Long Stay	0
Basement Pump Functional Areas	Single Room 12	3-C1.2-007	C1.2 Surgical Long Stay	35
Basement Pump Functional Areas	Room 12 - Ensuite	3-C1.2-008	C1.2 Surgical Long Stay	0
Basement Pump Additional Functional Areas	Touchdown Base 1	3-C1.2-009	C1.2 Surgical Long Stay	21
Basement Pump Additional Functional Areas	Single Room 10	3-C1.2-010	C1.2 Surgical Long Stay	35
Basement Pump Additional Functional Areas	Room 9 - Ensuite	3-C1.2-011	C1.2 Surgical Long Stay	0
Basement Pump Functional Areas	Dirty Utility	3-C1.2-012	C1.2 Surgical Long Stay	21
Basement Pump Additional Functional Areas	DSR	3-C1.2-013	C1.2 Surgical Long Stay	16
Basement Pump Functional Areas	Single Room 14	3-C1.2-014	C1.2 Surgical Long Stay	35
Basement Pump Functional Areas	Room 14 - Ensuite	3-C1.2-015	C1.2 Surgical Long Stay	0
Basement Pump Functional Areas	Hoist Bay	3-C1.2-016	C1.2 Surgical Long Stay	0.1
Basement Pump Functional Areas	Patients' Assisted Bathroom	3-C1.2-017	C1.2 Surgical Long Stay	21
Basement Pump Functional Areas	Single Room 15	3-C1.2-018	C1.2 Surgical Long Stay	35

Basement Pump Additional Functional Areas	Room 16 - Ensuite	3-C1.2-019	C1.2 Surgical Long Stay	0
Basement Pump Additional Functional Areas	Single Room 16	3-C1.2-020	C1.2 Surgical Long Stay	35
Basement Pump Additional Functional Areas	Room 15 - Ensuite	3-C1.2-021	C1.2 Surgical Long Stay	0
Basement Pump Additional Functional Areas	Touchdown Base 2	3-C1.2-022	C1.2 Surgical Long Stay	21
Basement Pump Functional Areas	Bay 2 (beds 5-8)	3-C1.2-023	C1.2 Surgical Long Stay	35
Basement Pump Functional Areas	Bay 2 - Toilet	3-C1.2-024	C1.2 Surgical Long Stay	0.8
Basement Pump Functional Areas	Bay 1 - Ensuite	3-C1.2-025	C1.2 Surgical Long Stay	21
Basement Pump Functional Areas	Bay 1 (beds 1-4)	3-C1.2-026	C1.2 Surgical Long Stay	35
Basement Pump Functional Areas	Bay 1 - Toilet	3-C1.2-027	C1.2 Surgical Long Stay	0.8
Basement Pump Additional Functional Areas	Senior Charge Nurse Office	3-C1.2-028	C1.2 Surgical Long Stay	0.4
Basement Pump Additional Functional Areas	Resuscitation Trolley Bay	3-C1.2-029	C1.2 Surgical Long Stay	0.1
Basement Pump Additional Functional Areas	Store - Equipment	3-C1.2-030	C1.2 Surgical Long Stay	0.2
Basement Pump Functional Areas	Clean Utility	3-C1.2-031	C1.2 Surgical Long Stay	50
Basement Pump Additional Functional Areas	Treatment Room	3-C1.2-032	C1.2 Surgical Long Stay	21
Basement Pump Additional Functional Areas	Dining / Play Room	3-C1.2-033	C1.2 Surgical Long Stay	10
Basement Pump Additional Functional Areas	Ward Kitchen	3-C1.2-034	C1.2 Surgical Long Stay	21
Basement Pump Additional Functional Areas	Patient Interview Room	3-C1.2-035	C1.2 Surgical Long Stay	10
Basement Pump Additional Functional Areas	Reception (1 person)	3-C1.2-036	C1.2 Surgical Long Stay	0.6
Basement Pump Additional Functional Areas	Discharge Lounge	3-C1.2-037	C1.2 Surgical Long Stay	21
Basement Pump Additional Functional Areas	Disposal Hold	3-C1.2-038	C1.2 Surgical Long Stay	0.9
Basement Pump Additional Functional Areas	Store - General	3-C1.2-039	C1.2 Surgical Long Stay	0.1
Basement Pump Functional Areas	WC - Staff	3-C1.2-040	C1.2 Surgical Long Stay	0.6
Basement Pump Functional Areas	WC - Ambulant (Visitors)	3-C1.2-041	C1.2 Surgical Long Stay	0.8
Basement Pump Additional Functional Areas	Touchdown Base 3	3-C1.2-042	C1.2 Surgical Long Stay	21
Basement Pump Additional Functional Areas	Multi-Disciplinary Office	3-C1.2-043	C1.2 Surgical Long Stay	0.4
Basement Pump Additional Functional Areas	WC - Staff	3-C1.2-044	C1.2 Surgical Long Stay	0.6
Basement Pump Additional Functional Areas	Corridor	3-C1.2-045	C1.2 Surgical Long Stay	0
Basement Pump Additional Functional Areas	Switch Cupboard	3-C1.2-046	C1.2 Surgical Long Stay	0
Basement Pump Functional Areas	DINING/PLAY ROOM	3-C1.3-039	C1.3 Neuroscience	10
Basement Pump Functional Areas	CLEAN UTILITY	3-C1.3-038	C1.3 Neuroscience	50
Basement Pump Functional Areas	TREATMENT ROOM	3-C1.3-037	C1.3 Neuroscience	21
Basement Pump Functional Areas	DIRTY UTILITY	3-C1.3-036	C1.3 Neuroscience	21

Basement Pump Functional Areas	ASSISTED BATH	3-C1.3-035	C1.3 Neuroscience	21
Basement Pump Functional Areas	ENSUITE ROOM	3-C1.4-009	C1.4 Haematology	21
Basement Pump Functional Areas	CORRIDOR WHB	3-C1.4-082	C1.4 Haematology	0
Basement Pump Functional Areas	NAPPY CHANGE	3-C1.5-005	C1.5 Shared Support	0.8
Basement Pump Functional Areas	BABY INFANT FEEDING	3-C1.5-004	C1.5 Shared Support	0.8
Basement Pump Functional Areas	BREAST PUMP ROOM	3-C1.5-006	C1.5 Shared Support	0.7
Basement Pump Functional Areas	WC(WCH)	3-C1.5-007	C1.5 Shared Support	0.8
Basement Pump Functional Areas	WC (WCH)	3-C1.5-008	C1.5 Shared Support	0.8
Basement Pump Functional Areas	ROOM 1 ENSUITE	3-C4-003	C4 Sleep Lab	0
Basement Pump Functional Areas	SLEEP ROOM 1	3-C4-005	C4 Sleep Lab	21
Basement Pump Functional Areas	PRIMARY CLASSROOM	4-C5-004	C5 Classrooms	0.4
Basement Pump Functional Areas	UPPER CLASSROM PRIMARY	4-C5-005	C5 Classrooms	0.4
Basement Pump Functional Areas	SECONDARY CLASSROOM	4-C5-006	C5 Classrooms	0.4
Basement Pump Functional Areas	WC-WCH	4-C5-002	C5 Classrooms	0.8
Basement Pump Functional Areas	WC (A)	4-C5-009	C5 Classrooms	0.8
Basement Pump Functional Areas	WC (WCH)	G-F1-038	F1 CAMHS	0.8
Basement Pump Functional Areas	WC (ST)	G-F1-043	F1 CAMHS	0.6
Basement Pump Functional Areas	WC (WCH)	G-F1-018	F1 CAMHS	0.8
Basement Pump Functional Areas	WAITING AREA 1	G-F1-041	F1 CAMHS	0.8
Basement Pump Functional Areas	DSR	G-F1-042	F1 CAMHS	16
Basement Pump Functional Areas	WARD KITCHEN	G-F1-039	F1 CAMHS	21
Basement Pump Functional Areas	DINING ROOM	G-F1-036	F1 CAMHS	21
Basement Pump Functional Areas	WC (A) (V)	G-I1-010	I1 RHSC Entrance	0.8
Basement Pump Functional Areas	DSR	B-I2-002	I2 Stores	16
Basement Pump Additional Functional Areas	Lobby	1-J1-001	J1 Bereavement Suite	21
Basement Pump Functional Areas	WC - Wheelchair accessible	1-J1-002	J1 Bereavement Suite	0.8
Basement Pump Functional Areas	Viewing Room	1-J1-003	J1 Bereavement Suite	21
Basement Pump Functional Areas	Sitting Room with Beverage Bay	1-J1-004	J1 Bereavement Suite	0.8
Basement Pump Additional Functional Areas	Corridor	G-J2-001	JS Spiritual Care	0
Basement Pump Additional Functional Areas	Interview Room	G-J2-002	JS Spiritual Care	10
Basement Pump Additional Functional Areas	Sanctuary	G-J2-003	JS Spiritual Care	10
Basement Pump Functional Areas	WC - Wheelchair accessible / Ritual Washing	G-J2-004	JS Spiritual Care	0.8

	Area			
Basement Pump Additional Functional Areas	Store	G-J2-005	JS Spiritual Care	0.1
Basement Pump Functional Areas	Office	G-J2-006	JS Spiritual Care	0.4
Basement Pump Additional Functional Areas	Switch Cupboard	G-J2-007	JS Spiritual Care	0
Basement Pump Functional Areas	CORRIDOR WHB	1-L1-105	L1 DCN Acute	0
Basement Pump Functional Areas	WC (ST)	1-L1-072	L1 DCN Acute	0.6
Basement Pump Functional Areas	RELATIVES ROOM – ENSUITE	1-L1-077	L1 DCN Acute	0
Basement Pump Functional Areas	ENSUITE	1-L1-092	L1 DCN Acute	0
Basement Pump Functional Areas	ENSUITE	1-L1-094	L1 DCN Acute	0
Basement Pump Functional Areas	ENSUITE	1-L1-087	L1 DCN Acute	35
Basement Pump Functional Areas	ENSUITE	1-L1-084	L1 DCN Acute	0
Basement Pump Functional Areas	Relatives Overnight Stay Room	1-L1-082	L1 DCN Acute	21
Basement Pump Functional Areas	Single Room 19	1-L1-091	L1 DCN Acute	35
Basement Pump Functional Areas	Single Room 18	1-L1-093	L1 DCN Acute	35
Basement Pump Functional Areas	Single Room 20	1-L1-088	L1 DCN Acute	35
Basement Pump Functional Areas	Single Room 21	1-L1-083	L1 DCN Acute	35
Basement Pump Functional Areas	WC (A)	2-L2-071	L2 DCN Inpatients	0.8
Basement Pump Functional Areas	SINGLE ROOM	2-L2-021	L2 DCN Inpatients	35
Basement Pump Functional Areas	DSR	2-L2-031	L2 DCN Inpatients	16
Basement Pump Functional Areas	ENSUITE	2-L2-027	L2 DCN Inpatients	0
Basement Pump Functional Areas	ENSUITE	2-L2-022	L2 DCN Inpatients	0
Basement Pump Functional Areas	SINGLE ROOM	2-L2-026	L2 DCN Inpatients	35
Basement Pump Functional Areas	SINGLE ROOM	2-L2-032	L2 DCN Inpatients	35
Basement Pump Functional Areas	ENSUITE	2-L2-033	L2 DCN Inpatients	0
Basement Pump Functional Areas	ENSUITE	2-L2-035	L2 DCN Inpatients	0
Basement Pump Functional Areas	DIRTY UTILITY	2-L2-030	L2 DCN Inpatients	21
Basement Pump Functional Areas	SINGLE ROOM 10	2-L2-013	L2 DCN Inpatients	35
Basement Pump Functional Areas	ENSUITE	2-L2-014	L2 DCN Inpatients	0
Basement Pump Functional Areas	ENSUITE	2-L2-011	L2 DCN Inpatients	0
Basement Pump Functional Areas	SINGLE	2-L2-010	L2 DCN Inpatients	35
Basement Pump Functional Areas	SINGLE	2-L2-006	L2 DCN Inpatients	35
Basement Pump Functional Areas	ENSUITE	2-L2-007	L2 DCN Inpatients	0

Basement Pump Functional Areas	ENSUITE	2-L2-005	L2 DCN Inpatients	0
Basement Pump Functional Areas	WC-WCH	2-L2-068	L2 DCN Inpatients	0.8
Basement Pump Functional Areas	ENSUITE	2-L2-037	L2 DCN Inpatients	0
Basement Pump Functional Areas	ENSUITE	2-L2-047	L2 DCN Inpatients	0
Basement Pump Functional Areas	SINGLE	2-L2-046	L2 DCN Inpatients	35
Basement Pump Functional Areas	SINGLE	2-L2-048	L2 DCN Inpatients	35
Basement Pump Functional Areas	ENSUITE	2-L2-049	L2 DCN Inpatients	0
Basement Pump Functional Areas	ENSUITE	2-L2-040	L2 DCN Inpatients	0
Basement Pump Functional Areas	SINGLE	2-L2-039	L2 DCN Inpatients	35
Basement Pump Functional Areas	ENSUITE	2-L2-042	L2 DCN Inpatients	0
Basement Pump Functional Areas	ENSUITE	2-L2-044	L2 DCN Inpatients	0
Basement Pump Functional Areas	DIRTY UTILITY	2-L2-054	L2 DCN Inpatients	21
Basement Pump Functional Areas	CORRIDOR WHB	2-L2-146	L2 DCN Inpatients	0
Basement Pump Functional Areas	SINGLE ROOM	2-L2-041	L2 DCN Inpatients	35
Basement Pump Functional Areas	ENSUITE	2-L2-136	L2 DCN Inpatients	0
Basement Pump Functional Areas	ENSUITE	2-L2-133	L2 DCN Inpatients	0
Basement Pump Functional Areas	ENSUITE	2-L2-131	L2 DCN Inpatients	35
Basement Pump Functional Areas	ENSUITE	2-L2-126	L2 DCN Inpatients	0
Basement Pump Functional Areas	Single Room 4	2-L2-028	L2 DCN Inpatients	35
Basement Pump Functional Areas	Single Room 16	2-L2-034	L2 DCN Inpatients	35
Basement Pump Functional Areas	Corridor	2-L2-001	L2 DCN Inpatients	0
Basement Pump Functional Areas	Room 11 - Ensuite	2-L2-016	L2 DCN Inpatients	0
Basement Pump Functional Areas	Single Room 7	2-L2-004	L2 DCN Inpatients	35
Basement Pump Functional Areas	Single Room 17	2-L2-036	L2 DCN Inpatients	35
Basement Pump Functional Areas	Single Room 1	2-L2-043	L2 DCN Inpatients	35
Basement Pump Functional Areas	Single Room 1	2-L2-135	L2 DCN Inpatients	35
Basement Pump Functional Areas	Single Room 2	2-L2-132	L2 DCN Inpatients	35
Basement Pump Functional Areas	Single Room 4	2-L2-125	L2 DCN Inpatients	35
Basement Pump Functional Areas	ADL KITCHEN	2-M2-009	M2 DCN Therapies	0.6
Basement Pump Functional Areas	CONSULTING ROOM	2-M2-010	M2 DCN Therapies	0.8
Basement Pump Functional Areas	TREATMENT ROOM	2-M2-011	M2 DCN Therapies	0.8
Basement Pump Functional Areas	TREATMENT ROOM	2-M2-008	M2 DCN Therapies	0.8

Basement Pump Functional Areas	ADL BATHROOM	2-M2-007	M2 DCN Therapies	0.6
Basement Pump Functional Areas	WAITING AREA	2-M2-006	M2 DCN Therapies	0.8
Basement Pump Functional Areas	TREATMENT ROOM	2-M3-002	M3 PIU	10
Basement Pump Functional Areas	WAITING AREA	2-M3-004	M3 PIU	0.8
Basement Pump Functional Areas	TREATMENT BAY	2-M3-003	M3 PIU	10
Basement Pump Functional Areas	IMMEDIATE PRE THEATRE WAIT	1-P1-170	P1 Theatres	200
Basement Pump Functional Areas	WC (WCH)	1-P1-168	P1 Theatres	0.8
Basement Pump Functional Areas	WC (WCH)	1-P1-169	P1 Theatres	0.8
Basement Pump Functional Areas	CONSULTING ROOM	1-P1-177	P1 Theatres	10
Basement Pump Functional Areas	TOY WASH ST	1-P1-193	P1 Theatres	0.8
Basement Pump Functional Areas	SINGLE ROOM	1-P1-005	P1 Theatres	35
Basement Pump Functional Areas	SINGLE ROOM	1-P1-010	P1 Theatres	35
Basement Pump Functional Areas	UTILITY ROOM	1-P1-152	P1 Theatres	75
Basement Pump Functional Areas	Patient Interview Room	1-P1-014	P1 Theatres	0.8
Basement Pump Functional Areas	CONSULTING ROOM	1-P1-118	P1 Theatres	16
Basement Pump Functional Areas	CONSULTING ROOM	1-P1-116	P1 Theatres	16
Basement Pump Functional Areas	CONSULTING ROOM	1-P1-120	P1 Theatres	16
Basement Pump Functional Areas	ULTRASOUND WAITING AREA	G-Q1-018	Q1 Radiology	0.8
Basement Pump Functional Areas	MALE STAFF CHANGING/LOCKERS	G-Q1-150	Q1 Radiology	0.7
Basement Pump Functional Areas	DENTAL ROOM	G-Q1-141	Q1 Radiology	200
Basement Pump Functional Areas	DSR	4-R1-017	R1 Clinical Management Suite	16
Basement Pump Functional Areas	STAFF ROOM	4-R1-009	R1 Clinical Management Suite	0.4
Basement Pump Functional Areas	WC (ST) (F)	4-R1-008	R1 Clinical Management Suite	0.6
Basement Pump Functional Areas	WC WCH	4-R1-006	R1 Clinical Management Suite	0.6
Basement Pump Functional Areas	WC (ST) (MALE)	4-R1-005	R1 Clinical Management Suite	0.6
Basement Pump Functional Areas	Preparation/Cooking Area	B-S1-001	S1 Kitchen	16
Basement Pump Functional Areas	Temperature Controlled Sandwich Prep	B-S1-005	S1 Kitchen	16
Basement Pump Functional Areas	Bakery Preparation Area	B-S1-006	S1 Kitchen	16
Basement Pump Functional Areas	Staff Room	B-S1-007	S1 Kitchen	0.4
Basement Pump Functional Areas	Office (5 person)	B-S1-008	S1 Kitchen	0.4
Basement Pump Functional Areas	Female Staff Changing inc Shower	B-S1-009	S1 Kitchen	0.7
Basement Pump Functional Areas	Male Staff Changing inc Shower	B-S1-010	S1 Kitchen	0.7

Basement Pump Functional Areas	Pan Wash	B-S1-012	S1 Kitchen	10
Basement Pump Functional Areas	Returned Trolleys	B-S1-013	S1 Kitchen	0.8
Basement Pump Functional Areas	Refuse	B-S1-015	S1 Kitchen	0.8
Basement Pump Functional Areas	DSR	B-S1-016	S1 Kitchen	16
Basement Pump Functional Areas	Clean Trolley Park	B-S1-017	S1 Kitchen	0.8
Basement Pump Functional Areas	Disposables / Detergent	B-S1-018	S1 Kitchen	0.8
Basement Pump Additional Functional Areas	Freezer	B-S1-021	S1 Kitchen	16
Basement Pump Additional Functional Areas	Freezer	B-S1-022	S1 Kitchen	16
Basement Pump Functional Areas	Receipt Bay	B-S1-023	S1 Kitchen	0.8
Basement Pump Functional Areas	Corridor	B-S1-024	S1 Kitchen	0
Basement Pump Additional Functional Areas	Dairy Store	B-S1-025	S1 Kitchen	0.8
Basement Pump Functional Areas	Dry Goods	B-S1-027	S1 Kitchen	0.8
Basement Pump Additional Functional Areas	Switch Cupboard	B-S1-028	S1 Kitchen	0
Basement Pump Additional Functional Areas	Switch Cupboard	B-S1-029	S1 Kitchen	0
Basement Pump Additional Functional Areas	Lobby	B-S1-030	S1 Kitchen	0
Basement Pump Additional Functional Areas	Pick and Pack	B-S1-031	S1 Kitchen	16
Basement Pump Functional Areas	SUPPLIES ST	B-S3-003	S3 Domestic Services	0.8
Basement Pump Functional Areas	LAUNDRY	B-S3-004	S3 Domestic Services	16
Basement Pump Functional Areas	LINEN POOL (CLEAN)	B-S3-002	S3 Domestic Services	16
Basement Pump Functional Areas	SANITARY BINS ST	B-S3-008	S3 Domestic Services	0.8
Basement Pump Functional Areas	DSR	B-S3-009	S3 Domestic Services	16
Basement Pump Functional Areas	BULK EQUIPMENT ST	B-S3-010	S3 Domestic Services	0.9
Basement Pump Functional Areas	Storage/Holding Area	B-S4-001	S4 Materials	0.8
Basement Pump Additional Functional Areas	Lobby	B-S4-002	S4 Materials	0
Basement Pump Additional Functional Areas	Mailroom	B-S4-003	S4 Materials	0.8
Basement Pump Additional Functional Areas	Office (2 person)	B-S4-004	S4 Materials	0.4
Basement Pump Functional Areas	Porters Office	B-S4-005	S4 Materials	0.4
Basement Pump Additional Functional Areas	Clocking In	B-S4-050	S4 Materials	0
Basement Pump Additional Functional Areas	BMS Room	B-S6-003	S6 Estates	16
Basement Pump Functional Areas	Workshop (NPD)	B-S6-004	S6 Estates	0
Basement Pump Functional Areas	Staff Change	B-S6-006	S6 Estates	0.7
Basement Pump Functional Areas	Shower	B-S6-007	S6 Estates	0.6

Basement Pump Functional Areas	Shower	B-S6-008	S6 Estates	0.6
Basement Pump Functional Areas	Workshop (NHSL)	B-S6-009	S6 Estates	10
Basement Pump Functional Areas	WC - Staff	B-S6-010	S6 Estates	0.6
Basement Pump Additional Functional Areas	Supervisors	B-S6-011	S6 Estates	0.4
Basement Pump Additional Functional Areas	Estates Library	B-S6-012	S6 Estates	0.4
Basement Pump Functional Areas	Office	B-S6-013	S6 Estates	0.4
Basement Pump Functional Areas	Store	B-S6-014	S6 Estates	0.8
Basement Pump Functional Areas	Contract Manager	B-S6-015	S6 Estates	0.4
Basement Pump Additional Functional Areas	Corridor	B-S6-017	S6 Estates	0
Basement Pump Functional Areas	WC - Staff	B-S6-019	S6 Estates	0.8
Basement Pump Functional Areas	WC - Staff	B-S6-021	S6 Estates	0.8
Basement Pump Functional Areas	Staff Welfare	B-S6-050	S6 Estates	35
Basement Pump Additional Functional Areas	Corridor	4-S7-001	S7 Restaurant	0
Basement Pump Functional Areas	WC - Ambulant (Male)	4-S7-002	S7 Restaurant	0.8
Basement Pump Functional Areas	WC - Ambulant (Female)	4-S7-003	S7 Restaurant	0.8
Basement Pump Functional Areas	WC - Ambulant (Male)	4-S7-004	S7 Restaurant	0.8
Basement Pump Additional Functional Areas	Corridor	4-S7-005	S7 Restaurant	0
Basement Pump Additional Functional Areas	Disposal Hold	4-S7-007	S7 Restaurant	0.9
Basement Pump Functional Areas	Storage/Dishwashing	4-S7-008	S7 Restaurant	0.8
Basement Pump Functional Areas	DSR	4-S7-009	S7 Restaurant	16
Basement Pump Functional Areas	Restaurant	4-S7-010	S7 Restaurant	0.8
Basement Pump Functional Areas	WC Accessible	4-S7-011	S7 Restaurant	0.8
Basement Pump Additional Functional Areas	Switch Cupboard	4-S7-012	S7 Restaurant	0
Basement Pump Additional Functional Areas	Corridor	4-S7-013	S7 Restaurant	0
Basement Pump Functional Areas	HSSD TROLLEY HOLD	B-S8-001	S8 Sterile Supplies	0
Basement Pump Functional Areas	WC - Ambulant	4-S9-001	S9 Helipad Support	0.8
Basement Pump Functional Areas	RFFS Support	4-S9-002A	S9 Helipad Support	21
Basement Pump Functional Areas	RFFS Changing	4-S9-002B	S9 Helipad Support	21
Basement Pump Functional Areas	Cleaner	4-S9-006	S9 Helipad Support	21
Basement Pump Functional Areas	Single Room 11	3-C1.4-010	C1.4 Haematology	35
Basement Pump Functional Areas	BEDS ST	B-I2-004	I2 Stores	0.6
Basement Pump Functional Areas	HV PLANT ROOM LOBBY	B-PLANT-	Basement	0

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Basement Pump Functional Areas	LINEN POOL (DIRTY)	B-S3-005	S3 Domestic Services	16
Basement Pump Functional Areas	HEAT STATION 04	B-PLANT-003	Basement	0
Basement Pump Functional Areas	CLEANING EQUIPMENT ST	B-S3-007	S3 Domestic Services	0.9
Basement Pump Functional Areas	HV PLANT ROOM 03	B-PLANT-007A	Basement	0
Basement Pump Functional Areas	PTS PLANT ROOM	B-PLANT-011	Basement	0
Basement Pump Functional Areas	NODE Room	B-T1-002	T1 Combined Plant	16
Basement Pump Functional Areas	Dictation Phone Booth	B-S3-011	S3 Domestic Services	0.2
Basement Pump Functional Areas	Rain water tank room	B-Plant-008	Basement	0
Basement Pump Functional Areas	WARD KITCHEN	3-C1.3-034	C1.3 Neuroscience	21
Basement Pump Functional Areas	3P DATA MANAGER/SECRETARIAL OFFICE	1-B1-051	B1 PICU	0.4
Basement Pump Functional Areas	SINGLE ROOM	3-C1.1-018	C1.1 Medical Inpatients	35
Basement Pump Functional Areas	ENSUITE (F)	3-C1.1-015	C1.1 Medical Inpatients	35
Basement Pump Functional Areas	HOIST BAY	3-C1.1-016	C1.1 Medical Inpatients	0
Basement Pump Functional Areas	SINGLE ROOM (F)	3-C1.1-014	C1.1 Medical Inpatients	35

PART F – CLINICAL ASSESSMENT PARU GSU

Part F of Schedule Part 3 Clinical Assessment Paru GSU is in the Agreed Form identified and executed as Part F of Schedule Part 3 Clinical Assessment Paru GSU Table of this SA1, referred to in and forming part of this SA1

Schedule Part 14 (Payment Mechanism)

Appendix 4 - Clinical Assessment PARU GSU

Pump Group	Room Name	Room No	Department	GSU
External Pump Functional Areas	MEDICAL GAS PLANT	4-PLANT-007	4th Floor	0
External Pump Functional Areas	CORRIDOR WHB'S	G-A1-001A	A1 EMERGENCY	0
External Pump Functional Areas	ST SHW (A)	G-A1-041	A1 EMERGENCY	0.8
External Pump Functional Areas	ST SHW (A)	G-A1-049	A1 EMERGENCY	0.6
External Pump Functional Areas	ST CHG (M)	G-A1-048	A1 EMERGENCY	0.7
External Pump Functional Areas	DSR	G-A1-056	A1 EMERGENCY	16
External Pump Functional Areas	NAPPY CHANGE	G-A1-047	A1 EMERGENCY	0.8
External Pump Functional Areas	BABY FEED	G-A1-046	A1 EMERGENCY	0.8
External Pump Functional Areas	WC -WCH	G-A1-041	A1 EMERGENCY	0.8
External Pump Functional Areas	WC - WCH	G-A1-042	A1 EMERGENCY	0.8
External Pump Functional Areas	TRIAGE ROOM	G-A1-035	A1 EMERGENCY	200
External Pump Functional Areas	BEV BAY	G-A1-054	A1 EMERGENCY	0.4
External Pump Functional Areas	ST CHANGE	G-A1-043	A1 EMERGENCY	0.7
External Pump Functional Areas	WC (ST)	G-A1-058	A1 EMERGENCY	0.6
External Pump Functional Areas	WC ST	G-A1-055	A1 EMERGENCY	0.6
External Pump Functional Areas	ST SHW(A)	G-A1-044	A1 EMERGENCY	0.6
External Pump Functional Areas	WAITING INC (PLAY)	G-A1-045	A1 EMERGENCY	100
External Pump Additional Functional Areas	Corridor	G-A2-001	A2 PARU	0
External Pump Additional Functional Areas	Single Room 27	G-A2-002	A2 PARU	35
External Pump Additional Functional Areas	Room 27 - Ensuite	G-A2-003	A2 PARU	0

External Pump Additional Functional Areas	Single Room 28	G-A2-004	A2 PARU	35
External Pump Functional Areas	Room 28 - Ensuite	G-A2-005	A2 PARU	0
External Pump Functional Areas	Single Room 26	G-A2-006	A2 PARU	35
External Pump Functional Areas	Room 26 - Ensuite	G-A2-007	A2 PARU	0
External Pump Additional Functional Areas	Reception	G-A2-008	A2 PARU	21
External Pump Additional Functional Areas	Single Room 29	G-A2-009	A2 PARU	35
External Pump Additional Functional Areas	Room 29 - Ensuite	G-A2-010	A2 PARU	0
External Pump Additional Functional Areas	Touchdown Base 2	G-A2-011	A2 PARU	21
External Pump Functional Areas	Single Room 31	G-A2-012	A2 PARU	35
External Pump Functional Areas	Room 31 - Ensuite	G-A2-013	A2 PARU	0
External Pump Functional Areas	Single Room 30	G-A2-014	A2 PARU	35
External Pump Additional Functional Areas	Room 30 - Ensuite	G-A2-015	A2 PARU	0
External Pump Additional Functional Areas	Resus Bay	G-A2-016	A2 PARU	0.1
External Pump Functional Areas	Single Room 6	G-A2-017	A2 PARU	35
External Pump Functional Areas	Room 6 - Ensuite	G-A2-018	A2 PARU	0
External Pump Functional Areas	Single Room 5	G-A2-019	A2 PARU	35
External Pump Functional Areas	Room 5 - Ensuite	G-A2-020	A2 PARU	0
External Pump Additional Functional Areas	Clean Utility	G-A2-021	A2 PARU	50
External Pump Functional Areas	Dirty Utility	G-A2-022	A2 PARU	21
External Pump Additional Functional Areas	WC - Staff	G-A2-023	A2 PARU	0.6
External Pump Additional Functional Areas	WC - Ambulant (Visitors)	G-A2-024	A2 PARU	0.8
External Pump Additional Functional Areas	Linen Bay (1 trolley)	G-A2-025	A2 PARU	0
External Pump Additional Functional Areas	Touchdown Base 1	G-A2-026	A2 PARU	21
External Pump Additional Functional Areas	Hoist Bay	G-A2-027	A2 PARU	0.1
External Pump Functional Areas	Observation Bay	G-A2-028	A2 PARU	35
External Pump Additional Functional Areas	Observation Bay - Ensuite	G-A2-029	A2 PARU	0
External Pump Functional Areas	Observation Bay - Toilet	G-A2-030	A2 PARU	0.8
External Pump Functional Areas	Single Room 1	G-A2-031	A2 PARU	35
External Pump Functional Areas	Room 1 - Ensuite	G-A2-032	A2 PARU	0
External Pump Functional Areas	Single Room 2	G-A2-033	A2 PARU	35
External Pump Functional Areas	Room 2 - Ensuite	G-A2-034	A2 PARU	0
External Pump Functional Areas	Single Room 3	G-A2-035	A2 PARU	35

External Pump Functional Areas	Room 3 - Ensuite	G-A2-036	A2 PARU	0
External Pump Functional Areas	Single Room 4	G-A2-037	A2 PARU	35
External Pump Functional Areas	Room 4 Ensuite	G-A2-038	A2 PARU	0
External Pump Additional Functional Areas	Treatment Room	G-A2-039	A2 PARU	21
External Pump Functional Areas	Dining / Play Room	G-A2-040	A2 PARU	10
External Pump Functional Areas	Ward Kitchen	G-A2-041	A2 PARU	21
External Pump Functional Areas	Single Room 7	G-A2-042	A2 PARU	35
External Pump Functional Areas	Room 7 - Ensuite	G-A2-043	A2 PARU	0
External Pump Functional Areas	Single Room 8	G-A2-044	A2 PARU	35
External Pump Functional Areas	Room 8 - Ensuite	G-A2-045	A2 PARU	0
External Pump Functional Areas	Bay 2	G-A2-046	A2 PARU	35
External Pump Functional Areas	Bay 2 - Toilet	G-A2-047	A2 PARU	0.8
External Pump Additional Functional Areas	Bay 2 - Ensuite	G-A2-048	A2 PARU	0
External Pump Additional Functional Areas	Touchdown Base 3	G-A2-049	A2 PARU	21
External Pump Functional Areas	Single Room 9	G-A2-050	A2 PARU	35
External Pump Functional Areas	Room 9 - Ensuite	G-A2-051	A2 PARU	0
External Pump Functional Areas	Single Room 10	G-A2-052	A2 PARU	35
External Pump Functional Areas	Room 10 - Ensuite	G-A2-053	A2 PARU	0
External Pump Functional Areas	Bay 1	G-A2-054	A2 PARU	35
External Pump Additional Functional Areas	Bay 1 - Ensuite	G-A2-055	A2 PARU	0
External Pump Functional Areas	Bay 1 - Toilet	G-A2-056	A2 PARU	0.8
External Pump Functional Areas	Corridor	G-A2-057	A2 PARU	0
External Pump Functional Areas	Single Room 11	G-A2-058	A2 PARU	35
External Pump Functional Areas	Room 11 - Ensuite	G-A2-059	A2 PARU	0
External Pump Functional Areas	Single Room 12	G-A2-060	A2 PARU	35
External Pump Functional Areas	Room 12 - Ensuite	G-A2-061	A2 PARU	0
External Pump Functional Areas	WC - Staff	G-A2-062	A2 PARU	0.6
External Pump Additional Functional Areas	Linen Bay (1 trolley)	G-A2-063	A2 PARU	0
External Pump Additional Functional Areas	Store - Equipment	G-A2-064	A2 PARU	0.2
External Pump Additional Functional Areas	Single Room 16	G-A2-065	A2 PARU	35
External Pump Additional Functional Areas	Room 16 - Ensuite	G-A2-066	A2 PARU	0
External Pump Functional Areas	Single Room 14	G-A2-067	A2 PARU	35

External Pump Functional Areas	Room 14 - Ensuite	G-A2-068	A2 PARU	0
External Pump Additional Functional Areas	Touchdown Base 4	G-A2-069	A2 PARU	21
External Pump Additional Functional Areas	Single Room 15	G-A2-070	A2 PARU	35
External Pump Functional Areas	Room 15 - Ensuite	G-A2-071	A2 PARU	0
External Pump Functional Areas	Single Room 17	G-A2-072	A2 PARU	35
External Pump Additional Functional Areas	Room 17 - Ensuite	G-A2-073	A2 PARU	0
External Pump Functional Areas	Room 17 - Lobby	G-A2-074	A2 PARU	35
External Pump Additional Functional Areas	Store - General	G-A2-075A	A2 PARU	0.1
External Pump Additional Functional Areas	Store - General	G-A2-075B	A2 PARU	0.1
External Pump Additional Functional Areas	Patients' Assisted Bathroom	G-A2-076	A2 PARU	21
External Pump Additional Functional Areas	Multi-Disciplinary Office	G-A2-077	A2 PARU	0.8
External Pump Additional Functional Areas	Senior Charge Nurse Office	G-A2-078	A2 PARU	0.4
External Pump Additional Functional Areas	On-Call Consultant Office (2 person)	G-A2-079	A2 PARU	0.4
External Pump Additional Functional Areas	DSR	G-A2-080	A2 PARU	16
External Pump Additional Functional Areas	Clinical Coordinators Office (2 person)	G-A2-081	A2 PARU	0.4
External Pump Additional Functional Areas	Disposal Hold	G-A2-082	A2 PARU	0.9
External Pump Additional Functional Areas	Patient Interview Room	G-A2-083	A2 PARU	10
External Pump Additional Functional Areas	Dirty Utility	G-A2-084	A2 PARU	21
External Pump Additional Functional Areas	Corridor	G-A2-085	A2 PARU	0
External Pump Additional Functional Areas	Switch Cupboard	G-A2-086	A2 PARU	0
External Pump Additional Functional Areas	Switch Cupboard	G-A2-088	A2 PARU	0
External Pump Additional Functional Areas	Switch Cupboard	G-A2-089	A2 PARU	0
External Pump Functional Areas	BAY 2	1-B1-031	B1 PICU	200
External Pump Functional Areas	DIRTY UTILITY	1-B1-029	B1 PICU	21
External Pump Functional Areas	CLEAN UTILITY	1-B1-027	B1 PICU	50
External Pump Functional Areas	SINGLE ROOM	1-B1-019	B1 PICU	200
External Pump Functional Areas	SINGLE ROOM	1-B1-021	B1 PICU	200
External Pump Functional Areas	SINGLE ROOM	1-B1-020	B1 PICU	200
External Pump Functional Areas	SINGLE ROOM	1-B1-017	B1 PICU	200
External Pump Functional Areas	LOBBY 6	1-B1-018	B1 PICU	0

External Pump Functional Areas	SINGLE ROOM	1-B1-016	B1 PICU	200
External Pump Functional Areas	BAY 1	1-B1-009	B1 PICU	200
External Pump Functional Areas	LABORATORY	1-B1-043	B1 PICU	200
External Pump Functional Areas	WC (ST)	1-B1-005	B1 PICU	0.6
External Pump Functional Areas	WC(ST)	1-B1-006	B1 PICU	0.6
External Pump Functional Areas	STAFFROOM	1-B1-003	B1 PICU	10
External Pump Functional Areas	CORRIDOR WHB	1-B1-040	B1 PICU	0
External Pump Functional Areas	CORRIDOR WHB	1-B1-052	B1 PICU	0
External Pump Functional Areas	Corridor	3-C1.1-001	C1.1 Medical Inpatients	0
External Pump Additional Functional Areas	IPS Room	3-C1.1-002	C1.1 Medical Inpatients	200
External Pump Additional Functional Areas	Senior Charge Nurse Office	3-C1.1-003	C1.1 Medical Inpatients	0.4
External Pump Functional Areas	Single Room 4 (Transitional Care Bed)	3-C1.1-004	C1.1 Medical Inpatients	35
External Pump Functional Areas	Room 4 - Ensuite	3-C1.1-005	C1.1 Medical Inpatients	0
External Pump Functional Areas	Room 4 - Lobby	3-C1.1-006	C1.1 Medical Inpatients	0
External Pump Additional Functional Areas	Hoist Bay	3-C1.1-007	C1.1 Medical Inpatients	0.1
External Pump Functional Areas	Sitting Room	3-C1.1-008	C1.1 Medical Inpatients	0.8
External Pump Functional Areas	Single Room 6 (Transitional Care Bed)	3-C1.1-009	C1.1 Medical Inpatients	35
External Pump Functional Areas	Room 6 - Ensuite	3-C1.1-010	C1.1 Medical Inpatients	0
External Pump Functional Areas	Touchdown Base 2	3-C1.1-011	C1.1 Medical Inpatients	21
External Pump Additional Functional Areas	Resus Bay	3-C1.1-012	C1.1 Medical Inpatients	0.1
External Pump Functional Areas	Single Room 5 (Transitional Care Bed)	3-C1.1-013	C1.1 Medical Inpatients	35
External Pump Functional Areas	Room 5 - Ensuite	3-C1.1-014	C1.1 Medical Inpatients	0
External Pump Functional Areas	Single Room 7 (Transitional Care Bed)	3-C1.1-015	C1.1 Medical Inpatients	35
External Pump Functional Areas	Room 7 - Ensuite	3-C1.1-016	C1.1 Medical Inpatients	0
External Pump Functional Areas	DSR	3-C1.1-017	C1.1 Medical Inpatients	16
External Pump Functional Areas	Bay 2 (beds 15-18)	3-C1.1-018	C1.1 Medical Inpatients	35
External Pump Functional Areas	Bay 2 - Ensuite	3-C1.1-019	C1.1 Medical Inpatients	0
External Pump Functional Areas	Bay 2 - Toilet	3-C1.1-020	C1.1 Medical Inpatients	0.8

External Pump Functional Areas	Dining / Play Room	3-C1.1-021	C1.1 Medical Inpatients	10
External Pump Additional Functional Areas	Store - Equipment	3-C1.1-022	C1.1 Medical Inpatients	0.2
External Pump Functional Areas	Ward Kitchen	3-C1.1-023	C1.1 Medical Inpatients	21
External Pump Additional Functional Areas	Linen Bay (2 trolleys)	3-C1.1-024	C1.1 Medical Inpatients	0
External Pump Additional Functional Areas	Store - General	3-C1.1-025	C1.1 Medical Inpatients	0.1
External Pump Additional Functional Areas	WC - Staff	3-C1.1-026	C1.1 Medical Inpatients	0.6
External Pump Functional Areas	WC - Staff	3-C1.1-027	C1.1 Medical Inpatients	0.6
External Pump Additional Functional Areas	Disposal Hold	3-C1.1-028	C1.1 Medical Inpatients	0.9
External Pump Additional Functional Areas	Mobile X-Ray / Ultrasound Bay	3-C1.1-029	C1.1 Medical Inpatients	0.8
External Pump Additional Functional Areas	Multi-Disciplinary Office	3-C1.1-030	C1.1 Medical Inpatients	0.4
External Pump Additional Functional Areas	Reception (1 person)	3-C1.1-031	C1.1 Medical Inpatients	0.6
External Pump Functional Areas	Room 21 - Lobby	3-C1.1-032	C1.1 Medical Inpatients	35
External Pump Functional Areas	Single Room 21	3-C1.1-033	C1.1 Medical Inpatients	35
External Pump Functional Areas	Room 21 - Ensuite	3-C1.1-034	C1.1 Medical Inpatients	0
External Pump Functional Areas	Room 20 - Lobby	3-C1.1-035	C1.1 Medical Inpatients	35
External Pump Functional Areas	Single Room 20	3-C1.1-036	C1.1 Medical Inpatients	35
External Pump Additional Functional Areas	Room 20 - Ensuite	3-C1.1-037	C1.1 Medical Inpatients	0
External Pump Additional Functional Areas	Touchdown Base 1	3-C1.1-038	C1.1 Medical Inpatients	21
External Pump Functional Areas	Room 19 - Lobby	3-C1.1-039	C1.1 Medical Inpatients	35
External Pump Functional Areas	Single Room 19	3-C1.1-040	C1.1 Medical Inpatients	35
External Pump Functional Areas	Room 19 - Ensuite	3-C1.1-041	C1.1 Medical Inpatients	0
External Pump Additional Functional Areas	Clean Utility	3-C1.1-042	C1.1 Medical Inpatients	50
External Pump Additional Functional Areas	Treatment Room	3-C1.1-043	C1.1 Medical Inpatients	21
External Pump Additional Functional Areas	Dirty Utility	3-C1.1-044	C1.1 Medical Inpatients	21
External Pump Additional Functional Areas	Touchdown Base 3	3-C1.1-045	C1.1 Medical Inpatients	21
External Pump Functional Areas	Bay 1 (beds 10-14 excl13)	3-C1.1-046	C1.1 Medical Inpatients	35
External Pump Functional Areas	Bay 1 - Toilet	3-C1.1-047	C1.1 Medical Inpatients	0.8
External Pump Functional Areas	Bay 1 - Ensuite	3-C1.1-048	C1.1 Medical Inpatients	0
External Pump Functional Areas	Patients' Assisted Bathroom	3-C1.1-049	C1.1 Medical Inpatients	21
External Pump Additional Functional Areas	Patient Interview Room	3-C1.1-050	C1.1 Medical Inpatients	10
External Pump Additional Functional Areas	Touchdown Base 4	3-C1.1-051	C1.1 Medical Inpatients	21
External Pump Functional Areas	Single Room 9	3-C1.1-052	C1.1 Medical Inpatients	35

External Pump Functional Areas	Room 9 - Ensuite	3-C1.1-053	C1.1 Medical Inpatients	0
External Pump Functional Areas	Single Room 8	3-C1.1-054	C1.1 Medical Inpatients	35
External Pump Functional Areas	Room 8 - Ensuite	3-C1.1-055	C1.1 Medical Inpatients	0
External Pump Functional Areas	Single Room 3	3-C1.1-056	C1.1 Medical Inpatients	35
External Pump Functional Areas	Room 3 - Ensuite	3-C1.1-057	C1.1 Medical Inpatients	0
External Pump Functional Areas	Single Room 1	3-C1.1-058	C1.1 Medical Inpatients	35
External Pump Additional Functional Areas	Room 1 - Ensuite	3-C1.1-059	C1.1 Medical Inpatients	0
External Pump Functional Areas	Single Room 2	3-C1.1-060	C1.1 Medical Inpatients	35
External Pump Functional Areas	Room 2 - Ensuite	3-C1.1-061	C1.1 Medical Inpatients	0
External Pump Additional Functional Areas	Touchdown Base 5	3-C1.1-062	C1.1 Medical Inpatients	21
External Pump Additional Functional Areas	Single Room 24	3-C1.1-063	C1.1 Medical Inpatients	35
External Pump Additional Functional Areas	Room 24 - Ensuite	3-C1.1-064	C1.1 Medical Inpatients	0
External Pump Functional Areas	Single Room 23	3-C1.1-065	C1.1 Medical Inpatients	35
External Pump Additional Functional Areas	Room 23 - Ensuite	3-C1.1-066	C1.1 Medical Inpatients	0
External Pump Functional Areas	Single Room 22	3-C1.1-067	C1.1 Medical Inpatients	35
External Pump Functional Areas	Room 22 - Ensuite	3-C1.1-068	C1.1 Medical Inpatients	0
External Pump Additional Functional Areas	WC - Ambulant (Visitors)	3-C1.1-070	C1.1 Medical Inpatients	0.8
External Pump Additional Functional Areas	Corridor	3-C1.1-071	C1.1 Medical Inpatients	0
External Pump Additional Functional Areas	Switch Cupboard	3-C1.1-072	C1.1 Medical Inpatients	0
External Pump Additional Functional Areas	Corridor	3-C1.1-073	C1.1 Medical Inpatients	0
External Pump Functional Areas	CORRIDOR WHB	3-C1.2-001	C1.2 Surgical Long Stay	0
External Pump Functional Areas	DIRTY UTILITY	3-C1.2-012	C1.2 Surgical Long Stay	21
External Pump Functional Areas	DSR	3-C1.2-013	C1.2 Surgical Long Stay	16
External Pump Functional Areas	ENSUITE	3-C1.2-011	C1.2 Surgical Long Stay	0
External Pump Functional Areas	SINGLE BED	3-C1.2-010	C1.2 Surgical Long Stay	35
External Pump Functional Areas	ENSUITE	3-C1.2-003	C1.2 Surgical Long Stay	0
External Pump Functional Areas	Single Room 9	3-C1.2-002	C1.2 Surgical Long Stay	35
External Pump Functional Areas	DINING/RECREATION	3-C1.6-001	C1.6 Adolescent	21
External Pump Functional Areas	SLEEP ROOM	3-C4-008	C4 Sleep Lab	21
External Pump Functional Areas	Parents Room 2	3-C4-009	C4 Sleep Lab	21
External Pump Functional Areas	SINGLE ROOM	3-D9-024	D9 Medical Day Care	35
External Pump Functional Areas	ENSUITE	3-D9-020	D9 Medical Day Care	0

External Pump Functional Areas	ENSUITE	3-D9-025	D9 Medical Day Care	0
External Pump Functional Areas	SINGLE ROOM	3-D9-019	D9 Medical Day Care	35
External Pump Functional Areas	WC ST	3-D9-028	D9 Medical Day Care	0.6
External Pump Functional Areas	DIRTY UTILITY	3-D9-017	D9 Medical Day Care	21
External Pump Functional Areas	BAY 1 (BEDS 3-5)	3-D9-022	D9 Medical Day Care	35
External Pump Functional Areas	CORRIDOR WHB	3-D9-029	D9 Medical Day Care	0
External Pump Functional Areas	WC ST	G-S6-022	Energy Centre	0.8
External Pump Functional Areas	PLAYROOM	G-F1-019	F1 CAMHS	21
External Pump Functional Areas	WARD KITCHEN	1-L1-054	L1 DCN Acute	0.4
External Pump Functional Areas	WC (WCH)	1-L1-080	L1 DCN Acute	0.8
External Pump Functional Areas	RELATIVES ENSUITE	1-L1-077	L1 DCN Acute	0
External Pump Functional Areas	BAY 2	1-L1-100	L1 DCN Acute	35
External Pump Functional Areas	ENSUITE	1-L1-039	L1 DCN Acute	0
External Pump Functional Areas	SINGLE ROOM	1-L1-093	L1 DCN Acute	35
External Pump Functional Areas	TREATMENT	1-L1-103	L1 DCN Acute	21
External Pump Functional Areas	BAY 2 ENSUITE	1-L1-101	L1 DCN Acute	0
External Pump Functional Areas	BAY 1 ENSUITE	1-L1-099	L1 DCN Acute	0
External Pump Functional Areas	SINGLE ROOM	1-L1-091	L1 DCN Acute	35
External Pump Functional Areas	SINGLE ROOM	1-L1-088	L1 DCN Acute	35
External Pump Functional Areas	ENSUITE	1-L1-087	L1 DCN Acute	35
External Pump Functional Areas	ENSUITE	1-L1-084	L1 DCN Acute	0
External Pump Functional Areas	SINGLE	1-L1-083	L1 DCN Acute	35
External Pump Functional Areas	CLEAN UTILITY	1-L1-047	L1 DCN Acute	50
External Pump Functional Areas	DIRTY UTILITY	1-L1-061	L1 DCN Acute	21
External Pump Functional Areas	DSR	1-L1-095	L1 DCN Acute	16
External Pump Functional Areas	LOBBY	1-L1-104	L1 DCN Acute	200
External Pump Functional Areas	SINGLE ROOM	1-L1-038	L1 DCN Acute	35
External Pump Functional Areas	SINGLE ROOM	1-L1-068	L1 DCN Acute	35
External Pump Functional Areas	ENSUITE	1-L1-067	L1 DCN Acute	0
External Pump Functional Areas	ENSUITE	1-L1-069	L1 DCN Acute	0
External Pump Functional Areas	SINGLE ROOM	1-L1-066	L1 DCN Acute	35
External Pump Functional Areas	SINGLE ROOM	1-L1-024	L1 DCN Acute	35

External Pump Functional Areas	ENSUITE	1-L1-035	L1 DCN Acute	0
External Pump Functional Areas	ENSUITE	1-L1-025	L1 DCN Acute	0
External Pump Functional Areas	ENSUITE	1-L1-040	L1 DCN Acute	0
External Pump Functional Areas	SINGLE ROOM	1-L1-021	L1 DCN Acute	35
External Pump Functional Areas	ENSUITE	1-L1-022	L1 DCN Acute	0
External Pump Functional Areas	ENSUITE	1-L1-018	L1 DCN Acute	0
External Pump Functional Areas	SINGLE ROOM	1-L1-017	L1 DCN Acute	35
External Pump Functional Areas	SINGLE ROOM	1-L1-015	L1 DCN Acute	35
External Pump Functional Areas	ENSUITE	1-L1-016	L1 DCN Acute	0
External Pump Functional Areas	ENSUITE	1-L1-011	L1 DCN Acute	0
External Pump Functional Areas	SINGLE ROOM	1-L1-034	L1 DCN Acute	35
External Pump Functional Areas	4 BED	1-L1-097	L1 DCN Acute	35
External Pump Functional Areas	Relatives Overnight Stay Room	1-L1-082	L1 DCN Acute	21
External Pump Functional Areas	Corridor	1-L1-001	L1 DCN Acute	0
External Pump Functional Areas	Single Room 25	1-L1-044	L1 DCN Acute	35
External Pump Functional Areas	SINGLE ROOM	2-L2-004	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-018	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE ROOM	2-L2-024	L2 DCN Inpatients	0
External Pump Functional Areas	ENSUITE ROOM	2-L2-019	L2 DCN Inpatients	0
External Pump Functional Areas	SINGLE ROOM	2-L2-023	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-028	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE ROOM	2-L2-029	L2 DCN Inpatients	0
External Pump Functional Areas	ENSUITE ROOM	2-L2-051	L2 DCN Inpatients	0
External Pump Functional Areas	SINGLE ROOM	2-L2-050	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE ROOM	2-L2-042	L2 DCN Inpatients	0
External Pump Functional Areas	SINGLE ROOM	2-L2-043	L2 DCN Inpatients	35
External Pump Functional Areas	CLEAN UTILITY	2-L2-052	L2 DCN Inpatients	50
External Pump Functional Areas	ROOM 20 LOBBY	2-L2-038	L2 DCN Inpatients	35
External Pump Functional Areas	WC (A)	2-L2-060	L2 DCN Inpatients	0.6
External Pump Functional Areas	WARD KITCHEN	2-L2-062	L2 DCN Inpatients	21
External Pump Functional Areas	WC (ST)	2-L2-072	L2 DCN Inpatients	0.8
External Pump Functional Areas	SINGLE ROOM	2-L2-034	L2 DCN Inpatients	35

External Pump Functional Areas	SINGLE ROOM	2-L2-036	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-135	L2 DCN Inpatients	35
External Pump Functional Areas	LOBBY	2-L2-134	L2 DCN Inpatients	35
External Pump Functional Areas	CLEAN UTILITY	2-L2-079	L2 DCN Inpatients	50
External Pump Functional Areas	PARENTS ASSISTED BATHROOM	2-L2-080	L2 DCN Inpatients	21
External Pump Functional Areas	SINGLE ROOM	2-L2-087	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE	2-L2-088	L2 DCN Inpatients	0
External Pump Functional Areas	ENSUITE	2-L2-091	L2 DCN Inpatients	0
External Pump Functional Areas	SINGLE ROOM	2-L2-090	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-097	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE	2-L2-103	L2 DCN Inpatients	0
External Pump Functional Areas	ENSUITE	2-L2-096	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-102	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-104	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE	2-L2-105	L2 DCN Inpatients	0
External Pump Functional Areas	SINGLE ROOM	2-L2-132	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-130	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE	2-L2-131	L2 DCN Inpatients	0
External Pump Functional Areas	ENSUITE	2-L2-126	L2 DCN Inpatients	0
External Pump Functional Areas	SINGLE ROOM	2-L2-125	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-123	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE	2-L2-124	L2 DCN Inpatients	0
External Pump Functional Areas	ENSUITE	2-L2-120	L2 DCN Inpatients	0
External Pump Functional Areas	SINGLE ROOM	2-L2-119	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE	2-L2-110	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-111	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-113	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE	2-L2-114	L2 DCN Inpatients	0
External Pump Functional Areas	ENSUITE	2-L2-122	L2 DCN Inpatients	0
External Pump Functional Areas	SINGLE ROOM	2-L2-121	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-142	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE	2-L2-143	L2 DCN Inpatients	0

External Pump Functional Areas	ENSUITE	2-L2-138	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-117	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE	2-L2-118	L2 DCN Inpatients	0
External Pump Functional Areas	ENSUITE	2-L2-109	L2 DCN Inpatients	0
External Pump Functional Areas	SINGLE ROOM	2-L2-108	L2 DCN Inpatients	35
External Pump Functional Areas	SINGLE ROOM	2-L2-106	L2 DCN Inpatients	35
External Pump Functional Areas	ENSUITE	2-L2-107	L2 DCN Inpatients	0
External Pump Functional Areas	ENSUITE	2-L2-095	L2 DCN Inpatients	0
External Pump Functional Areas	DIRTY UTILITY	2-L2-127	L2 DCN Inpatients	21
External Pump Functional Areas	Room 7 - Ensuite	2-L2-005	L2 DCN Inpatients	0
External Pump Functional Areas	Single Room 2	2-L2-041	L2 DCN Inpatients	35
External Pump Functional Areas	Single Room 20	2-L2-039	L2 DCN Inpatients	35
External Pump Functional Areas	Room 1 - Ensuite	2-L2-136	L2 DCN Inpatients	0
External Pump Functional Areas	Touchdown Base 4	2-L2-009	L2 DCN Inpatients	21
External Pump Functional Areas	Store	2-L2-012	L2 DCN Inpatients	0.1
External Pump Functional Areas	Room 10 - Ensuite	2-L2-014	L2 DCN Inpatients	0
External Pump Functional Areas	Single Room 10	2-L2-013	L2 DCN Inpatients	35
External Pump Functional Areas	Room 9 - Ensuite	2-L2-011	L2 DCN Inpatients	0
External Pump Functional Areas	Single Room 16	2-L2-139	L2 DCN Inpatients	35
External Pump Functional Areas	Room 11 - Ensuite	2-L2-016	L2 DCN Inpatients	0
External Pump Functional Areas	Single Room 10	2-L2-094	L2 DCN Inpatients	35
External Pump Functional Areas	BEV BAY	4-R1-004	R1 Clinical Management Suite	0.2
External Pump Functional Areas	WC (ST) (M)	4-R1-005	R1 Clinical Management Suite	0.6
External Pump Additional Functional Areas	Corridor	4-S7-001	S7 Restaurant	0
External Pump Additional Functional Areas	WC - Ambulant (Male)	4-S7-002	S7 Restaurant	0.8
External Pump Additional Functional Areas	WC - Ambulant (Female)	4-S7-003	S7 Restaurant	0.8
External Pump Functional Areas	WC - Ambulant (Male)	4-S7-004	S7 Restaurant	0.8
External Pump Additional Functional Areas	Corridor	4-S7-005	S7 Restaurant	0
External Pump Additional Functional Areas	Disposal Hold	4-S7-007	S7 Restaurant	0.9
External Pump Additional Functional Areas	Storage/Dishwashing	4-S7-008	S7 Restaurant	0.8
External Pump Additional Functional Areas	DSR	4-S7-009	S7 Restaurant	16
External Pump Functional Areas	Restaurant	4-S7-010	S7 Restaurant	0.8

External Pump Additional Functional Areas	WC Accessible	4-S7-011	S7 Restaurant	0.8
External Pump Additional Functional Areas	Switch Cupboard	4-S7-012	S7 Restaurant	0
External Pump Additional Functional Areas	Corridor	4-S7-013	S7 Restaurant	0

PART 4

JOINT COMPLETION PROGRAMME

Schedule Part 4 Joint Completion Programme is in the Agreed Form identified and executed as Schedule Part 4 Joint Completion Programme of this SA1, referred to in and forming part of this SA1

JOINT COMPLETION PROGRAMME

Schedule Part 4

in the

AGREED FORM

relative to the

Settlement Agreement and Supplemental Agreement

between

Lothian Health Board

and

IHS Lothian Limited

RHSC and DCN, Little France

This is the Joint Completion Programme in the Agreed Form as referred to in the Settlement Agreement and Supplemental Agreement entered into by Lothian Health Board and IHS Lothian Limited 22 February 2019.

[redacted] .....SIGNED ON BEHALF OF LOTHIAN HEALTH BOARD

J GOLDSMITH .....Print Name

Director of Finance .....Position held

[redacted] .....SIGNED ON BEHALF OF IHS LOTHIAN LIMITED

MATTHEW TEMPLETON .....Print Name

Director .....Position held

Schedule 1 Part 4 - Joint Completion Programme

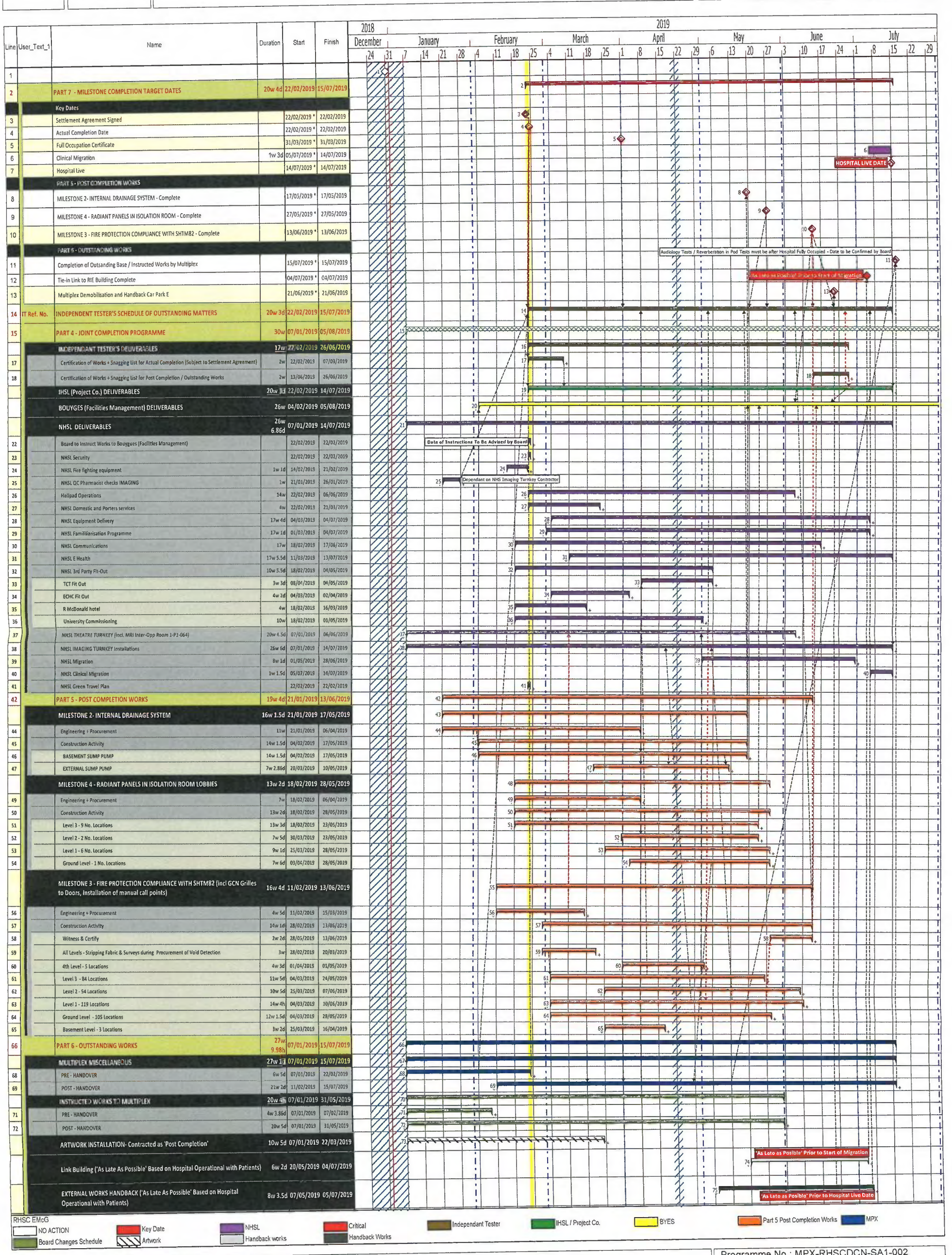
Page 1 of 1

Royal Hospital for Sick Children & DCN

JOINT COMPLETION / JOINT COMMISSIONING PROGRAMME

MULTIPLEX

Line	User_Text_1	Name	Duration	Start	Finish
1					
2		PART 7 - MILESTONE COMPLETION TARGET DATES	20w 4d	22/02/2019	15/07/2019
		Key Dates			
3		Settlement Agreement Signed		22/02/2019 *	22/02/2019
4		Actual Completion Date		22/02/2019 *	22/02/2019
5		Full Occupation Certificate		31/03/2019 *	31/03/2019
6		Clinical Migration	1w 3d	05/07/2019 *	14/07/2019
7		Hospital Live		14/07/2019 *	14/07/2019
		PART 5 - POST COMPLETION WORKS			
8		MILESTONE 2- INTERNAL DRAINAGE SYSTEM - Complete		17/05/2019 *	17/05/2019
9		MILESTONE 4 - RADIANT PANELS IN ISOLATION ROOM - Complete		27/05/2019 *	27/05/2019
10		MILESTONE 3 - FIRE PROTECTION COMPLIANCE WITH SHTM82 - Complete		13/06/2019 *	13/06/2019
		PART 5 - OUTSTANDING WORKS			
11		Completion of Outsanding Base / Instructed Works by Multiplex		15/07/2019 *	15/07/2019
12		Tie-in Link to RIE Building Complete		04/07/2019 *	04/07/2019
13		Multiplex Demobilisation and Handback Car Park E		21/06/2019 *	21/06/2019
14	IT Ref. No.	INDEPENDENT TESTER'S SCHEDULE OF OUTSTANDING MATTERS	20w 3d	22/02/2019	15/07/2019
15		PART 4 - JOINT COMPLETION PROGRAMME	30w	07/01/2019	05/08/2019
		INDEPENDANT TESTER'S DELIVERABLES	17w	22/02/2019	26/06/2019
17		Certification of Works + Snagging List for Actual Completion (Subject to Settlement Agreement)	2w	22/02/2019	07/03/2019
18		Certification of Works + Snagging List for Post Completion / Outstanding Works	2w	13/06/2019	26/06/2019
		IHSL (Project Co.) DELIVERABLES	20w 3d	22/02/2019	14/07/2019
		BOUYGES (Facilities Management) DELIVERABLES	26w	04/02/2019	05/08/2019
		NHSL DELIVERABLES	26w 6.86d	07/01/2019	14/07/2019
22		Board to Instruct Works to Bouygues (Facilities Management)		22/02/2019	22/02/2019
23		NHSL Security		22/02/2019	22/02/2019
24		NHSL Fire fighting equipment	1w 1d	14/02/2019	21/02/2019
25		NHSL QC Pharmacist checks IMAGING	1w	21/01/2019	26/01/2019
26		Helipad Operations	14w	22/02/2019	06/06/2019
27		NHSL Domestic and Porters services	4w	22/02/2019	21/03/2019
28		NHSL Equipment Delivery	17w 4d	04/03/2019	04/07/2019
29		NHSL Familiarisation Programme	17w 1d	01/03/2019	04/07/2019
30		NHSL Communications	17w	18/02/2019	17/06/2019
31		NHSL E Health	17w 5.5d	11/03/2019	13/07/2019
32		NHSL 3rd Party Fit-Out	10w 5.5d	18/02/2019	04/05/2019
33		TCT Fit Out	3w 3d	08/04/2019	04/05/2019
34		ECHC Fit Out	4w 2d	04/03/2019	02/04/2019
35		R McDonald hotel	4w	18/02/2019	16/03/2019
36		University Commissioning	10w	18/02/2019	01/05/2019
37		*NHSL THEATRE TURNKEY (Incl. MRI Inter-Opp Room 1-P1-064)*	20w 4.5d	07/01/2019	06/06/2019
38		NHSL IMAGING TURNKEY Installations	26w 6d	07/01/2019	14/07/2019
39		NHSL Migration	8w 1d	01/05/2019	28/06/2019
40		NHSL Clinical Migration	1w 1.5d	05/07/2019	14/07/2019
41		NHSL Green Travel Plan		22/02/2019	22/02/2019
42		PART 5 - POST COMPLETION WORKS	19w 4d	21/01/2019	13/06/2019
		MILESTONE 2- INTERNAL DRAINAGE SYSTEM	16w 1.5d	21/01/2019	17/05/2019
44		Engineering + Procurement	11w	21/01/2019	06/04/2019
45		Construction Activity	14w 1.5d	04/02/2019	17/05/2019
46		BASEMENT SUMP PUMP	14w 1.5d	04/02/2019	17/05/2019
47		EXTERNAL SUMP PUMP	7w 2.86d	20/03/2019	10/05/2019
		MILESTONE 4 - RADIANT PANELS IN ISOLATION ROOM LOBBIES	13w 2d	18/02/2019	28/05/2019
49		Engineering + Procurement	7w	18/02/2019	06/04/2019
50		Construction Activity	13w 2d	18/02/2019	28/05/2019
51		Level 3 - 9 No. Locations	13w 3d	18/02/2019	23/05/2019
52		Level 2 - 2 No. Locations	7w 5d	30/03/2019	23/05/2019
53		Level 1 - 6 No. Locations	9w 1d	25/03/2019	28/05/2019
54		Ground Level - 1 No. Locations	7w 6d	03/04/2019	28/05/2019
		MILESTONE 3 - FIRE PROTECTION COMPLIANCE WITH SHTM82 (incl GCN Grilles to Doors, Installation of manual call points)	16w 4d	11/02/2019	13/06/2019
56		Engineering + Procurement	4w 5d	11/02/2019	15/03/2019
57		Construction Activity	14w 1d	28/02/2019	13/06/2019
58		Witness & Certify	2w 2d	28/05/2019	13/06/2019
59		All Levels - Stripping Fabric & Surveys during Procurement of Void Detection	3w	28/02/2019	20/03/2019
60		4th Level - 5 Locations	4w 3d	01/04/2019	01/05/2019
61		Level 3 - 84 Locations	11w 5d	04/03/2019	24/05/2019
62		Level 2 - 54 Locations	10w 5d	25/03/2019	07/06/2019
63		Level 1 - 119 Locations	14w 4h	04/03/2019	10/06/2019
64		Ground Level - 105 Locations	12w 1.5d	04/03/2019	28/05/2019
65		Basement Level - 3 Locations	3w 2d	25/03/2019	16/04/2019
66		PART 6 - OUTSTANDING WORKS	27w 9.98h	07/01/2019	15/07/2019
		MULTIPLEX MISCELLANEOUS	27w 1d	07/01/2019	15/07/2019
68		PRE - HANDOVER	6w 5d	07/01/2019	22/02/2019
69		POST - HANDOVER	21w 2d	11/02/2019	15/07/2019
		INSTRUCTED WORKS TO MULTIPLEX	20w 4d	07/01/2019	31/05/2019
71		PRE - HANDOVER	4w 3.86d	07/01/2019	07/02/2019
72		POST - HANDOVER	20w 5d	07/01/2019	31/05/2019
		ARTWORK INSTALLATION- Contracted as 'Post Completion'	10w 5d	07/01/2019	22/03/2019
		Link Building ('As Late As Possible' Based on Hospital Operational with Patients)	6w 2d	20/05/2019	04/07/2019
		EXTERNAL WORKS HANDBACK ('As Late As Possible' Based on Hospital Operational with Patients)	8w 3.5d	07/05/2019	05/07/2019



RHSC EMcG

NO ACTION | Key Date | NHSL | Critical | Independant Tester | IHSL / Project Co. | BYES | Part 5 Post Completion Works | MPX

Board Changes Schedule | Artwork | Handback works | Handback Works

Date of Issue: 20/02/2019 Purpose of Issue: Revised Actual Completion to 22/02/2019	Comments: Revised Actual Completion to 22/02/2019	Programme No.: MPX-RHSCDCN-SA1-002 Revision: F Revision Date: 20/02/2019

File Path: C:\Users\Eddie\Documents\03 eddie mcgibbon ltd\Multiplex\1. EMcG Programme to Completion\Overall Master Programme\Settlement Agreement Jan 2019\20_02_2019 Joint Commissioning Programme Rev 2F.pp 20/02/2019 14:55:39 V Bar Chart View F None S None

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Page 1 of 7	"This programme is copyright and the property of Multiplex Construction (UK) Ltd and must not be used with out written approval".	Royal Hospital for Sick Children & DCN JOINT COMPLETION / JOINT COMMISSIONING PROGRAMME		MULTIPLEX

Line	User_Text_1	Name	Duration	Start	Finish
1					
2		PART 7 - MILESTONE COMPLETION TARGET DATES	20w 4d	22/02/2019	15/07/2019
		Key Dates			
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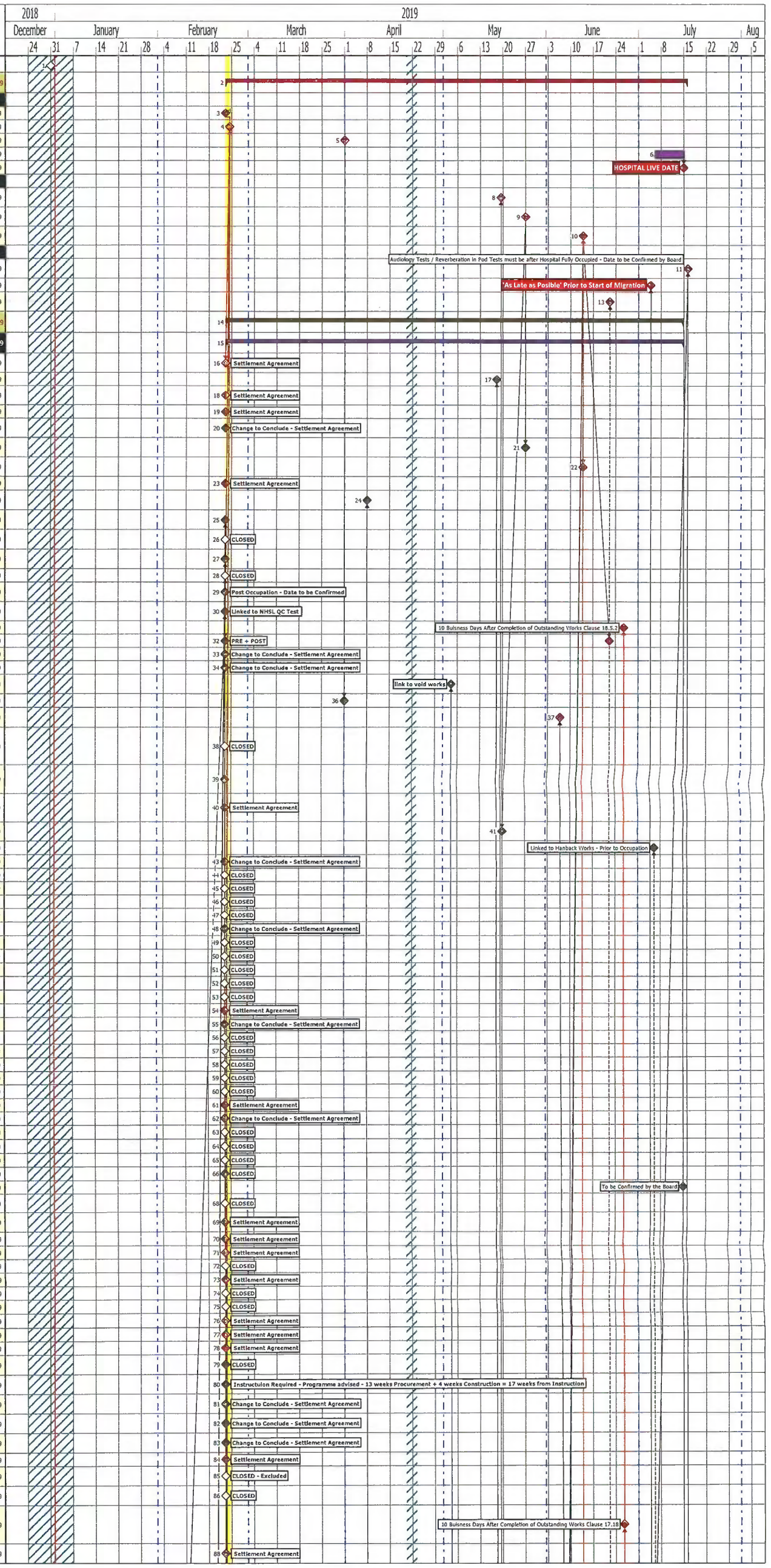
5		Full Occupation Certificate		31/03/2019 *	31/03/2019
6		Clinical Migration	1w 3d	05/07/2019 *	14/07/2019
7		Hospital Live		14/07/2019 *	14/07/2019
		PART 5 - POST COMPLETION WORKS			
8		MILESTONE 2- INTERNAL DRAINAGE SYSTEM - Complete		17/05/2019 *	17/05/2019
9		MILESTONE 4 - RADIANT PANELS IN ISOLATION ROOM - Complete		27/05/2019 *	27/05/2019
10		MILESTONE 3 - FIRE PROTECTION COMPLIANCE WITH SHTM82 - Complete		13/06/2019 *	13/06/2019
		PART 4 - OUTSTANDING WORKS			
11		Completion of Outsanding Base / Instructed Works by Multiplex		15/07/2019 *	15/07/2019
12		Tie-in Link to RIE Building Complete		04/07/2019 *	04/07/2019
13		Multiplex Demobilisation and Handback Car Park E		21/06/2019 *	21/06/2019
14	IT Ref. No.	INDEPENDENT TESTER'S SCHEDULE OF OUTSTANDING MATTERS	20w 3d	22/02/2019	15/07/2019
		Independent Tester Issues 'Schedule of Outstanding Matters'	20w 3d	22/02/2019 *	15/07/2019
16	1	Movement Joint through Critial Areas non-compliant with the requirements		22/02/2019 *	22/02/2019
17	2	Internal Drainage System - Milestone 2		17/05/2019 *	17/05/2019
18	3	Ventilation to Isolation Rooms (NHSL Turnkey Works dependant)		22/02/2019 *	22/02/2019
19	4	Lighting of Fire Fighting Stairs		22/02/2019 *	22/02/2019
20	5	Helipad not Compliant with HBN15-03 or CAP 1264 (CCP061)		22/02/2019 *	22/02/2019
21	6	Heater batteries in Isolation room lobbies - Milestone 4		27/05/2019 *	27/05/2019
22	7	Fire Protection System Compliance with SHTM 82 - Milestone 3		13/06/2019 *	13/06/2019
23	8	Interleave power supplies to Critical Areas		22/02/2019 *	22/02/2019
24	9	Opening windows as part of lobby smoke ventilation		08/04/2019 *	08/04/2019
25	10	Theatre / CT /Anaestetics Scrub Taps fitted at wrong Height		22/02/2019 *	22/02/2019
26	11	Threshold to Spiritual Care not Barrier Free		22/02/2019 *	22/02/2019
27	12	Goods Yard Access to Loading Bay - Constricted by Compactor		22/02/2019 *	22/02/2019
28	13	Key Suiting ready for Handover		22/02/2019 *	22/02/2019
29	14	Acoustic Testing - Atrium Reverbiration Post PC - TBC		22/02/2019 *	22/02/2019
30	15	Medical Gas Systems complete - Dependency on Turnkey Works		22/02/2019 *	22/02/2019
31	16	IT Documentation - Final Clause		26/06/2019 *	26/06/2019
32	17	Handover Clean - Last Clause		22/02/2019 *	21/06/2019
33	18	Removal of Site Establishment		22/02/2019 *	22/02/2019
34	19	Reinstatement of Car Park E		22/02/2019 *	22/02/2019
35	20	Operating Theatres complete - Post completion void detector works		03/05/2019 *	03/05/2019
36	21	Building Warrant Completion Certificate		31/03/2019 *	31/03/2019
37	22	Fire Alarm sounders - will require degree of recheck following alterations		06/06/2019 *	06/06/2019
38	23	Water systems (heating and domestic water) in accordance with CIBSE Commissioning Code W and SHTM 04-01 - Confirmation evidence being sought		22/02/2019 *	22/02/2019
39	24	Pneumatic Tube Transfer - Project Change to be Concluded [Works to complete Post Completion]		22/02/2019 *	22/02/2019
40	25	Ductwork physical cleaning certification in accordance with SHTM 03-01 and the HVCA (2005) 'TR/19 – Guide to good practice;		22/02/2019 *	22/02/2019
41	26	Proving of Isolation Rooms Differential Pressure - Works Complete		20/05/2019 *	20/05/2019
42	27	External Signage		05/07/2019 *	05/07/2019
43	28	Change of LTHW Pipework		22/02/2019 *	22/02/2019
44	29	Helipad Height Reduction		22/02/2019 *	22/02/2019
45	30	Change to Zone A Level 4 Plantrooms		22/02/2019 *	22/02/2019
46	31	Change to Link Building		22/02/2019 *	22/02/2019
47	32	Change to Gas Meter Housing		22/02/2019 *	22/02/2019
48	33	Change to Entrance Mat		22/02/2019 *	22/02/2019
49	34	BREEM Certification		22/02/2019 *	22/02/2019
50	35	Temprature Control Monitoring		22/02/2019 *	22/02/2019
51	36	Positioning of Node Rooms in Basement		22/02/2019 *	22/02/2019
52	37	Change to Curtain Tracks		22/02/2019 *	22/02/2019
53	38	Change to MRI Access		22/02/2019 *	22/02/2019
54	39	Changes to Ceiling Heights		22/02/2019 *	22/02/2019
55	40	Change to Service Yard Crib Wall		22/02/2019 *	22/02/2019
56	41	Radiology Room WC Omission		22/02/2019 *	22/02/2019
57	42	Change to Over Panels Over Doors		22/02/2019 *	22/02/2019
58	43	Change to Standing Seam Roof		22/02/2019 *	22/02/2019
59	44	Change to Warning Lights		22/02/2019 *	22/02/2019
60	45	Change to Skirting		22/02/2019 *	22/02/2019
61	46	Changes to Bed Lift Core 3		22/02/2019 *	22/02/2019
62	47	Provision of Gas Store Level 4		22/02/2019 *	22/02/2019
63	48	Provision of Shower Trays and Pumping		22/02/2019 *	22/02/2019
64	49	Fire Strategy Sprinkler Omission		22/02/2019 *	22/02/2019
65	50	Tactile Sensors to anti-lig sanitary spaces		22/02/2019 *	22/02/2019
66	51	OUT 904 Connections		22/02/2019 *	22/02/2019
67	52	Timing of the Audiolody Acoustic Tests		15/07/2019 *	15/07/2019
68	53	Change to SHPN 40 Intercon / Isolation Suite Functionality		22/02/2019 *	22/02/2019
69	54	Changes to As-Built Energy Model / Seasonal Commissioning		22/02/2019 *	22/02/2019
70	55	Neuropenic Ventilation Change		22/02/2019 *	22/02/2019
71	56	Single Bed Ventilation Changes		22/02/2019 *	22/02/2019
72	57	Change to FCU Traps		22/02/2019 *	22/02/2019
73	58	Change to High Level Drainage		22/02/2019 *	22/02/2019
74	59	Change to Node Room Cooling		22/02/2019 *	22/02/2019
75	60	Change to IPS Room Ceilings		22/02/2019 *	22/02/2019
76	61	4-CORR-007 Change to Ceiling Height		22/02/2019 *	22/02/2019
77	62	0-A1-062 Change to Ceiling Height		22/02/2019 *	22/02/2019
78	63	Group 2 Socket Change		22/02/2019 *	22/02/2019
79	64	Omission of RIE Adult Ambulant Canopy (Board Change 20)		22/02/2019 *	22/02/2019
80	65	Number Plate Recognition (Board Change 87)		22/02/2019 *	22/02/2019
81	66	Fire Evacuation Strategy (Board Change 106) - Works Complete		22/02/2019 *	22/02/2019
82	67	IOMRI Change Instruction (Board Change 109)		22/02/2019 *	22/02/2019
83	68	Vent Ductwork in MRI Equipment Rooms (Board Change 129) - Works Complete		22/02/2019 *	22/02/2019
84	69	ED Store Ventilation		22/02/2019 *	22/02/2019
85	70	Cycle Racks Change (does not form part of the Works)		22/02/2019 *	22/02/2019
86	71	Angiography Proceedures Machine Room (does not form part of the Works)		22/02/2019 *	22/02/2019
87	72	Testing and Commissioning Documentation to be completed following outstanding Works and current issues resolved		26/06/2019 *	26/06/2019
88	73	Issues with Water Proofing and Gas Proofing Specification - item closed		22/02/2019 *	22/02/2019



Date of Issue: 20/02/2019 Purpose of Issue: Revised Actual Completion to 22/02/2019	Comments: Revised Actual Completion to 22/02/2019	Programme No.: MPX-RHSCDCN-SA1-002 Revision: F Revision Date: 20/02/2019

File Path: C:\Users\Eddie\Documents\03 eddie mcgibbon ltd\Multiplex\1. EMcG Programme to Completion\Overall Master Programme\Settlement Agreement Jan 2019\20_02_2019 Joint Commissioning Programme Rev 2F.pp 20/02/2019 14:56:55 V Bar Chart View F None S None

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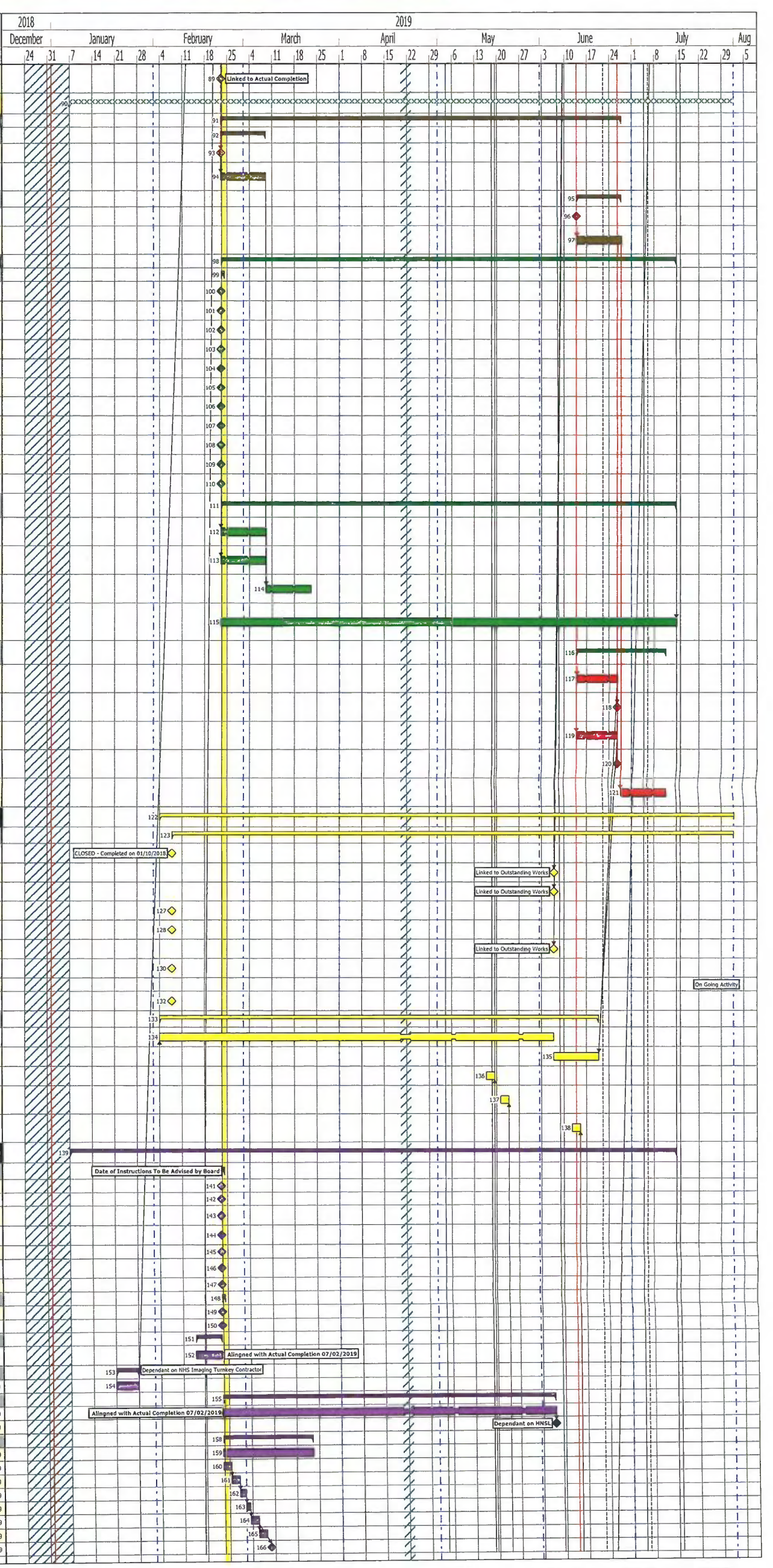
Royal Hospital for Sick Children & DCN

JOINT COMPLETION / JOINT COMMISSIONING PROGRAMME

MULTIPLEX

Line	User_Text_1	Name	Duration	Start	Finish
89	74	RDD Items not reaching Status A or B to be completed (Note: All outstanding Status C Items have provided to NHSL)		22/02/2019 *	22/02/2019
90		PART 4 - JOINT COMPLETION PROGRAMME	30w	07/01/2019	05/08/2019
		INDEPENDANT TESTER'S DELIVERABLES	17w	22/02/2019	26/06/2019
92		Certification of Works + Snagging List for Actual Completion (Subject to Settlement Agreement)	2w	22/02/2019	07/03/2019
93		IT Issues commissioning completion certificate		22/02/2019 *	22/02/2019
94		IT issues snagging notice within 10 business days of issuing Actual Completion (Clause 17.14)	2w	22/02/2019 *	07/03/2019
95		Certification of Works + Snagging List for Post Completion / Outstanding Works	2w	13/06/2019	26/06/2019
96		Independent Tester Certifed Post Completion Works (MILESTONES 2,3,4)		13/06/2019 *	13/06/2019
97		IT issues snagging notice within 10 business days of issuing Actual Completion (Clause 17.14)	2w	13/06/2019 *	26/06/2019
		IHSL (Project Co.) DELIVERABLES	20w 3d	22/02/2019	14/07/2019
99		For Actual Completion		22/02/2019	22/02/2019
100		Project Co. CDM arrangements for post handover agreed with NHSL		22/02/2019 *	22/02/2019
101		Project Co provide Draft O and M Manual (Clause 18.5.2)		22/02/2019 *	22/02/2019
102		Planning Conditions satisfied for Main build as schedule part 29		22/02/2019 *	22/02/2019
103		Planning Conditions satisfied for petrol station site as schedule part 29		22/02/2019 *	22/02/2019
104		Keys handed over to NHS (from Multiplex)		22/02/2019 *	22/02/2019
105		Delivery of Project Co Contract Management Plan		22/02/2019 *	22/02/2019
106		Access system transfers to NHS (from Multiplex)		22/02/2019 *	22/02/2019
107		Transfer of Service Licences (Gas , Water, Electricity)		22/02/2019 *	22/02/2019
108		Room Data Sheets Finalised (from Multiplex)		22/02/2019 *	22/02/2019
109		Project Co Delivery of Building User Guide (from Bouygues)		22/02/2019 *	22/02/2019
110		Project Co submits Energy Strategy to Board (from Bouygues)		22/02/2019 *	22/02/2019
111		Post-Actual Completion (Excluding PART 5 - COMPLETION MILESTONES + PART 6 - OUTSTANDING WORKS)	20w 1d	22/02/2019	14/07/2019
112		Project Co. provide relevant As Built Specifications and Drawings 10 days post Actual Completion (Clause 17.18)	2w	22/02/2019 *	07/03/2019
113		Project Co. provide relevant Principle O and M Manual (Clause 18.5.3) 10 days after completion date (Clause 18.5.2)	2w	22/02/2019 *	07/03/2019
114		Project Co. rectify all snagging matters within 10 business days of receiving snagging notice (clause 17.15)	2w	08/03/2019 *	21/03/2019
115		Project Co. and The Board respectively complete Post Completion Commissioning in accordance with Final Commissioning Programme (Clause 18.1)	20w 3d	22/02/2019 *	14/07/2019
116		Post-Actual Completion (PART 5 - COMPLETION MILESTONES + PART 6 - OUTSTANDING WORKS)	4w	13/06/2019	10/07/2019
117		Project Co. prepare further As Built Specifications and Drawings 10 days post Milestone Completions (Clause 17.18)	1w 4d	13/06/2019 *	25/06/2019
118		Project Co. provide further As Built Specifications and Drawings 10 days post Milestone Completions (Clause 17.18)		26/06/2019 *	26/06/2019
119		Project Co. provide Principle O and M Manual (Clause 18.5.3) 10 days post Milestone Completions (Clause 18.5.2)	1w 4d	13/06/2019 *	25/06/2019
120		Project Co. provide Principle O and M Manual (Clause 18.5.3) 10 days post Milestone Completions (Clause 18.5.2)		26/06/2019 *	26/06/2019
121		Project Co. rectify all snagging matters within 10 business days of receiving snagging notice (clause 17.15)	2w	27/06/2019 *	10/07/2019
		BOUYGES (Facilities Management) DELIVERABLES	26w	04/02/2019	05/08/2019
123		BOUYGES (Facilities Management) Pre-Completion Activity	25w 4d	07/02/2019	05/08/2019
124		Bouygues - Service Commencement / Helpdesk Fully Operational		07/02/2019 *	07/02/2019
125		1 Year PPM Schedule Finalised (lifecycle maintainance plan)		06/06/2019 *	06/06/2019
126		5 Year PPM Schedule Finalised (lifecycle maintainance plan)		06/06/2019 *	06/06/2019
127		Bouygues commence Water Quality Management Regime		07/02/2019 *	07/02/2019
128		Bouygues commence Environmental Monitoring Regime		07/02/2019 *	07/02/2019
129		Document Management System + Record Management System		06/06/2019 *	06/06/2019
130		IT Install Complete & Tested with Board Access to Maximo		07/02/2019 *	07/02/2019
131		Joint Procedures (NHSL - BYES)		05/08/2019 *	05/08/2019
132		Handover Documentation (MPX / BYES Joint review)		07/02/2019 *	07/02/2019
133		Handover of Part 5 Post Completion Works (MPX - BYES)	19w 3d	04/02/2019	19/06/2019
134		On-Going Site Inspections of Part 5 Post Completion Works	16w 4d	04/02/2019 *	05/06/2019
135		Transfer of Final Handover Documentation (MPX / BYES)	2w	06/06/2019 *	19/06/2019
136		Critical System Pre-Handover Inspection (INTERNAL DRAINAGE SYSTEM)	2d	16/05/2019 *	17/05/2019
137		Critical System Pre-Handover Inspection (RADIANT PANELS IN ISOLATION ROOM LOBBIES)	2d	21/05/2019 *	22/05/2019
138		Critical System Pre-Handover Inspection (FIRE PROTECTION COMPLIANCE WITH SHTM82 (VOID DETECTION))	2d	12/06/2019 *	13/06/2019
		NHSL DELIVERABLES	26w 6.86d	07/01/2019	14/07/2019
140		Board to Instruct Works to Bouygues (Facilities Management)		22/02/2019	22/02/2019
141		Sky Ceilings in Basement		22/02/2019 *	22/02/2019
142		socket change for clocking in machine		22/02/2019 *	22/02/2019
143		Additional curtain track in 2 rooms in Neurophysiology		22/02/2019 *	22/02/2019
144		Installation of brackets in riser cupboards for massimo installation		22/02/2019 *	22/02/2019
145		Installation of Push Bars on doors		22/02/2019 *	22/02/2019
146		Installation of brackets for sleep lab cameras in rooms		22/02/2019 *	22/02/2019
147		Sockets in DCN outpatients for eye tests		22/02/2019 *	22/02/2019
148		NHSL Security		22/02/2019	22/02/2019
149		NHS take over security		22/02/2019 *	22/02/2019
150		NHS security fully operational		22/02/2019 *	22/02/2019
151		NHSL Fire fighting equipment	1w 1d	14/02/2019	21/02/2019
152		Final Installation of NHS Fire fighting equipment	1w 1d	14/02/2019 *	21/02/2019
153		NHSL QC Pharmacist checks IMAGING	1w	21/01/2019	26/01/2019
154		NHS QC Pharmacist checks IMAGING	1w	21/01/2019 *	26/01/2019
155		Helipad Operations	14w	22/02/2019	06/06/2019
156		Test Flights x 15	14w	22/02/2019 *	05/06/2019
157		Helipad Certification		06/06/2019 *	06/06/2019
158		NHSL Domestic and Porters services	4w	22/02/2019	21/03/2019
159		FM fill dispensers, DSR's etc	4w	22/02/2019 *	21/03/2019
160		Clinical Clean of Level 4	2d	22/02/2019 *	25/02/2019
161		Clinical clean of Level 3	2d	25/02/2019 *	27/02/2019
162		Clinical clean of Level 2	1d 4h	27/02/2019 *	28/02/2019
163		Clinical clean of Level 1	1d	01/03/2019 *	01/03/2019
164		Clinical clean of Basement Level	2d	02/03/2019 *	05/03/2019
165		Clinical clean of Ground Level	2d	05/03/2019 *	07/03/2019
166		Clinical clean complete		08/03/2019 *	08/03/2019



Date of Issue: 20/02/2019

Purpose of Issue:
Revised Actual Completion to 22/02/2019

Comments: Revised Actual Completion to 22/02/2019

Programme No.: MPX-RHSCDCN-SA1-002

Revision: F

Revision Date: 20/02/2019

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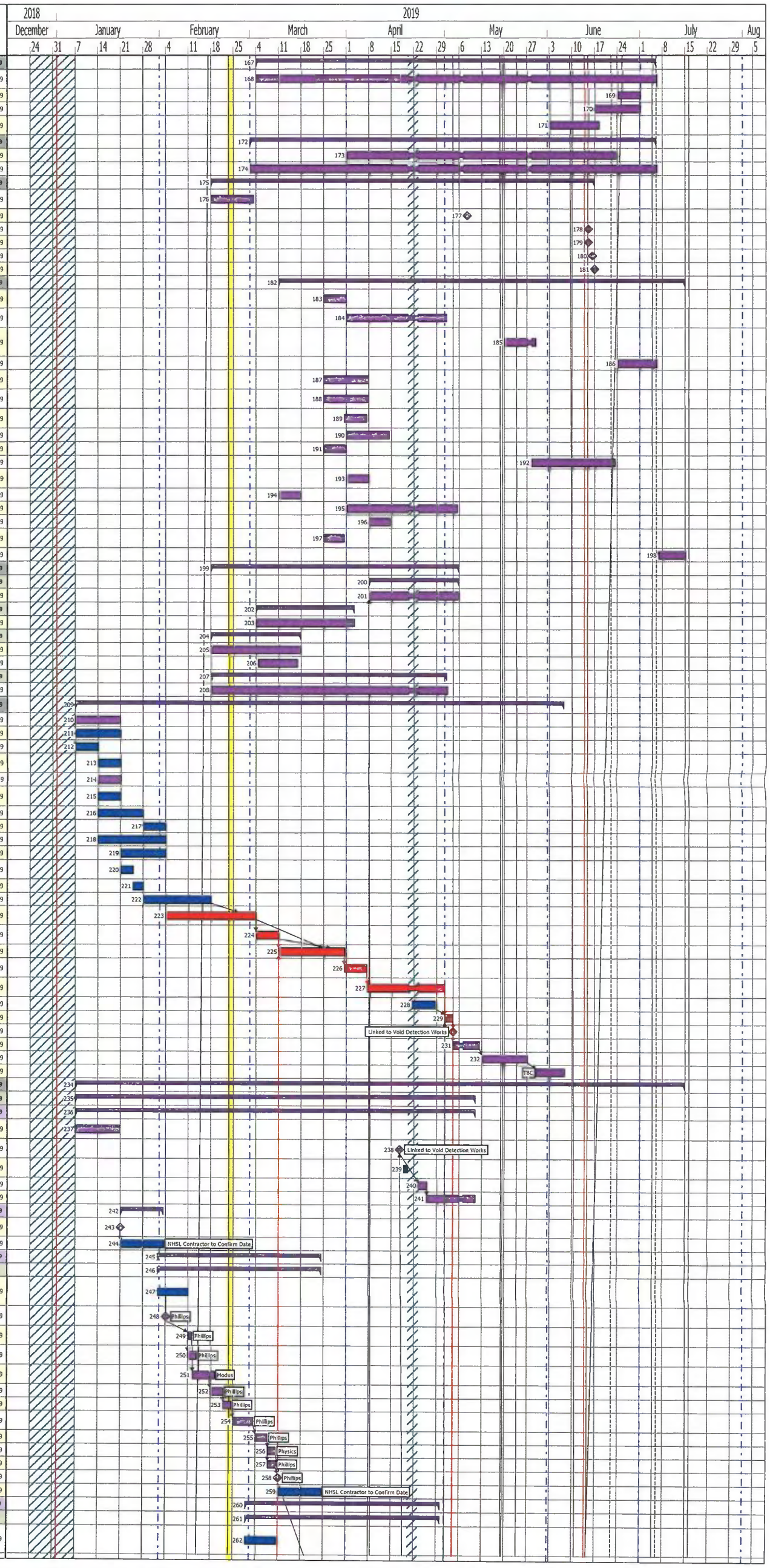
Royal Hospital for Sick Children & DCN

JOINT COMPLETION / JOINT COMMISSIONING PROGRAMME

MULTIPLEX

Line	User_Text_1	Name	Duration	Start	Finish
167		NHSL Equipment Delivery	17w 4d	04/03/2019	04/07/2019
168		NHSL Equipment delivery and distribution	16w 5d	04/03/2019 *	04/07/2019
169		DCN Theatre microscopes	1w	24/06/2019 *	29/06/2019
170		RHSC Theatre microscopes	2w	17/06/2019 *	29/06/2019
171		transfer Optima neurology equipment installation and calibration	2w 1d	03/06/2019 *	17/06/2019
172		NHSL Famililiarisation Programme	17w 1d	01/03/2019	04/07/2019
173		NHS Familliarisation Programme	11w 4h	01/04/2019 *	21/06/2019
174		NHS Remote Inductions	17w 1d	01/03/2019 *	04/07/2019
175		NHSL Communications	17w	18/02/2019	17/06/2019
176		Formal communication to all staff re moves	1w 5d	18/02/2019 *	01/03/2019
177		Leaflet Drop		08/05/2019 *	08/05/2019
178		Gift for Patient and Staff		14/06/2019 *	14/06/2019
179		Maps for all Staff		14/06/2019 *	14/06/2019
180		Formal Open Day		15/06/2019 *	15/06/2019
181		Visit for Taxis Drivers		17/06/2019 *	17/06/2019
182		NHSL E Health	17w 5.5d	11/03/2019	13/07/2019
183		External WiFi Access points for Installation	1w	25/03/2019 *	30/03/2019
184		Telephone engineer & deployment of numbers and phones	4w	01/04/2019 *	01/05/2019
185		Massimo - Server and SaO2 deployment and pager transmitter. Required for Innfrastructure Works	1w 1d	20/05/2019 *	28/05/2019
186		RICOH New Printer installs	1w 4d	24/06/2019 *	04/07/2019
187		Brunsdon Radio infrastructure installation for HAN	2w	25/03/2019 *	06/04/2019
188		Digital Angels - Radio Infrastructure for FM	2w	25/03/2019 *	06/04/2019
189		3rd Party Meeting / Teaching Rm AV suites installation (new)	1w	30/03/2019 *	05/04/2019
190		Info Points telephone installation	1w 5d	01/04/2019 *	12/04/2019
191		Public telephone installation	1w	25/03/2019 *	30/03/2019
192		Health Records Library Move	3w 4d	28/05/2019 *	21/06/2019
193		Bleep replacement system installation & deployment (ASCOM)	1w	01/04/2019 *	06/04/2019
194		ED SAS system Installation	1w	11/03/2019 *	16/03/2019
195		NHS deployment of desk top PC's	4w 2.5d	01/04/2019 *	03/05/2019
196		Metavision software Install & Test	5d	08/04/2019 *	12/04/2019
197		Installation of MONIKA catering monitoring system	5d	25/03/2019 *	29/03/2019
198		RICOH printer moves and Installation	1w 1d	05/07/2019 *	13/07/2019
199		NHSL 3rd Party Fit-Out	10w 5.5d	18/02/2019	04/05/2019
200		TCT Fit Out	3w 3d	08/04/2019	04/05/2019
201		TCT Fit Out	3w 3d	08/04/2019 *	04/05/2019
202		ECHC Fit Out	4w 2d	04/03/2019	02/04/2019
203		Scotmid Fit-out of the ECHC Shop	4w 2d	04/03/2019 *	02/04/2019
204		R McDonald hotel	4w	18/02/2019	16/03/2019
205		R McD Internet provision/installation	4w	18/02/2019 *	16/03/2019
206		R McD Commissioning	1w 4d	04/03/2019 *	15/03/2019
207		University Commissioning	10w	18/02/2019	01/05/2019
208		University Commissioning	10w	18/02/2019 *	01/05/2019
209		NHSL THEATRE TURNKEY (incl. MRI Inter-Opp Room 1-P1-064)	20w 4.5d	07/01/2019	06/06/2019
210		Theatre Storts AV System Installation	2w	07/01/2019 *	19/01/2019
211		Brackets for monitors	2w	07/01/2019 *	19/01/2019
212		Fridge door Alteration Anaesthetic room	1w	07/01/2019 *	12/01/2019
213		Theatre/ED and Radiology grilles changed	1w	14/01/2019 *	19/01/2019
214		*Theatre Jones System Installation*	1w	14/01/2019 *	19/01/2019
215		Video Outlets - Cut Holes - 2 theatres require blanks	1w	14/01/2019 *	19/01/2019
216		Speed Cables Critical Care	2w	14/01/2019 *	26/01/2019
217		Clog Washer	1w	28/01/2019 *	02/02/2019
218		Change to Theatre sink Heights	3w	14/01/2019 *	02/02/2019
219		Manifestations - Privicy	2w	21/01/2019 *	02/02/2019
220		Protection to Ventilation Grilles before Ceiling Remove	3d	21/01/2019 *	23/01/2019
221		Remove Ceiling	2d 4h	24/01/2019 *	26/01/2019
222		Drager to correct Pendant Movements	3w	28/01/2019 *	16/02/2019
223		White Rock Wall Protection + Pat Slide Hooks	4w	04/02/2019 *	02/03/2019
224		Protection to Ventilation before Void Works	1w	04/03/2019 *	09/03/2019
225		Void Detection - Installation Works	2w 5d	11/03/2019 *	29/03/2019
226		Void Detection - Continuity and Device Test & Loop Commission	1w	30/03/2019 *	05/04/2019
227		Void Detection - Fire stopping, Reinstatement, Making Good + Mastic	3w	06/04/2019 *	30/04/2019
228		Reset all doors for theatre suites	1w	20/04/2019 *	26/04/2019
229		Void Detection - Builders Clean	2d	01/05/2019 *	02/05/2019
230		Final Inspection to Validate Completion		03/05/2019 *	03/05/2019
231		Deep Clean by NHS Domestics	1w	03/05/2019 *	10/05/2019
232		Biological Theatre Plate Testing	2w	13/05/2019 *	25/05/2019
233		NHS to install non-ATD TV's	1w 1.5d	29/05/2019 *	06/06/2019
234		NHSL IMAGING TURNKEY Installations	26w 6d	07/01/2019	14/07/2019
235		MRI Scanner Fit-Out Works	17w 4d	07/01/2019	09/05/2019
236		MRI (Room 1-P1-064)	17w 4d	07/01/2019	09/05/2019
237		NHSL Turnkey Contractor Works Complete	2w	07/01/2019 *	19/01/2019
238		NHSL Turnkey Contractor Pressure Cascade SetUp		17/04/2019 *	17/04/2019
239		NHSL Turnkey Contractor /MPX Joint Pressure Review / Check	1d	18/04/2019 *	18/04/2019
240		Deep Clean by NHS Domestics	2d	23/04/2019 *	24/04/2019
241		Biological Theatre Plate Testing	2w	25/04/2019 *	09/05/2019
242		MRI (Room G-Q1-134)	1w 5d	21/01/2019	01/02/2019
243		Modus Turnkey Contractor Fit-Out Complete		21/01/2019 *	21/01/2019
244		Controls Interface (MPX / NHSL)	2w	21/01/2019 *	01/02/2019
245		MRI (Room G-Q1-123)	7w 1.5d	31/01/2019	22/03/2019
246		Phillips Fit-Out	7w 1.5d	31/01/2019	22/03/2019
247		Removal and reinstatement of pop out panels and main corridor doors to allow MRI delivery	1w 2d	31/01/2019 *	09/02/2019
248		Magnet Delivery - MRI (Room G-Q1-123)		04/02/2019 *	04/02/2019
249		Back End Delivery (cabinets, coils, etc.)	1d	11/02/2019 *	11/02/2019
250		Magnet Mechanically Installed / connected to life support)	2d	11/02/2019 *	12/02/2019
251		Cage Closure room completion works	1w	12/02/2019 *	18/02/2019
252		Cabling	3d	18/02/2019 *	20/02/2019
253		Ramp & Shim IATD1	2d	21/02/2019 *	22/02/2019
254		IATD2 SNAPSHOT (including Coil Checks)	1w	25/02/2019 *	01/03/2019
255		Ambient Final Commissioning	3d	04/03/2019 *	06/03/2019
256		Physics Checks	2d	07/03/2019 *	08/03/2019
257		Engineering Support	2d	07/03/2019 *	08/03/2019
258		System Acceptance		11/03/2019 *	11/03/2019
259		Controls Interface (MPX / NHSL)	2w	11/03/2019 *	22/03/2019
260		MRI (Room G-Q1-110)	8w 5d	28/02/2019	29/04/2019
261		Phillips Fit-Out	8w 4.5d	28/02/2019	29/04/2019
262		Removal and reinstatement of pop out panels and main corridor doors to allow MRI delivery	1w 2d	28/02/2019 *	08/03/2019



Date of Issue: 20/02/2019

Purpose of Issue:
Revised Actual Completion to 22/02/2019

Comments: Revised Actual Completion to 22/02/2019

Programme No.: MPX-RHSCDCN-SA1-002

Revision: F

Revision Date: 20/02/2019

File Path: C:\Users\Eddie\Documents\03 eddie mcgibbon ltd\Multiplex\1. EMcG Programme to Completion\Overall Master Programme\Settlement Agreement Jan 2019\20_02_2019 Joint Commissioning Programme Rev 2F.pp 20/02/2019 14:56:56 V Bar Chart View F None S None

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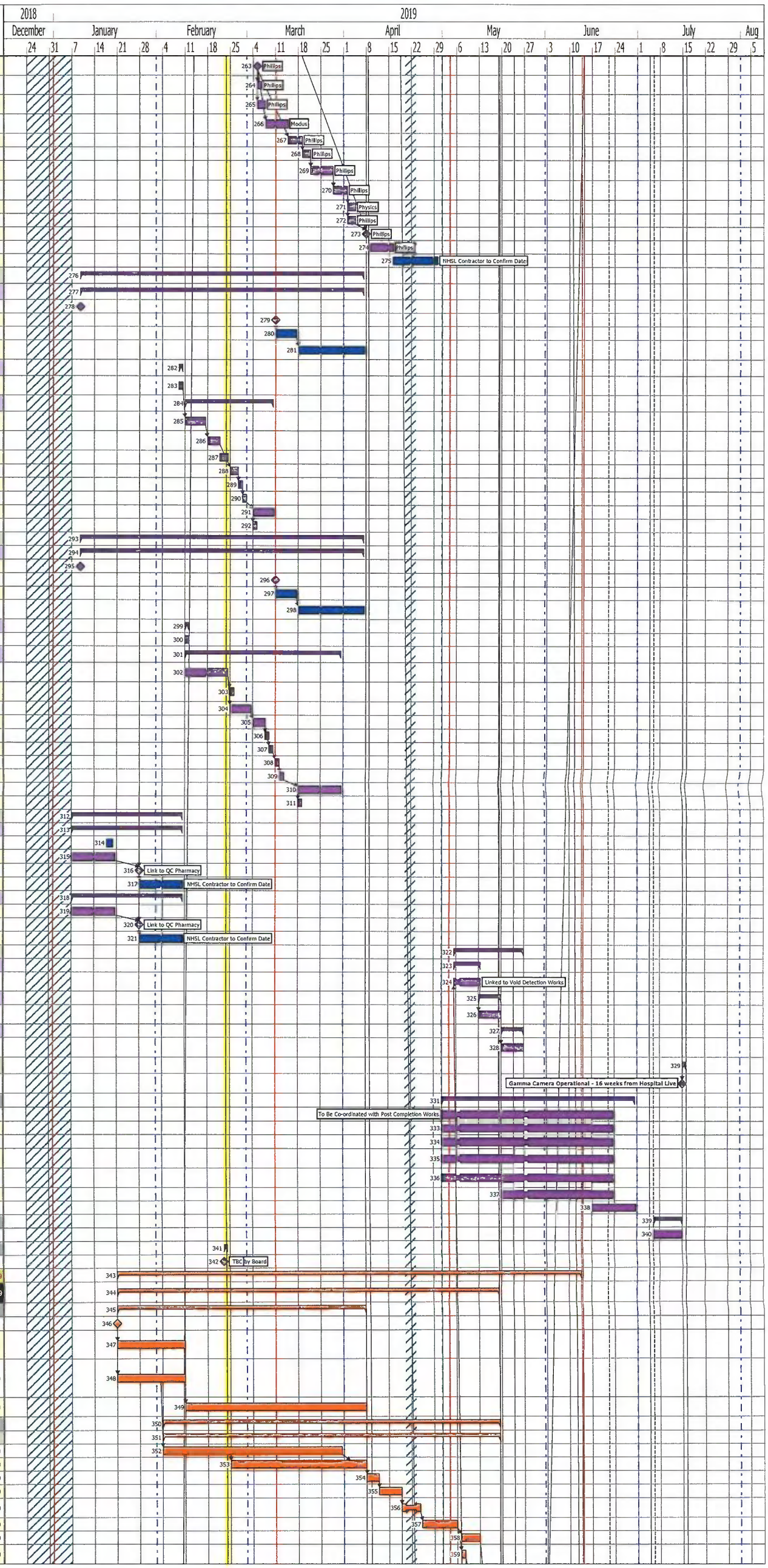
Royal Hospital for Sick Children & DCN

JOINT COMPLETION / JOINT COMMISSIONING PROGRAMME

MULTIPLEX

Line	User_Text_1	Name	Duration	Start	Finish
263		Magnet Delivery - MRI (Room G-Q1-110)		05/03/2019 *	05/03/2019
264		Back End Delivery (cabinets, coils, etc.)	1d	05/03/2019 *	05/03/2019
265		Magnet Mechanically Installed / connected to life support)	2d	05/03/2019 *	06/03/2019
266		Cage Closure room completion works	1w	07/03/2019 *	13/03/2019
267		Cabling	3d	14/03/2019 *	18/03/2019
268		Ramp & Shim IATD1	2d	19/03/2019 *	20/03/2019
269		IATD2 SNAPSHOT (including Coil Checks)	1w	21/03/2019 *	27/03/2019
270		Amibient and MRI Final Commissioning	3d	28/03/2019 *	01/04/2019
271		Physics Checks	2d	02/04/2019 *	03/04/2019
272		Engineering Support	2d	02/04/2019 *	03/04/2019
273		System Acceptance		08/04/2019 *	08/04/2019
274		Applications - All Rooms	1w	09/04/2019 *	15/04/2019
275		Controls Interface (MPX / NHSL)	2w	16/04/2019 *	29/04/2019
276		Fluro (Siemens Prog ref:rev 8_05122018_Go Live 2019)	12w 3d	09/01/2019	05/04/2019
277		Enabling Works	12w 2.86d	09/01/2019	05/04/2019
278		Delivery of Airdale Cooling Unit		09/01/2019	09/01/2019
279		Board Instruction 177 to Proceed		11/03/2019	11/03/2019
280		MPX Procurement	1w	11/03/2019	15/03/2019
281		MPX Installation, testing & Commissioning of Airdale Unit	3w	18/03/2019	05/04/2019
282		PCL & Tclarke UPS Delivery, Installatio & Commissioning	1d	08/02/2019 *	08/02/2019
283		Tclarke & PCL UPS System Commissioning	1d	08/02/2019 *	08/02/2019
284		Delivery, Installation and Commissioning Phase	3w 4.86d	11/02/2019 *	08/03/2019
285		Commissioning by Siemens Factory Engineer	1w	11/02/2019 *	15/02/2019
286		Final Commissioning by Siemens UK Engineer	3d	18/02/2019 *	20/02/2019
287		Make Good Floors etc	2d	21/02/2019 *	22/02/2019
288		Medical Physics (2days)	2d	25/02/2019 *	26/02/2019
289		RPA Room Check	1d	27/02/2019 *	27/02/2019
290		Clinical Clean	1d	28/02/2019 *	28/02/2019
291		Full Applications Training - TBC	1w	04/03/2019 *	08/03/2019
292		Equipment Handover	1d	04/03/2019 *	04/03/2019
293		BI Plane / Angiography	12w 3d	09/01/2019	05/04/2019
294		Enabling Works	12w 3d	09/01/2019	05/04/2019
295		Delivery of Airdale Cooling Unit		09/01/2019 *	09/01/2019
296		Board Instruction 176 to Proceed		11/03/2019 *	11/03/2019
297		MPX Procurement	1w	11/03/2019 *	15/03/2019
298		MPX Installation, testing & Commissioning of Airdale Unit	3w	18/03/2019 *	05/04/2019
299		Borri UPS & Tclarke Equipment Removal	1d	11/02/2019 *	11/02/2019
300		Commissioning of Tclarke & PCL UPS	1d	11/02/2019 *	11/02/2019
301		Equipment Mechanical Installation and Commissioning Phase	6w 5d	11/02/2019 *	29/03/2019
302		Commissioning by Siemens Factory Engineer	2w	11/02/2019 *	22/02/2019
303		Siemens Product Specialist Systems Config Check	1d	25/02/2019 *	25/02/2019
304		Siemens UK Final Config	1w	25/02/2019 *	01/03/2019
305		Medical Physics (3days)	3d	04/03/2019 *	06/03/2019
306		RPA Room Check	1d	07/03/2019 *	07/03/2019
307		Snagging / Floor Coverings etc	1d	08/03/2019 *	08/03/2019
308		Injector Installation	1d	11/03/2019 *	11/03/2019
309		Clinical Clean & Plate Test PM	1d	12/03/2019 *	12/03/2019
310		Applications Training - TBC	2w	18/03/2019 *	29/03/2019
311		Equipment Handover	1d	18/03/2019 *	18/03/2019
312		CT 1 + 2	4w 5d	07/01/2019	08/02/2019
313		CT 1 - RHSC - G-Q1-136 (Children)	4w 5d	07/01/2019	08/02/2019
314		Lead shielding remedial in imaging	1d 4h	17/01/2019 *	18/01/2019
315		NHS Works	2w	07/01/2019 *	18/01/2019
316		NHS Works Complete		28/01/2019 *	28/01/2019
317		Controls Interface (MPX / NHSL)	2w	28/01/2019 *	08/02/2019
318		CT 2 - DCN - G-Q1-059 (Adult)	4w 5d	07/01/2019 *	08/02/2019
319		NHS Works	2w	07/01/2019 *	18/01/2019
320		NHS Works Complete		28/01/2019 *	28/01/2019
321		Controls Interface (MPX / NHSL)	2w	28/01/2019 *	08/02/2019
322		Dental Rooms 1,2+3	2w 5d	04/05/2019	25/05/2019
323		Room 1 (Samsung GC85)	1w	04/05/2019	13/05/2019
324		Turnkey Final Testing + Commissioning	1w	04/05/2019 *	13/05/2019
325		Room 2 (Samsung GC85)	1w	13/05/2019	18/05/2019
326		Turnkey Final Testing + Commissioning	1w	13/05/2019 *	18/05/2019
327		Room 3 (Relocated Samsung GC80)	1w	20/05/2019	25/05/2019
328		Turnkey Final Testing + Commissioning	1w	20/05/2019 *	25/05/2019
329		Gamma Camera - Commence Transfer Plan - (16 Week Duration after Hospital Operational)		14/07/2019	14/07/2019
330		Commence Gamma Turnkey Relocation and Installation		14/07/2019	14/07/2019
331		NHSL Migration	8w 1d	01/05/2019	28/06/2019
332		RHSC C/N setting up wards	7w 1d	01/05/2019 *	21/06/2019
333		CAMHS C/N setting up wards	7w 1d	01/05/2019 *	21/06/2019
334		DCN C/N setting up wards	7w 1d	01/05/2019 *	21/06/2019
335		Fire evacuation training for super users and HODs	7w 1d	01/05/2019 *	21/06/2019
336		ward/dept. Fire risk assessments to be completed	7w 1d	01/05/2019 *	21/06/2019
337		Transfer equipment commences	4w 4d	20/05/2019 *	21/06/2019
338		Project Team move out of 4th floor base	1w 5d	17/06/2019 *	28/06/2019
339		NHSL Clinical Migration	1w 1.5d	05/07/2019	14/07/2019
340		Clinical Migration	1w 3d	05/07/2019 *	14/07/2019
341		NHSL Green Travel Plan		22/02/2019	22/02/2019
342		Board to Complete Green Travel Plan		22/02/2019 *	22/02/2019
343		PART 5 - POST COMPLETION WORKS	19w 4d	21/01/2019	13/06/2019
		MILESTONE 2- INTERNAL DRAINAGE SYSTEM	16w 1.5d	21/01/2019	17/05/2019
345		Engineering + Procurement	11w	21/01/2019	06/04/2019
346		Agreement to Proceed		21/01/2019 *	21/01/2019
347		Place orders and write instructions, including time for Others to instruct their supply chain	3w	21/01/2019 *	09/02/2019
348		Place orders and instruct, including time for Others to instruct their supply chain (mercury, ID verde, Linear, CVD, Astins, Henshaw)	3w	21/01/2019 *	09/02/2019
349		Pump and panel delivery 8 weeks once order placed with Manufacturer	8w	11/02/2019 *	06/04/2019
350		Construction Activity	14w 1.5d	04/02/2019	17/05/2019
351		BASEMENT SUMP PUMP	14w 1.5d	04/02/2019	17/05/2019
352		Civils Works	7w 5d	04/02/2019 *	29/03/2019
353		1st & 2nd Fix M+E	6w	25/02/2019 *	06/04/2019
354		Pump & Panel Installations	3d	08/04/2019 *	10/04/2019
355		M+E Connections / Terminations	1w	11/04/2019 *	17/04/2019
356		Testing /Commissioning of pumps, panels, controls and I-Host	2d	18/04/2019 *	23/04/2019
357		Re-instatement / Make Good	1w 3d	24/04/2019 *	04/05/2019
358		Basement - Witness / Cause and Effect	4d 4h	07/05/2019 *	11/05/2019
359		Re-instate cladding after pipework install	1d	07/05/2019 *	07/05/2019



Date of Issue: 20/02/2019 Purpose of Issue: Revised Actual Completion to 22/02/2019	Comments: Revised Actual Completion to 22/02/2019	Programme No.: MPX-RHSCDCN-SA1-002 Revision: F Revision Date: 20/02/2019

File Path: C:\Users\Eddie\Documents\03 eddie mcgibbon ltd\Multiplex\1. EMcG Programme to Completion\Overall Master Programme\Settlement Agreement Jan 2019\20_02_2019 Joint Commissioning Programme Rev 2F.pp 20/02/2019 14:56:57 V Bar Chart View F None S None

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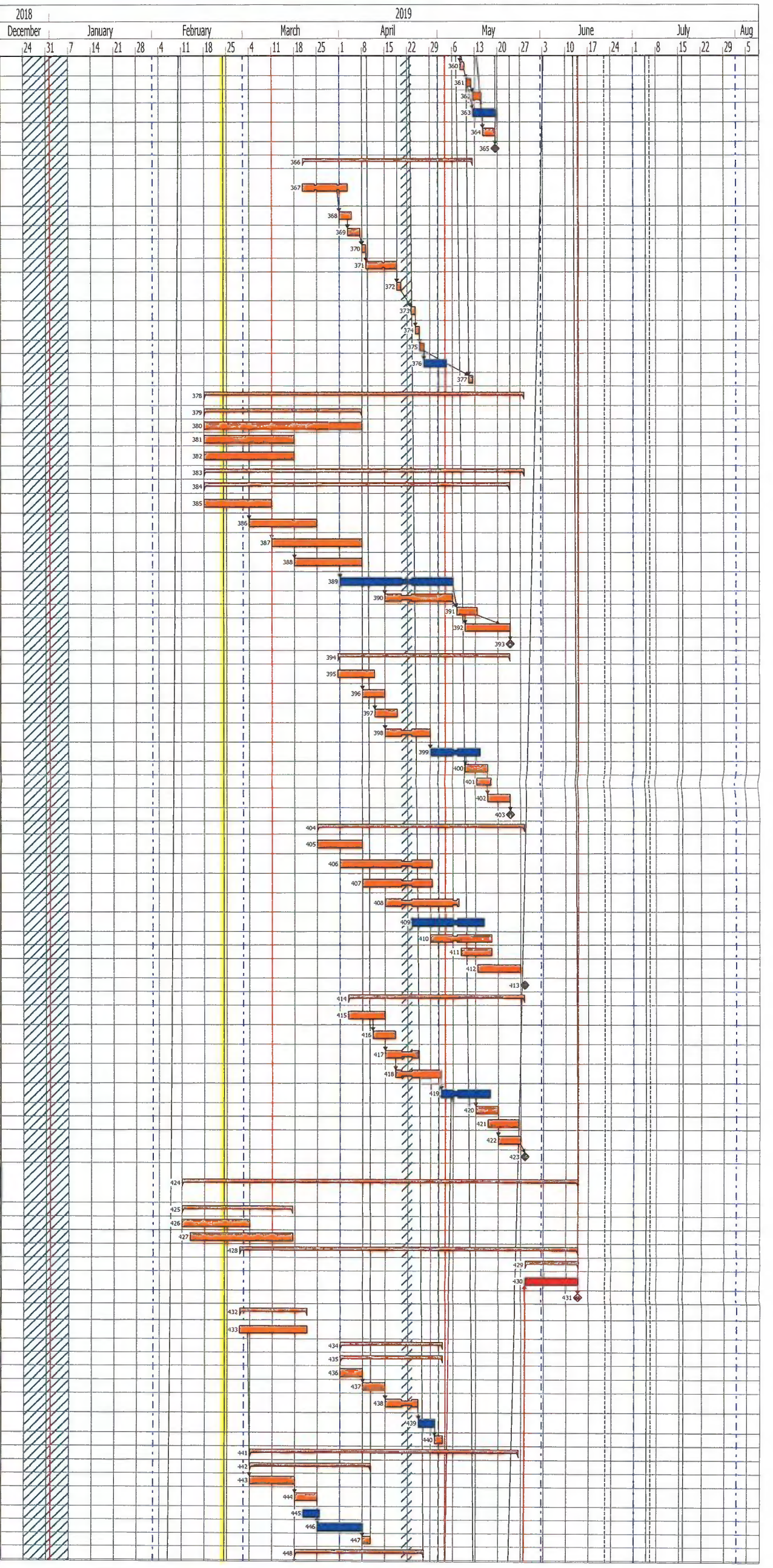
Page 5 of 7	"This programme is copyright and the property of Multiplex Construction (UK) Ltd and must not be used with out written approval".	Royal Hospital for Sick Children & DCN JOINT COMPLETION / JOINT COMMISSIONING PROGRAMME		MULTIPLEX

Line	User_Text_1	Name	Duration	Start	Finish
360		Install of new cladding around external pipework on wall	1d	08/05/2019 *	08/05/2019
361		Training on new installed pumps	1d	09/05/2019 *	10/05/2019
362		Install Double seals to Manhole covers	2d	11/05/2019 *	14/05/2019
363		Basement - Reinstatement and Making Good	1w	11/05/2019 *	17/05/2019
364		Full Demonstration of New Installation and Pump Replacement	3d	15/05/2019 *	17/05/2019
365		Independent Tester Certify		17/05/2019 *	17/05/2019
366		EXTERNAL SUMP PUMP	7w 2.86d	20/03/2019	10/05/2019
367		Excavate externally, core hole into chamber, Install cable ducting from chamber to External electrical junction box, leave in draw cords and Re-instate ground works.	2w	20/03/2019 *	02/04/2019
368		Increase height of external vent pipe to above roof level 3mtr from any opening	3d	01/04/2019 *	03/04/2019
369		Concrete around pump chamber lids	3d	03/04/2019 *	05/04/2019
370		Delivery of pumps, panels, Isolation box	1d	08/04/2019 *	08/04/2019
371		M+E Connections / Terminations	1w 2d	09/04/2019 *	17/04/2019
372		Isolations to Electrical supply for changeover and any connections testing required. Man in attendance from Mercury.	1d	18/04/2019 *	18/04/2019
373		Switchover from old system to new system	1d	23/04/2019 *	23/04/2019
374		Testing / Commision 2 x pumps, panels, controls, I-host	1d	24/04/2019 *	24/04/2019
375		Seal up ducts after cable install	1d	25/04/2019 *	25/04/2019
376		External Works - Reinstatement and Making Good	1w	26/04/2019 *	02/05/2019
377		Training on new installed pumps	1d	10/05/2019 *	10/05/2019
		MILESTONE 4 - RADIANT PANELS IN ISOLATION ROOM LOBBIES	13w 2d	18/02/2019	28/05/2019
379		Engineering + Procurement	7w	18/02/2019	06/04/2019
380		Order Radiant Panels - Material Lead In	7w	18/02/2019 *	06/04/2019
381		Order - Material Lead In	4w	18/02/2019 *	16/03/2019
382		Order New HEPA Filters - Material Lead In	4w	18/02/2019 *	16/03/2019
383		Construction Activity	13w 2d	18/02/2019	28/05/2019
384		Level 3 - 9 No. Locations	13w 3d	18/02/2019	23/05/2019
385		Builderswork /Stripping Fabric / Protection	3w	18/02/2019 *	09/03/2019
386		Lobby - Alter LTHW incl. Draining and Cappig Heater Battery	3w	04/03/2019 *	23/03/2019
387		Corridor - Cut In New LTHW Valves (incl Service Route Alterations)	4w	11/03/2019 *	06/04/2019
388		Isolation Rooms - Install New Radiant Panel	3w	18/03/2019 *	06/04/2019
389		Reinstatement and Making Good (incl Taping + Decoration)	4w 3d	01/04/2019 *	04/05/2019
390		Test & Commission	2w 3d	15/04/2019 *	04/05/2019
391		Builders Clean	5d	07/05/2019 *	13/05/2019
392		Isolation Room Pressure Tests / Validations	2w	09/05/2019 *	22/05/2019
393		Independant Tester Certify		23/05/2019 *	23/05/2019
394		Level 2 - 2 No. Locations	7w 5d	30/03/2019	23/05/2019
395		Builderswork /Stripping Fabric / Protection	1w 3.5d	30/03/2019 *	10/04/2019
396		Lobby - Alter LTHW incl. Draining and Cappig Heater Battery	1w	08/04/2019 *	13/04/2019
397		Corridor - Cut In New LTHW Valves (incl Service Route Alterations)	1w	11/04/2019 *	17/04/2019
398		Isolation Rooms - Install New Radiant Panel	1w 3d	15/04/2019 *	27/04/2019
399		Reinstatement and Making Good (incl Taping + Decoration)	2w	29/04/2019 *	13/05/2019
400		Test & Commission	1w	09/05/2019 *	15/05/2019
401		Builders Clean	3d 4h	13/05/2019 *	16/05/2019
402		2nd Level Isolation Room Pressure Tests / Validations	1w	16/05/2019 *	22/05/2019
403		Independant Tester Certify		23/05/2019 *	23/05/2019
404		Level 1 - 6 No. Locations	9w 1d	25/03/2019	28/05/2019
405		Builderswork /Stripping Fabric / Protection	2w	25/03/2019 *	06/04/2019
406		Lobby - Alter LTHW incl. Draining and Cappig Heater Battery	3w 3.5d	01/04/2019 *	29/04/2019
407		Corridor - Cut In New LTHW Valves (incl Service Route Alterations)	2w 3.5d	08/04/2019 *	29/04/2019
408		Isolation Rooms - Install New Radiant Panel	2w 3.5d	15/04/2019 *	07/05/2019
409		Reinstatement and Making Good (incl Taping + Decoration)	3w	23/04/2019 *	14/05/2019
410		Test & Commission	2w 3d	29/04/2019 *	16/05/2019
411		Builders Clean	1w 2d	08/05/2019 *	16/05/2019
412		Level 1 - Isolation Room Pressure Tests / Validations	1w 5d	13/05/2019 *	25/05/2019
413		Independant Tester Certify		28/05/2019 *	28/05/2019
414		Ground Level - 1 No. Locations	7w 6d	03/04/2019	28/05/2019
415		Builderswork /Stripping Fabric / Protection	1w 3.5d	03/04/2019 *	13/04/2019
416		Lobby - Alter LTHW incl. Draining and Cappig Heater Battery	1w	10/04/2019 *	17/04/2019
417		Corridor - Cut In New LTHW Valves (incl Service Route Alterations)	1w	15/04/2019 *	24/04/2019
418		Isolation Rooms - Install New Radiant Panel	1w 3d	17/04/2019 *	01/05/2019
419		Reinstatement and Making Good (incl Taping + Decoration)	2w	01/05/2019 *	16/05/2019
420		Test & Commission	1w	13/05/2019 *	18/05/2019
421		Builders Clean	1w 2d	16/05/2019 *	24/05/2019
422		2nd Level Isolation Room Pressure Tests / Validations	1w	20/05/2019 *	25/05/2019
423		Independant Tester Certify		28/05/2019 *	28/05/2019
		MILESTONE 3 - FIRE PROTECTION COMPLIANCE WITH SHTM82 (incl GCN Grilles to Doors, Installation of manual call points)	16w 4d	11/02/2019	13/06/2019
425		Engineering + Procurement	4w 5d	11/02/2019	15/03/2019
426		DCN Grille Material Lead In	3w	11/02/2019 *	02/03/2019
427		Void Detection Material Lead In	4w 3d	13/02/2019 *	15/03/2019
428		Construction Activity	14w 1d	28/02/2019	13/06/2019
429		Witness & Certify	2w 2d	28/05/2019	13/06/2019
430		System Test / Cause and Effect Sample Check + Audibility Checks	2w 2d	28/05/2019 *	12/06/2019
431		Independant Tester Certify		13/06/2019 *	13/06/2019
432		All Levels - Stripping Fabric & Surveys during Procurement of Void Detection	3w	28/02/2019	20/03/2019
433		All Levels - Stripping Fabric, Marking Out	3w	28/02/2019	20/03/2019
434		4th Level - 5 Locations	4w 3d	01/04/2019	01/05/2019
435		Area 1 - 5 No.	4w 3d	01/04/2019	01/05/2019
436		Builderswork and Stripping Fabric	1w	01/04/2019 *	06/04/2019
437		Void Detection Installation Works	1w	08/04/2019 *	13/04/2019
438		Continuity and Device Test & Loop Commission	1w	15/04/2019 *	24/04/2019
439		Basement - Reinstatement and Making Good	4d	24/04/2019 *	29/04/2019
440		Builders Clean	2d	30/04/2019 *	01/05/2019
441		Level 3 - 84 Locations	11w 5d	04/03/2019	24/05/2019
442		Area 1 - 23 No.	5w 2d	04/03/2019	09/04/2019
443		Void Detection Installation Works	2w	04/03/2019 *	16/03/2019
444		Continuity and Device Test & Loop Commission	1w	18/03/2019 *	23/03/2019
445		Fire stopping	4d	20/03/2019 *	25/03/2019
446		reinstatement and Making Good	2w	25/03/2019 *	06/04/2019
447		Builders Clean	2d	08/04/2019 *	09/04/2019
448		Area 2 - 11 No.	5w 4d	18/03/2019	25/04/2019



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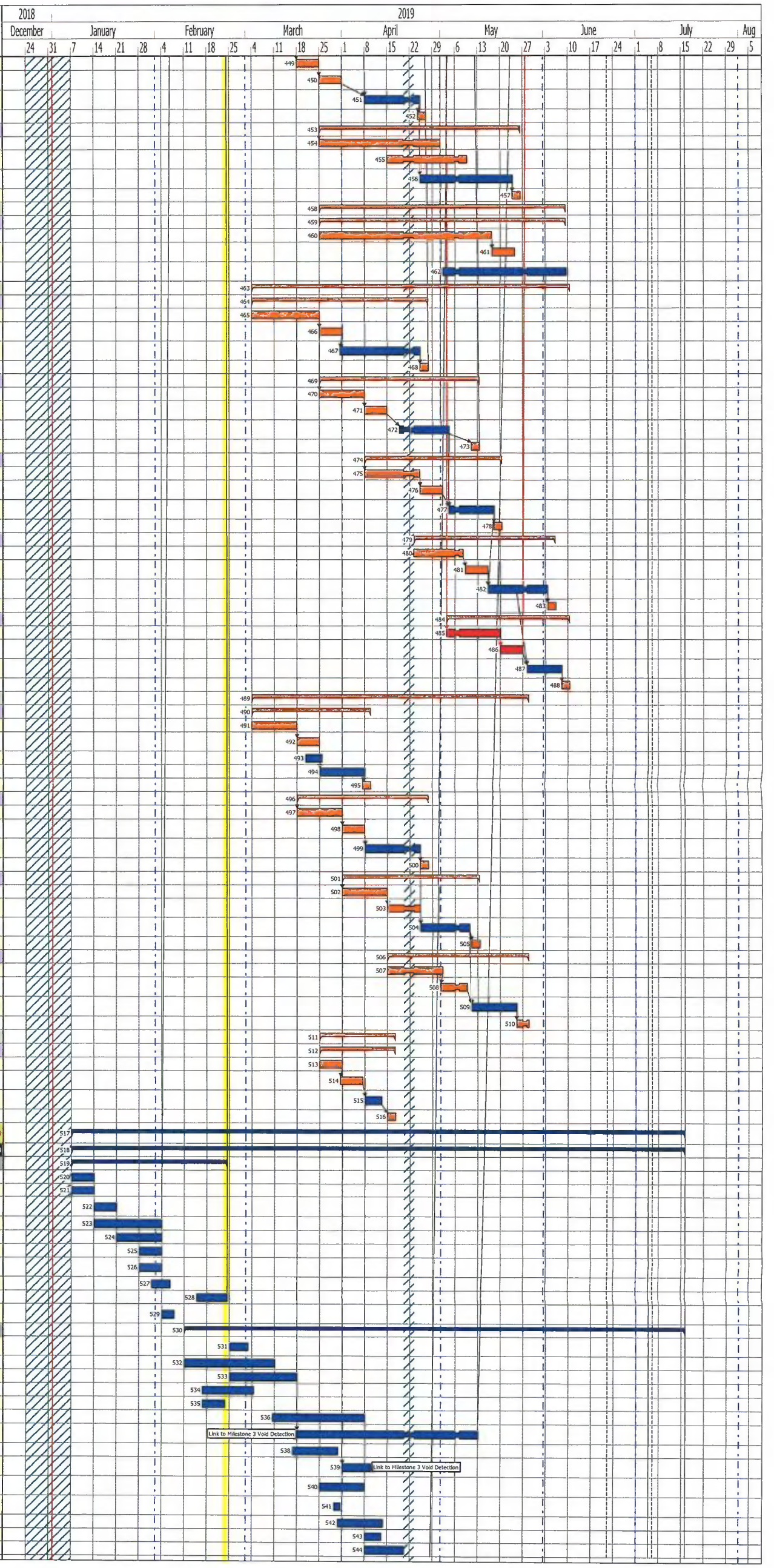
Royal Hospital for Sick Children & DCN

JOINT COMPLETION / JOINT COMMISSIONING PROGRAMME

MULTIPLEX

Line	User_Text_1	Name	Duration	Start	Finish
449		Void Detection Installation Works	1w	18/03/2019 *	23/03/2019
450		Continuity and Device Test & Loop Commission	1w	25/03/2019 *	30/03/2019
451		Fire stopping, reinstatement and Making Good	2w	08/04/2019 *	24/04/2019
452		Builders Clean	2d	24/04/2019 *	25/04/2019
453		Area 3 - 47 No.	8w 5d	25/03/2019	24/05/2019
454		Void Detection Installation Works	4w 5d	25/03/2019 *	30/04/2019
455		Continuity and Device Test & Loop Commission	2w 5d	15/04/2019 *	08/05/2019
456		Fire stopping, reinstatement and Making Good	3w 5d	24/04/2019 *	22/05/2019
457		Builders Clean	2d	23/05/2019 *	24/05/2019
458		Level 2 - 54 Locations	10w 5d	25/03/2019	07/06/2019
459		Area 1 - 35 No.	10w 5d	25/03/2019	07/06/2019
460		Void Detection Installation Works	7w	25/03/2019 *	16/05/2019
461		Continuity and Device Test & Loop Commission	1w	16/05/2019 *	23/05/2019
462		Fire stopping, reinstatement and Making Good	5w 4h	01/05/2019 *	07/06/2019
463		Level 1 - 119 Locations	14w 4h	04/03/2019	10/06/2019
464		Area 1 - 35 No.	7w 4.5d	04/03/2019	26/04/2019
465		Void Detection Installation Works	3w	04/03/2019 *	23/03/2019
466		Continuity and Device Test & Loop Commission	1w	25/03/2019 *	30/03/2019
467		Fire stopping, reinstatement and Making Good	3w 4h	30/03/2019 *	24/04/2019
468		Builders Clean	2d	24/04/2019 *	26/04/2019
469		Area 2 - 19 No.	7w 4h	25/03/2019	13/05/2019
470		Void Detection Installation Works	2w	25/03/2019 *	06/04/2019
471		Continuity and Device Test & Loop Commission	1w	08/04/2019 *	13/04/2019
472		Fire stopping, reinstatement and Making Good	1w 4d	18/04/2019 *	02/05/2019
473		Builders Clean	2d	10/05/2019 *	13/05/2019
474		Area 3 - 19 No.	6w 4h	08/04/2019	20/05/2019
475		Void Detection Installation Works	2w	08/04/2019 *	24/04/2019
476		Continuity and Device Test & Loop Commission	1w	24/04/2019 *	01/05/2019
477		Fire stopping, reinstatement and Making Good	1w 4.5d	03/05/2019 *	16/05/2019
478		Builders Clean	2d	17/05/2019 *	20/05/2019
479		Area 4 - 24 No.	6w 1.5d	23/04/2019	05/06/2019
480		Void Detection Installation Works	2w	23/04/2019 *	07/05/2019
481		Continuity and Device Test & Loop Commission	1w	08/05/2019 *	15/05/2019
482		Fire stopping, reinstatement and Making Good	2w 2.5d	15/05/2019 *	03/06/2019
483		Builders Clean	2d	03/06/2019 *	05/06/2019
484		Area 5 - 19 No.	5w 4d	02/05/2019	10/06/2019
485		Void Detection Installation Works	2w 1d	02/05/2019 *	18/05/2019
486		Continuity and Device Test & Loop Commission	1w	20/05/2019 *	25/05/2019
487		Fire stopping, reinstatement and Making Good	1w 3d	28/05/2019 *	06/06/2019
488		Builders Clean	2d	07/06/2019 *	10/06/2019
489		Ground Level - 105 Locations	12w 1.5d	04/03/2019	28/05/2019
490		Area 1 - 23 No.	5w 1.5d	04/03/2019	09/04/2019
491		Void Detection Installation Works	2w	04/03/2019 *	16/03/2019
492		Continuity and Device Test & Loop Commission	1w	18/03/2019 *	23/03/2019
493		Fire stopping	4d	20/03/2019 *	25/03/2019
494		reinstatement and Making Good	2w	25/03/2019 *	06/04/2019
495		Builders Clean	2d	06/04/2019 *	09/04/2019
496		Area 2 - 29 No.	5w 4.5d	18/03/2019	26/04/2019
497		Void Detection Installation Works	2w	18/03/2019 *	30/03/2019
498		Continuity and Device Test & Loop Commission	1w	01/04/2019 *	06/04/2019
499		Fire stopping, reinstatement and Making Good	2w	08/04/2019 *	24/04/2019
500		Builders Clean	2d	24/04/2019 *	26/04/2019
501		Area 3 - 24 No.	6w 4h	01/04/2019	13/05/2019
502		Void Detection Installation Works	2w	01/04/2019 *	13/04/2019
503		Continuity and Device Test & Loop Commission	1w	15/04/2019 *	24/04/2019
504		Fire stopping, reinstatement and Making Good	2w	24/04/2019 *	09/05/2019
505		Builders Clean	2d	10/05/2019 *	13/05/2019
506		Area 4 - 28 No.	6w 1.5d	15/04/2019	28/05/2019
507		Void Detection Installation Works	2w	15/04/2019 *	01/05/2019
508		Continuity and Device Test & Loop Commission	1w	01/05/2019 *	08/05/2019
509		Fire stopping, reinstatement and Making Good	2w	10/05/2019 *	23/05/2019
510		Builders Clean	2d	24/05/2019 *	28/05/2019
511		Basement Level - 3 Locations	3w 2d	25/03/2019	16/04/2019
512		Area 1 - 3 No.	3w 2d	25/03/2019	16/04/2019
513		Void Detection Installation Works	1w	25/03/2019 *	30/03/2019
514		Continuity and Device Test & Loop Commission	1w	30/03/2019 *	05/04/2019
515		Basement - Reinstatement and Making Good	4d	08/04/2019 *	11/04/2019
516		Builders Clean	2d	15/04/2019 *	16/04/2019
517		PART 6 - OUTSTANDING WORKS	27w 9.98h	07/01/2019	15/07/2019
518		MULTIPLEX MISCELLANEOUS	27w 1d	07/01/2019	15/07/2019
519		PRE - HANDOVER	6w 5d	07/01/2019	22/02/2019
520		Video entry to haem Onc day care unit	1w	07/01/2019 *	12/01/2019
521		Static guardian room naming	1w	07/01/2019 *	12/01/2019
522		Theatre/ED and Radiology grilles changed	1w	14/01/2019 *	19/01/2019
523		Theatre sink Heights	3w	14/01/2019 *	02/02/2019
524		Service yard kerb	2w	21/01/2019 *	02/02/2019
525		Installation of P-Traps Nuclear Medicine	1w	28/01/2019 *	02/02/2019
526		Protection to Lift Isolators to Energy Centre	1w	28/01/2019 *	02/02/2019
527		MRI theatre side doors	4d 4h	31/01/2019 *	05/02/2019
528		Key Suiting ready for Handover	1w 2d	14/02/2019 *	22/02/2019
529		Gas supression for 4 substations - Ventilation	3d	04/02/2019 *	06/02/2019
530		POST - HANDOVER	21w 2d	11/02/2019	15/07/2019
531		Low level Grilles on en suite doors (privacy and dignity)	4d 4h	25/02/2019 *	01/03/2019
532		Move of PTS and diverter	4w	11/02/2019 *	09/03/2019
533		RIE Fire Stopping	3w	25/02/2019 *	16/03/2019
534		Missing CCTV in Imaging	2w 1.5d	15/02/2019 *	04/03/2019
535		02-026 Air Handling Unit Duty	1w	15/02/2019 *	22/02/2019
536		Heat station overheating	4w 4h	09/03/2019 *	06/04/2019
537		Additional sockets + Data Points at each nurses station	7w 2d	18/03/2019 *	11/05/2019
538		Lights in Service Yard	2w	15/03/2019 *	29/03/2019
539		Sealed hatches in category 4 rooms and above	1w 1.5d	01/04/2019 *	09/04/2019
540		Opening windows as part of lobby smoke ventilation	2w	25/03/2019 *	06/04/2019
541		Connect lightning protection for Quench pipes	1d 4h	28/03/2019 *	29/03/2019
542		Re-Planting	2w	29/03/2019 *	12/04/2019
543		Tail lift power supplies in service yard	4d	08/04/2019 *	11/04/2019
544		Re-routing of the oxygen pipe/s at VIE	1w 4d	08/04/2019 *	18/04/2019



Date of Issue: 20/02/2019

Purpose of Issue:
Revised Actual Completion to 22/02/2019

Comments: Revised Actual Completion to 22/02/2019

Programme No.: MPX-RHSCDCN-SA1-002

Revision: F

Revision Date: 20/02/2019

File Path: C:\Users\Eddie\Documents\03 eddie mcgibbon ltd\Multiplex\1. EMcG Programme to Completion\Overall Master Programme\Settlement Agreement Jan 2019\20_02_2019 Joint Commissioning Programme Rev 2F.pp 20/02/2019 14:56:58 V Bar Chart View F None S None

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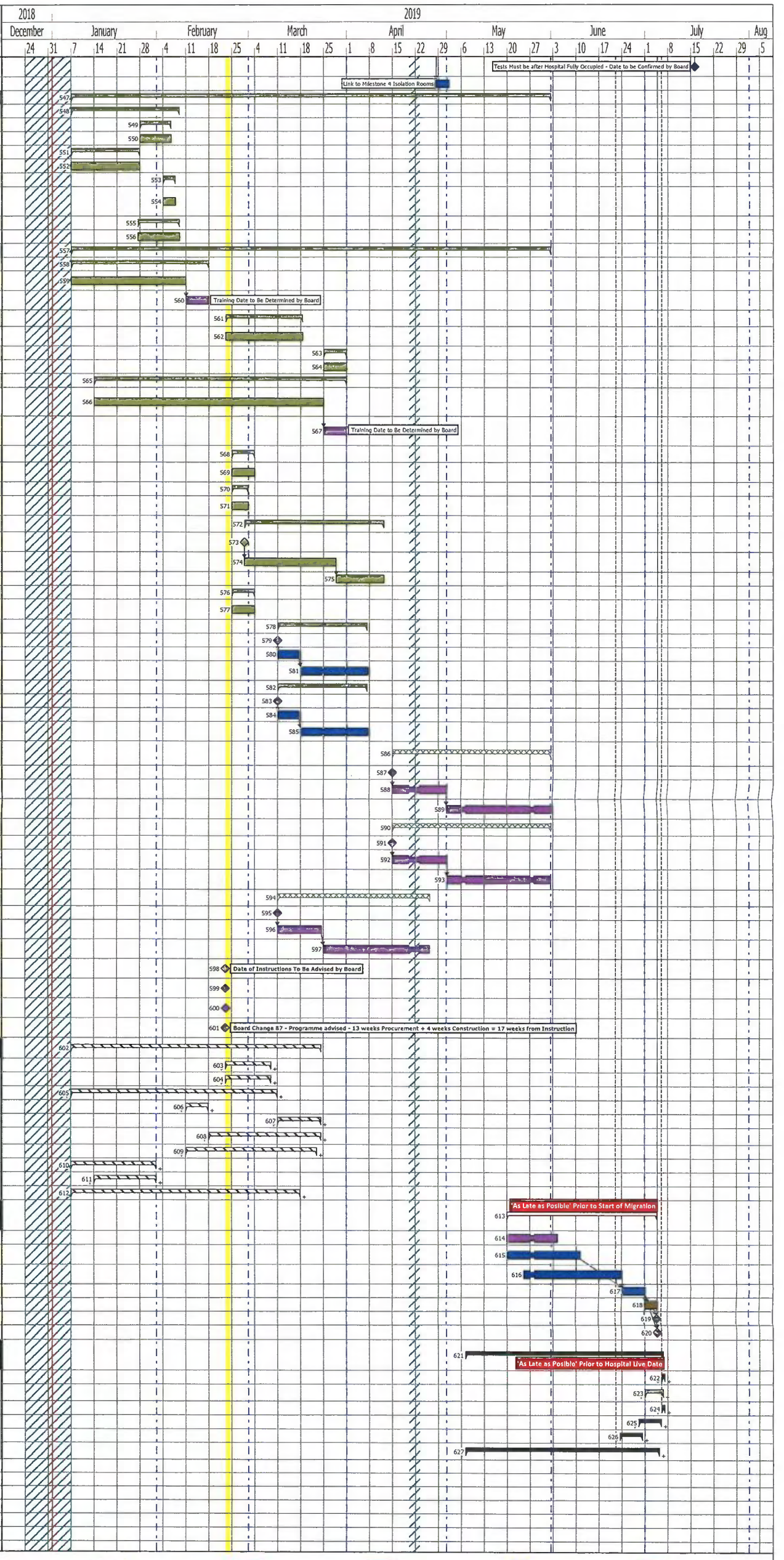
Royal Hospital for Sick Children & DCN

JOINT COMPLETION / JOINT COMMISSIONING PROGRAMME

MULTIPLEX

Line	User_Text_1	Name	Duration	Start	Finish
545		Final Audiology Testing Reverberation in Pods (after hospital fully occupied)		15/07/2019 *	15/07/2019
546		Isolation room edging apllied to doors	3d	27/04/2019 *	01/05/2019
		INSTRUCTED WORKS TO MULTIPLEX	**20w 4h**	**07/01/2019**	**31/05/2019**
548		**PRE - HANDOVER**	**4w 3.86d**	**07/01/2019**	**07/02/2019**
549		**NHS 109 - IOMRI Change Instruction**	**1w 2d**	**28/01/2019**	**05/02/2019**
550		Installation of Doors	1w 2d	28/01/2019 *	05/02/2019
551		**NHS 137 - Doors in CAMHS**	**3w**	**07/01/2019**	**26/01/2019**
552		NHS 137 - Doors in CAMHS - Installation	3w	07/01/2019 *	26/01/2019
553		**NHS 154 - Gas Suppression Subs 1A & 1B**	**3d**	**04/02/2019**	**06/02/2019**
554		NHS 154 - Gas Suppression Subs 1A & 1B - Works Complete - Re-Test and validation to 1A Required	3d	04/02/2019 *	06/02/2019
555		**NHS 160 - BIM Model for Quench Pipe**	**1w 4.5d**	**26/01/2019**	**07/02/2019**
556		NHS 160 - BIM Model for Quench Pipe	1w 4.5d	26/01/2019 *	07/02/2019
557		**POST - HANDOVER**	**20w 5d**	**07/01/2019**	**31/05/2019**
558		**NHS 119 - Patient Absconding**	**6w**	**07/01/2019**	**16/02/2019**
559		NHS 119 - Patient Absconding - Commissioning	5w	07/01/2019 *	09/02/2019
560		NHS 119 - Patient Absconding - Client Demos / Training	1w	11/02/2019 *	16/02/2019
561		**NHS 133 - Additional Security Doors in OPD Zone A**	**3w 2d**	**22/02/2019**	**18/03/2019**
562		NHS 133 - Additional Security Doors in OPD Zone A - Installation / Commission	3w 2d	22/02/2019 *	18/03/2019
563		**NHS 147 - Changes to Access Control**	**1w**	**25/03/2019**	**30/03/2019**
564		NHS 147 - Changes to Access Control	1w	25/03/2019 *	30/03/2019
565		**NHS 156 + 157 - Patient Entertainment**	**11w**	**14/01/2019**	**30/03/2019**
566		NHS 156 + 157 - Patient Entertainment - Installation of Television Screens & Commissioning (Tablets to be handed over)	10w	14/01/2019 *	23/03/2019
567		NHS 156 + 157 - Patient Entertainment - Client Demos / Training / (Tablets to be handed over)	1w	25/03/2019 *	30/03/2019
568		**Change 164 Installation of water for bin washer**	**1w**	**25/02/2019**	**02/03/2019**
569		Change 164 Installation of water for bin washer	1w	25/02/2019 *	02/03/2019
570		**NHS 165 - Reinstatement of Temp Protection**	**4d**	**25/02/2019**	**28/02/2019**
571		NHS 165 - Reinstatement of Temp Protection	4d	25/02/2019 *	28/02/2019
572		**NHS 169 - Internal Signage - Additional Change**	**6w 4h**	**28/02/2019**	**11/04/2019**
573		NHS 169 - Internal Signage - Additional Change - awaiting Approved Document		28/02/2019 *	28/02/2019
574		NHS 169 - Internal Signage - Procurement	4w	28/02/2019 *	27/03/2019
575		NHS 169 - Internal Signage - Installation	2w 4h	28/03/2019 *	11/04/2019
576		**Change 170 Installation of dishwasher in cafe**	**1w**	**25/02/2019**	**02/03/2019**
577		Change 170 Installation of dishwasher in cafe	1w	25/02/2019 *	02/03/2019
578		**NHS 176 - Angio cooling**	**3w 5d**	**11/03/2019**	**05/04/2019**
579		Board Instruction 176 to Proceed		11/03/2019 *	11/03/2019
580		MPX Procurement	1w	11/03/2019 *	15/03/2019
581		MPX Installation, testing & Commissioning of Airdale Unit	3w	18/03/2019 *	05/04/2019
582		**NHS 177 - Fluro Cooling**	**3w 5d**	**11/03/2019**	**05/04/2019**
583		Board Instruction 177 to Proceed		11/03/2019 *	11/03/2019
584		MPX Procurement	1w	11/03/2019 *	15/03/2019
585		MPX Installation, testing & Commissioning of Airdale Unit	3w	18/03/2019 *	05/04/2019
586		**Board Change 178 - Reprogramming of doors imaging for fire (Subject to Building Control Approval)**	**6w 4.9d**	**15/04/2019**	**31/05/2019**
587		Board to Instruct Change 178		15/04/2019 *	15/04/2019
588		Procurement - Reprogramming of doors imaging for fire	1w 5d	15/04/2019 *	30/04/2019
589		*Install - Reprogramming of doors imaging for fire*	4w 1d	01/05/2019 *	31/05/2019
590		**Board Change 179 - 2 doors opening mechanism in radiology**	**6w 4.9d**	**15/04/2019**	**31/05/2019**
591		Board to Instruct Change 179		15/04/2019 *	15/04/2019
592		Procurement - Reprogramming of doors imaging for fire	1w 5d	15/04/2019 *	30/04/2019
593		Install - Reprogramming of doors imaging for fire	4w 1d	01/05/2019 *	31/05/2019
594		**Board Change 180 - 9 additional power and data for TVs in 3-C1.4-084 and 3-C1.4-061**	**6w 3.43d**	**11/03/2019**	**25/04/2019**
595		Board to Instruct Change 180		11/03/2019 *	11/03/2019
596		Procurement - 9 additional power and data for TVs	1w 5d	11/03/2019 *	22/03/2019
597		Install - 9 additional power and data for TVs	4w 1d	25/03/2019 *	25/04/2019
598		Board Change 172 Hospital Square Works - Instruction Process to be Concluded		22/02/2019 *	22/02/2019
599		Toucan crossing - Associated with Board Change 172 Hospital Square - TBC		22/02/2019 *	22/02/2019
600		Little France street lighting - Associated with Board Change 172 Hospital Square - TBC		22/02/2019 *	22/02/2019
601		Number Plate Recognition (Board Change 87)		22/02/2019 *	22/02/2019
		ARTWORK INSTALLATION- Contracted as 'Post Completion'	**10w 5d**	**07/01/2019**	**22/03/2019**
603		ATD 2.1 - Wall Graphics	2w	22/02/2019	07/03/2019
604		ATD 4.1 - Porthole Cabinets and Artwork	2w	22/02/2019	07/03/2019
605		ATD 7.1 Play and Waiting Enhancement	9w	07/01/2019	09/03/2019
606		ATD 7.2 DCN Waiting Areas	1w	11/02/2019	16/02/2019
607		ADT 9.1 - Mural	1w 5d	11/03/2019	22/03/2019
608		ATD 10.1 Bedside environment Overview Patient device user Interface	4w 5d	18/02/2019	22/03/2019
609		ADT 15.1 Multisensory Design & Distraction	5w 4d	11/02/2019	21/03/2019
610		ATD 17.1 CAMHS	3w 4d	07/01/2019	31/01/2019
611		ATD 17.3 Shared Adolescent Spaces	2w 4d	14/01/2019	31/01/2019
612		ATD 22.1 - NHS Direct - Protection Unit	10w	07/01/2019	16/03/2019
		Link Building ('As Late As Possible' Based on Hospital Operational with Patients)	**6w 2d**	**20/05/2019**	**04/07/2019**
614		Internal RIE Signage	2w	20/05/2019 *	03/06/2019
615		Fit Motors to RIE ED door and G1 access corridor to RIE	3w	20/05/2019 *	10/06/2019
616		RIE Link Bridge Builderwork & Breakthrough	4w 4h	24/05/2019 *	22/06/2019
617		RIE Link Clean, Inspect, Snag	1w	24/06/2019 *	29/06/2019
618		Independant Tester Certify	3d	01/07/2019 *	03/07/2019
619		Open Link Ground Floor		04/07/2019 *	04/07/2019
620		Open Link First Floor		04/07/2019 *	04/07/2019
		EXTERNAL WORKS HANDBACK ('As Late As Possible' Based on Hospital Operational with Patients)	**8w 3.5d**	**07/05/2019**	**05/07/2019**
622		Bus stop reopens		05/07/2019	05/07/2019
623		NHS 167 - Bloquater Signage Supervision (As late as Possible)	4d 4h	01/07/2019	05/07/2019
624		Signage unveiled		05/07/2019	05/07/2019
625		Consort install pay station in E	1w	28/06/2019	04/07/2019
626		Car park barriers	1w	22/06/2019	28/06/2019
627		MPX Demobilisation / Reinstatement of Car Park E	8w 1.5d	07 May 19	04 Jul 19



RHSC EMcG

NO ACTION | Key Date | NHSL | Critical | Independant Tester | IT - Settlement Agreement | IHSL / Project Co. | BYES | MPX

Part 5 Post Completion Works | Board Changes Schedule | Artwork | Handback works | Handback Works

Date of Issue: 20/02/2019 Purpose of Issue: Revised Actual Completion to 22/02/2019	Comments: Revised Actual Completion to 22/02/2019	Programme No.: MPX-RHSCDCN-SA1-002 Revision: F Revision Date: 20/02/2019

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PART 5

PART A POST COMPLETION WORKS

Item	Post Completion Disputed Works	Description of Post Completion Works Agreed Resolution
1	**Fire detection** The Board believes that Project Co's design and installation of the fire detection and alarm system in relation to: 1. The void detection in voids with patient dependent services, detection in staff toilets and en-suites to bedrooms; and 2. In relation to provision of manual call point are non-compliant with SHTM 82. Project Co's position is that the design and installation of the fire detection and alarm system complies with SHTM 82 and they have demonstrated this through the Schedule Part 8 (Review Procedure) and implementation of developed risk assessments. Each party disagrees with the other party's position and therefore a dispute has arisen.	The agreed resolution of the Dispute is as follows; For the staff toilets which can be accessed by patients and visitors (i.e. staff toilets in public/clinical areas) - Digi-locks will be fitted on the doors, restricting access to staff members only. For the en-suites – the patient groups viewed as a potential risk are DCN & CAMHS. These en-suites will be treated with a high level grille and top cut reduced door respectively, along with increasing detector sensitivity within the bedroom. Where voids contain either natural gas, medical gas or IPS (Isolated Power Supply) circuitry, automatic smoke detection will be added within these voids. For the fire alarm manual call point, Project Co shall provide additional manual call points developed on the basis of the Risk Assessment. The Board and Project Co have reached agreement on this matter and Project Co shall carry out and complete works to the fire detection and alarm system in accordance with the information contained within aconex ref MPX-GC-029626 "void detection technical pack" and "manual call point technical pack" contained within aconex ref HCP UK-GC-001810 to meet the terms of the Project Agreement as supplemented and amended pursuant to this Agreement.
2	**Isolation room heating** The Board believes that Project Co has installed heater batteries within critical areas in contravention of SHTM 03-01. The Board is of the view that heater batteries should be located above corridors or other non-critical areas and never above patient occupied spaces. Project Co's position is that the design and installation meets the requirements of the Project Agreement and was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	The agreed resolution of the Dispute is as follows; Following a collaborative review of the design between the Board and Project Co, Project Co will make changes to the location and support infrastructure on heater batteries in all location except Isolation rooms. These changes will include fitting of drip trays and leak detection at these locations. In Isolation rooms the heater battery will be replaced by radiant panels within these rooms and associated en-suites. Heater Battery in the ceiling void above the Isolation room lobby will be removed and replaced with a duct spool piece. The Board and Project Co have reached agreement on this matter and Project Co shall carry out and complete all works to the heater batteries, including to the isolation room heating accordance with the information contained within aconex ref MPX-GC-029622) "isolation room radiant panel technical pack" to meet the terms of the Project Agreement as supplemented and amended pursuant to this Agreement. The final location of panels and remote sensors should be discussed and agreed with the Board.

Item	Post Completion Disputed Works	Description of Post Completion Works Agreed Resolution
3	**Internal and external foul drainage** The Board believes that the number and location of sanitary appliances discharging into the basement and PARU sumps, as installed by Project Co, is in contravention with the BCR's (including the non-domestic technical handbook) and the PCPs. Project Co's position is that the design and installation meets the requirements of the non-domestic technical handbook and is unable to meet the PCPs due to topography of the site and proximity of the foul drainage network. Project Co's position is that the design and installation was based on the package approved through Schedule Part 8 (Review Procedure). Each party disagrees with the other party's position and therefore a dispute has arisen.	The agreed resolution of the Dispute is as follows; Both systems resilience in the case of an emergency to be enhanced. Internal Basement sump system, Project Co shall provide the following; Key to Pumps: Pump 1: Vortex – In use Pump 2: Vortex – In use Pump 3: Third Emergency Pump Pump 4: Vortex – Spare Pump Pump 5: Vortex – Spare Pump • Project Co changing the current installed duty and standby foul pumps (Pumps 1 & 2) to new Vortex Wilo submersible pumps; • Each pump shall be rail mounted; • A further full complete spare set of pumps shall be provided for rapid changeover by Project Co (Pumps 4 & 5) ; • The controls shall be upgraded to Ultrasonic measuring and I-host back up; • A third self-priming suction pump shall be provided by Project Co, located within the Heat Station 04 (B-PLANT-002) (Pump 3); • This third pump shall be fully automatic with its own control panel and dual fed power supplies; • The Third pump shall be located on a purpose made gantry, approximately 1 metre off the ground above the installed LTHW pipework; • Pipework within the sump chamber shall be ductile iron, pipework below ground shall be fusion welded HDPE and above ground section shall be ABS plastic solvent welded; • The third pump will utilize a 10m section below ground of the current pumped discharge and an additional 10m of newly installed pipework within the chamber and above ground with a series of control valves with the back-up of manual valves to open and close retrospectively in order to change the 10m section of pumped discharge pipework into a suction pipe, 20m in total; • The third pump shall be backed up by dual power supplies and separate controls; • The float switches shall be upgraded from float switches to ultrasonic measuring and with back-up float switch connected to the BMS as a critical alarm. I-Host monitoring and warning back up shall also be provided. Secondary local power isolation and disconnection for cabling shall be installed underneath the new control panel to facilitate quick change over; • The secondary discharge pipework from the third pump will run along the basement, up riser V10 and run within the ceiling void on the ground floor to exit the building externally into manhole FWMH20 located outside DCN outpatients; • Project Co shall provide and maintain on site a complete spare pump sets (pumps four and five); • Project Co shall provide one porta reid gantry system which is capable of all lifting requirements within the basement and PARU garden pumping stations; • Project Co shall provide and maintain on site a Zipwall plastic disposable and re-usable fire proof wall sheeting system, to allow the area in the basement to be cordoned off and contained; • Project Co shall provide and maintain on site a fan and carbon filter for the basement which will have the suction side

Item	Post Completion Disputed Works	Description of Post Completion Works Agreed Resolution
		connected to the screened off area in the basement; • The fan and filter shall be permanently connected to the electrical power supply and located within Heat Station 01 (B-PLANT-003) with flex ducting attached; • Maintenance and emergency procedures shall be submitted by Project Co through Schedule Part 8 (Review Procedure); • Project Co shall provide full demonstration of the pump replacement to the Independent Tester and Board's Representative. Demonstration shall include all tasks necessary to install and / or replace the pumps safely and satisfactorily in accordance with all manufacturers' requirements, including (without limitation) all relevant infrastructure required for the basement sump (for example the erection of zip wall, erection and use of lifting gantry, carbon filter fan, lifting pump out and swapping with spare); • Handover Clean shall be undertaken by Project Co following Post Completion Works. External sump system, Project Co shall provide the following; • Project Co changing the current installed duty and standby foul pumps to new Vortex Wilo submersible pumps; • Each Pump shall be rail mounted; • A further third full complete spare pump set shall be provided by Project Co (Bouygues); • The controls shall be upgraded to Ultrasonic measuring and I-host back up; • Secondary local power isolation and disconnection for cabling shall be installed on the main building wall in the PARU garden, adjacent to the pumping station to facilitate quick changeover within a lockable and suitable IP rated enclosure; • Hard standing with a minimum of 600mm around chamber lids shall be provided; • Chamber lids shall be sealed; • Maintenance and emergency procedures shall be submitted by Project Co through Schedule Part 8 (Review Procedure); • Project Co shall provide full demonstration of the pump replacement to the Independent Tester and Board's Representative. Demonstration shall include all tasks necessary to install and / or replace the pumps safely and satisfactorily in accordance with all manufacturers' requirements, including (without limitation) all relevant infrastructure required for the external sump (for example erection and use of lifting gantry, lifting pump out and swapping with spare); • Handover Clean shall be undertaken by Project Co following Post Completion Works. The Board and Project Co have reached agreement on this matter and Project Co shall carry out and complete works to the internal and external foul drainage system in accordance with the full details set out within the supporting documentation aconex ref MPX-GC-029655-"foul drainage technical pack" to meet the terms of the Project Agreement as supplemented and amended pursuant to this Agreement.

POST COMPLETION WORKS TECHNICAL WORKS

Schedule Part 5 Part B

in the

AGREED FORM

relative to the

Settlement Agreement and Supplemental Agreement

between

Lothian Health Board

and

IHS Lothian Limited

RHSC and DCN, Little France

This is the Post Completion Works Technical Packs as set out USB Memory Stick in the Agreed Form as referred to in the Settlement Agreement and Supplemental Agreement entered into by Lothian Health Board and IHS Lothian Limited 22 February 2019.

[redacted] .....SIGNED ON BEHALF OF LOTHIAN HEALTH BOARD

J GOLDSMITH .....Print Name

Director of Finance .....Position held

[redacted] ....SIGNED ON BEHALF OF IHS LOTHIAN LIMITED

MATTHEW THOMPSON .....Print Name

Director .....Position held

SCHEDULE PART 5 POST COMPLETION WORKS

PART B

POST COMPLETION WORKS TECHNICAL PACKS

Part B of Schedule Part 5 Post Completion Works Technical Packs are as set out on the USB memory stick is in the Agreed Form identified and executed as Part B of Schedule Part 5 Post Completion Works Technical Packs of this SA1, referred to in and forming part of this SA1

SCHEDULE PART 5 POST COMPLETION WORKS

PART C

POST COMPLETION WORKS COMPLETION CRITERIA

1. DRAINAGE COMPLETION CRITERIA

Project Co shall demonstrate that the following criteria (the "Drainage Completion Criteria") has been achieved:

1.1. The Drainage Works are installed as described at Parts A and B of this Part 5 of the Schedule (Post Completion Works).

1.2. The Drainage Works are tested, commissioned, and operating satisfactorily in accordance with the specified design criteria, any manufacturers' operating requirements and all other relevant terms of the Project Agreement (as amended by this SA1).

1.3. The sump pumps are replaced in accordance with Parts A and B of this Part 5 of the Schedule (Post Completion Works), tested, commissioned and proven to operate satisfactorily in accordance with the manufacturers' operating requirements.

1.4. Spare sump pumps (2 for basement and 1 external) are available on site.

1.5. The third pump for emergency use is installed, tested and commissioned and proven to operate satisfactorily in accordance with the manufacturers' operating requirements.

1.6. The Building Management System alarms and iHost system are both installed, tested, commissioned and operating satisfactorily in accordance with the manufacturers' operating requirements.

1.7. Project Co has demonstrated to the IT and the Board's Representative single pump replacement of both the basement sump and external sump. Demonstration to include all tasks necessary to install and / or replace the pumps safely and satisfactorily in accordance with all manufacturers' requirements, including (without limitation) all relevant infrastructure required for the basement and external sumps (for example the erection of zip wall, erection and use of lifting gantry, carbon filter fan, lifting pump out and swapping with spare).

1.8. The areas within the Site where the Drainage Works were undertaken are free from all surplus materials, plant and equipment and any damage caused by the works undertaken to complete the Drainage Works reinstated.

1.9. A Handover Clean (as defined at paragraph 3 of Schedule Part 1 (Appendix B) Completion Criteria of the Project Agreement) has been undertaken to the areas within the Site where the Drainage Works were undertaken.

1.10. All mechanical and electrical plant and systems associated with the internal and external foul drainage shall be tested, commissioned and operate satisfactorily in accordance with the specified design criteria, any manufacturers' operating requirements, and all other relevant terms of the Project Agreement (as amended by this Agreement).

2. VOID DETECTION COMPLETION CRITERIA

Project Co shall demonstrate that the following criteria (the "Void Detection Completion Criteria") has been achieved:

2.1. The Void Detection Works are installed as described in Parts A and B of Part 5 of the Schedule (Post Completion Works) .

2.2. The Void Detection Works are tested, commissioned and operating satisfactorily in accordance with the specified design criteria, any manufacturers' operating requirements and all other relevant terms of the Project Agreement (as amended by this SA1).

2.3. The fire detector, manual call point and fire-alarm are re-tested and re-commissioned.

2.4. Cause and effect testing of the fire detector, manual call point and fire-alarm in each zone are complete and proven.

2.5. All ceilings and walls are reinstated.

2.6. The areas within the Site where the Void Detection Works were undertaken are free from all surplus materials, plant and equipment and any damage caused by the works undertaken to complete the Void Detection Works reinstated.

2.7. A Handover Clean (as defined at paragraph 3 of Schedule Part 1 (Appendix B) Completion Criteria of the Project Agreement) has been undertaken to the areas within the Site where the Void Detection Works were undertaken.

2.8. All mechanical and electrical plant and systems associated with the void detection shall be tested, commissioned and operate satisfactorily in accordance with the specified design criteria, any manufacturers' operating requirements and all other relevant terms of the Project Agreement (as amended by this SA1).

3. HEATER BATTERY COMPLETION CRITERIA

Project Co shall demonstrate that the following criteria (the "Heater Battery Completion Criteria") has been achieved:

3.1. The Heater Battery Works are installed as described in Parts A and B of this Part 5 of the Schedule (Post Completion Works).

3.2. The Heater Battery Works are tested, commissioned and operating satisfactorily in accordance with the specified design criteria, any manufacturers' operating requirements and all other relevant terms of the Project Agreement (as amended by this SA1).

3.3. The radiant panels are tested, commissioned and operating satisfactorily in accordance with the specified design criteria and any manufacturers' operating requirements.

3.4. The room conditions are proven against the required testing regimes set out in Parts A and B of this Part 5 of the Schedule (Post Completion Works) in order to ensure the specified room conditions are achieved in all relevant isolation rooms.

3.5. Pressure testing of all relevant isolation room suites is completed satisfactorily.

3.6. All mechanical and electrical plant and systems associated with the heater batteries shall be tested, commissioned and operate satisfactorily in accordance with the specified design criteria, any manufacturers' operating requirements and all other relevant terms of the Project Agreement (as amended by this SA1).

3.7. The areas within the Site where the Heater Battery Works were undertaken are free from all surplus materials, plant and equipment and any damage caused by the works undertaken to complete the Heater Battery Works reinstated.

3.8. A Handover Clean (as defined at paragraph 3 of Schedule Part 1 (Appendix B) Completion Criteria of the Project Agreement) has been undertaken to the areas within the Site where the Heater Battery Works were undertaken.

4. GENERAL- COMPLETION CRITERIA APPLICABLE TO ALL POST COMPLETION WORKS

4.1. Project Co shall reinstate the work areas of the Site and/or rooms where the Post Completion Works are being undertaken to the standard set out in the Project Agreement (as amended and supplemented pursuant to this SA1). This will include reinstatement of fire protection, ceilings, floors and walls affected by the Post Completion Works and decoration of same.

PART 6

PART A: OUTSTANDING WORKS

BASE BUILD OUTSTANDING WORKS
Tail lift power supplies in service yard
Validation of air cascade between IOMRI and theatre
Provision of missing CCTV in imaging
Installation of low level grilles on en-suite doors (privacy and dignity)
Minor lead shielding remedials to room in imaging department
Imaging Department doors adjusted from double to single swing
Additional power and data sockets at each nurses station for the Nurse Call PC
Sealed hatches in all category 4 rooms and above
Plate testing and final commissioning of theatres
Opening widows size, smoke clearance
Heat station overheating
CT room (G-Q1-136)/control room (G-Q1-135) & MRI room (G-Q1-134) and MRI equipment rooms (G-Q1-133 and G-Q1-124) overheating
Replanting of soft landscaping areas, including grass, courtyards etc throughout the Facility
Re-routing of the oxygen pipe/s at VIE
Removal and reinstatement of pop out panels and main corridor doors to allow MRI delivery
Little France street lighting
RHCYP and DCN to be added to external signage
Fan upgrades to AHU 02, 04, 06
Project Co (Otto Boc) commissioning of orthotics grinder, router and dust extractor
RIE fire stopping
Isolation rooms – edging applied to doors
Internal RIE signage
Energy Centre Lighting Calcs - Project Co shall undertake any works necessary to make the Energy Centre Lighting Calcs compliant with LG2.
Base Build - Items awaiting Independent Tester confirmation they are complete
Connect lightning protection for Quench pipes
Protection to lift changeover gear in Energy Centre
Installation of removable bollards for fire tender egress at paediatric small car park
CCTV coverage of service yard
Video entry to Haematology and Oncology day care unit
Theatre sinks height amendments
Project Co updating (Static) guardian staff attack room naming
Theatre/Emergency Department and Radiology grilles changed
Installation of service yard ramp including handrail
Installation of nuclear medicine traps
Key suiting ready for handover

Fire suppression for substation 2A and 2B
Lights in service yard
Project Co Change Outstanding Works
Project Co Change 039 Helipad Certification
Project Co Change 065 PTS
Project Co Change 067 Building Warrant Completion Certificate
Project Co Change 068 Manual Call Points
Board Change Outstanding Works
Board Change Notice 087 Number plate recognition
Board Change Notice 109 IOMRI
Board Change Notice 118 O&M Manuals
Board Change Notice 119 Patient absconding system
Board Change Notice 122 ECHC shop (MPX works)
Board Change Notice 133 2 Security doors in OPD
Board Change Notice 137 Anti lig in CAMHS
Board Change Notice 139 Update to 3 signs
Board Change Notice 143 installation of additional cycle provision
Board Change Notice 144 Power Supply Alterations
Board Change Notice 145 Power / data for Massimo
Board Change Notice 146 Emergency Department Crash Box
Board Change Notice 147 Changes to Access Control
Board Change Notice 149 Infrastructure to support pager installation
Board Change Notice 151 Medirail Installation
Board Change Notice 154 Gas suppression in substation 1A and 1B
Board Change Notice 157 Patient entertainment equipment
Board Change Notice 160 updating of BIM model for quench pipes
Board Change Notice 164 Installation of water for bin washer
Board Change Notice 165 installation of temp protection
Board Change Notice 169 Internal Signage
Board Change Notice 170 Installation of dishwasher in cafe
Board Change Notice 172 Hospital Square works
Board Change Notice 176 Angio cooling
Board Change Notice 177 Fluoro cooling
Board Change Notice 178 MRI Access Control
Board Change Notice 179 MRI Access Control during fire alarm
Board Change Notice 180 for 9 additional power and data for TVs in 3-C1.4-084 and 3-C1.4-061
In addition to the above Board Changes, remaining ATD elements required to be undertaken post Actual Completion include - Board Change Notices No 067, 068, 075, 078A, 093, 094, 099, 100, 110, 111, 114, 156.

Outstanding Works Exclusions (post 20 May 19)	Completion Dates
Board Change Notice 167 Signage unveiled	As per Joint Completion Programme
Reopening of the bus stop	As per Joint Completion Programme

Removal of the site establishment	As per Joint Completion Programme
Project Co Change 030 Car park E	As per Joint Completion Programme
Link building opening including fitting motors to RIE ED and G1 access corridor	As per Joint Completion Programme
Open Link Ground Floor	As per Joint Completion Programme
Open link First Floor	As per Joint Completion Programme
Project Co Change 025 BREEAM Certification	01/03/20
Project Co Change 047 Audiology testing	As per Joint Completion Programme
As Built Energy Model / Seasonal Commissioning – former Project Co Change forming part of SA	01/05/20
Reverberation tests in POD	As per Joint Completion Programme

PART B: OUTSTANDING WORKS COMPLETION CRITERIA

1. Project Co shall demonstrate to the Independent Tester's satisfaction that the relevant Completion Criteria as set out in Appendix B of Schedule Part 10 (Outline Commissioning Programme) have been achieved for the Outstanding Works.

2. In relation to the Outstanding Works, Project Co shall also demonstrate the following to the Independent Tester's satisfaction;

2.1 The Outstanding Works are tested, commissioned and proven to operate satisfactorily in accordance with the manufacturers' operating requirements;

2.2 The areas within the Site where the Outstanding Works were undertaken are free from all surplus materials, plant and equipment and any damage caused by the works undertaken to complete the Outstanding Works Agreed are reinstated;

2.3 A Handover Clean (as defined at paragraph 3 of Schedule Part 1 (Appendix B) Completion Criteria of the Project Agreement) has been undertaken to the areas within the Site where the Outstanding Works were undertaken;

3. In relation to the Board Changes set out in the Outstanding Works, Project Co shall demonstrate to the Independent Tester the Completion Criteria have been achieved as set out in Appendix B of Schedule Part 10 (Outline Commissioning Programme), including any relevant information contained in the respective Board Change.

4. In relation to the Project Co Changes set out in the Outstanding Works, Project Co shall demonstrate to the Independent Tester the Completion Criteria have been achieved as set out in Appendix B of Schedule Part 10 (Outline Commissioning Programme), including any relevant information contained in the respective Project Co Change.

PART 7

PAYMENT AND MILESTONES

Project Co shall deliver invoices to the Board in accordance with the invoicing arrangements set out in column 3 of the table below. The relevant element of the Settlement Sum set out in column 2 of the table below shall be paid by the Board to Project Co in instalments by the payment dates set out in column 4 of the table below.

Event	Element of Settlement Sum (£)	Invoicing Arrangements	Payment Date
Milestone 1 Signature of this SA1	£6m (plus VAT)	Project Co to submit invoice to the Board on the date of final signature of this SA1	Board to pay invoice within five (5) Business Days of receipt of valid VAT invoice
Milestone 2 Completion of the Drainage Works in accordance with the Drainage Completion Criteria	£2m (plus VAT)	Project Co to submit an invoice to the Board when the Independent Tester has certified that Milestone 2 has been achieved	Board to pay invoice within five (5) Business Days of receipt of valid VAT invoice (which valid invoice can only be issued once the Independent Tester has certified that Milestone 2 has been achieved).
Milestone 3 Completion of the Void Detection Works in accordance with the Void Detection Completion Criteria	£2m (plus VAT)	Project Co to submit an invoice to the Board when the Independent Tester has certified that Milestone 3 has been achieved.	Board to pay invoice within five (5) Business Days of receipt of valid VAT invoice (which valid invoice can only be issued once the Independent Tester has certified that Milestone 3 has been achieved).
Milestone 4 Completion of the Heater Battery Works in accordance with the Heater Battery Completion Criteria	£1.6m (plus VAT)	Project Co to submit an invoice to the Board when the Independent Tester has certified that Milestone 4 has been achieved	Board to pay invoice within five (5) Business Days of receipt of valid VAT invoice (which valid invoice can only be issued once the Independent Tester has certified that Milestone 4 has been achieved).

PART 8

BOARD CHANGES

PART 1

1. Reference 169A Internal Signage.
2. Reference 176 Angiography Procedures Machine Room.
3. Reference 177 Fluoroscopy Equipment Cooling
4. Reference 178 IOMRI Access Control
5. Reference 179 MRI Access Control During Fire Alarm
6. Reference 180 Power & Data Sockets

PART 2

1. Reference 020 Removing RIE Ambulant Canopy from IHSL Scope
2. Reference 036B Family Hotel - Ronald McDonald
3. Reference 068 Courtyard Enhancement
4. Reference 069A Cooling in Clinical Research - Construction
5. Reference 073A ATD 10.1 Enabling Works - Construction
6. Reference 075 ATD Reference 1.1 Spine Wall
7. Reference 079 Capex 9 - 14
8. Reference 087 Number plate Recognition
9. Reference 093 ATD Projects 2.1, 4.1, 5.3, 17.3 & 20.1
10. Reference 094 ATD Project Reference 15.1
11. Reference 097 ATD 7.1 - Section 1
12. Reference 098 ATD 7.1 - Section 2
13. Reference 099 ATD 7.2
14. Reference 100 CAMHS - ATD Enhancements
15. Reference 106 Zone A fire evacuation strategy
16. Reference 109A Interoperative MRI - Construction
17. Reference 110 ATD 7.3 - Family Support / Interview Rooms
18. Reference 111 ATD Reference 1.3 - Atrium Lighting
19. Reference 112 Doors & Ironmongery
20. Reference 114A ATD Reference 16.1 - Sanctuary & Bereavement Suite - Construction
21. Reference 116 ATD Reference 1.3 - Atrium Lighting Part 2
22. Reference 119 Patient Security System
23. Reference 122 ECHC Retail Shop
24. Reference 124 PARU Garden Ducting & RMU
25. Reference 129 Dental
26. Reference 130 Obscure glass
27. Reference 131 Cycle Path
28. Reference 134 Medical Gas Trunking Alterations
29. Reference 135 MRI / CT Chiller Pipe Maintenance and LCC

30. Reference 136 Alcohol gel dispensers
31. Reference 138 Emergency Department Drug Store
32. Reference 140 Helipad CCTV
33. Reference 141 Bin tipper 3 phase supply
34. Reference 142 Nurse call removal
35. Reference 143 Additional cycle racks
36. Reference 145 Power / Data for Massimo
37. Reference 146 Emergency Department crash box
38. Reference 152 Audiology Blackout to windows
39. Reference 154 Gas suppression
40. Reference 156 Patient Entertainment - Infrastructure
41. Reference 157 Patient Entertainment - Equipment
42. Reference 164 Bin washer water supply
43. Reference 169A Internal signage alterations
44. Reference 170 Grab & Go alterations
45. Reference 176 Angiogram equipment room cooling
46. Reference 177 Fluoroscopy room cooling
47. Reference 178 MRI access control
48. Reference 179 MRI access control on fire alarm activation[1]
49. Reference 180 Additional power and data sockets

[1] The Parties agree that Board Change 179 will only be instructed if building control approval for that Board Change is received.

PART 9

INDEPENDENT TESTER VARIED SERVICES LETTER

Dear Sirs

LOTHIAN HEALTH BOARD ("the **"Board"**");
IHS LOTHIAN LIMITED ("**Project Co**");
ARCADIS LLP (previously EC HARRIS LLP) (the "**Independent Tester**");

Royal Hospital for Sick Children, Child and Adolescent Mental Health Service and the Department of Clinical Neurosciences in a single building adjoining the Royal Infirmary of Edinburgh at Little France at the Site and Off-Site (the "Project")

The Board and Project Co entered into the Project Agreement in respect of the Project. The Board and Project Co have agreed to amend and supplement the Project Agreement (the "**PA Settlement Agreement**") on or around the date of this letter, and as a result of the PA Settlement Agreement the Board and Project Co have agreed to vary the Services of the Independent Tester.

Terms used in this letter have the meanings given to them in the PA Settlement Agreement. Any references to the Project Agreement shall be deemed to be references to the Project Agreement as amended and supplemented by the PA Settlement Agreement.

1. Pursuant to Clause 3 of the Independent Tester Contract amongst (amongst others) the Board, Project Co and the Independent Tester, we hereby instruct the Independent Tester to perform the following Varied Services:-

1.1 issue the Certificate of Practical Completion pursuant to Clause 17.12 (Completion Certificate) of the Project Agreement when he is satisfied that the Facilities and the Retained Estate Handback Infrastructure are complete in accordance with the Completion Criteria as amended by the Agreed Resolution and the other relevant provisions of the Project Agreement (as amended) notwithstanding:

1.1.1 any requirement to procure the completion of: (a) the Post Completion Works in accordance with Clause 6.11 of the PA Settlement Agreement; (b) the Outstanding Works; and/or (c) the RDD Status C Submitted Items;

1.1.2 the dispute between the Parties regarding the Concrete Specification, De-Watering, Geotechnical Reports, Submains Schedule and the Energy Centre Lighting Calcs;

1.1.3 that there are Snagging Matters;

1.2 certify the relevant works comprising Milestone 2, Milestone 3, and/ or Milestone 4 as the case may be as complete when the Independent Tester is satisfied that the works comprising Milestone 2, Milestone 3 and/ or Milestone 4 (as applicable) are complete in accordance with the relevant Post Completion Works Completion Criteria and all other relevant provisions of the Project Agreement (as amended by SA1) notwithstanding:

1.2.1 any requirement to procure the completion of: (a) the other Post Completion Works (to the extent not yet complete); (b) the Outstanding Works (to the extent not yet complete); and/or (c) the RDD Status C Submitted Items;

1.2.2 the dispute between the Parties regarding the Concrete Specification, De-Watering, Geotechnical Reports, Submains Schedule, the Energy Centre Lighting Calcs and any other disputes which arise after the SA1 Effective Date or any Future Claims;

1.2.3 that there are Snagging Matters;

1.2.4 that there are any defects in the Works not forming part of the applicable Post Completion Works;

1.3 issue certificates to the Board and Project Co confirming achievement of Milestone 2, Milestone 3 and Milestone 4 as the case may be; and

1.4 certify the relevant works comprising the Outstanding Works as complete when the Independent Tester is satisfied that the Outstanding Works are complete in accordance with the Outstanding Works Completion Criteria and all other relevant provisions of the Project Agreement (as amended by SA1) notwithstanding:

1.4.1 any requirement to procure the completion of: (a) the Post Completion Works (to the extent not yet complete); (b) the Outstanding Works Exclusions; and/or (c) the RDD Status C Submitted Items;

1.4.2 the dispute between the Parties regarding the Concrete Specification, De-Watering, Geotechnical Reports and Submains Schedule, any other disputes which arise after the SA1 Effective Date or any Future Claims;

1.4.3 that there are Snagging Matters;

1.4.4 that there are any defects in the Works not forming part of the applicable Outstanding Works;

1.5 familiarise himself with the PA Settlement Agreement in order to issue a Certificate of Practical Completion in accordance with Paragraph 1.1 above, certify completion of the Outstanding Works in accordance with Paragraph 1.4 above, and certify Milestone 2, Milestone 3 and Milestone 4 in accordance with Paragraph 1.2 above.

2. The Parties have enclosed a copy of Part 1 of the Schedule (Technical Schedule), a copy of Part 2 of the Schedule (Technical Schedule Documentation), a copy of Part 5 of the Schedule (Post Completion Works) and a copy of Part 6 of the Schedule (Outstanding Works) of the PA Settlement Agreement.

3. The Independent Tester acknowledges that no representations or comments concerning compliance of the Works forming part of Part 1 of the Schedule (Technical Schedule) of the PA Settlement Agreement and/ or the Post Completion Works forming part of Part 5 of the Schedule (Post Completion Works) of the PA Settlement Agreement shall be made to the Independent Tester by any party to the Independent Tester's Appointment provided that the Independent Tester is entitled to request or invite any such party to make representations or comments and/or to require information from any of such parties. In the event of such request or invitation and/or requirement for information to the Board or Project Co, the Board or Project Co (as the case may be) shall be obliged to respond to such request or invitation and provide the information required.

4. All oral representations and/or comments to the Independent Tester on compliance of the Works with the Project Agreement (under exclusion of the Works forming part of Part 1 of the Schedule (Technical Schedule) of the PA Settlement Agreement and/ or the Post Completion Works forming part of Part 5 of the Schedule (Post Completion Works) of the PA Settlement Agreement) shall be made at meetings with the Independent Tester, such meetings to take place twice weekly, or on such other date or such frequency as may be agreed at the said meetings, or as may be reasonably requested in writing by the Independent Tester or Project Co or the Board.

5. Any written submissions and/or comments to the Independent Tester concerning compliance of the Works with the Project Agreement (under exclusion of the Works forming part of Part 1 of the Schedule (Technical Schedule) of the PA Settlement Agreement and/ or Part 5 of the Schedule (Post Completion Works) of the PA Settlement Agreement) shall be discussed at the meeting immediately following issue of the written submission and or comment.

6. Project Co shall procure that the Contractor shall issue commissioning and testing methodology for the Post Completion Works to the Independent Tester and the Board's Representative not less

than five (5) Business Days prior to the date when Project Co (acting reasonably) considers that the Contractor shall commence the Post Completion Works commissioning.

7. By signature of this letter Project Co, the Board and the Independent Tester agree that the Services shall be varied as set out above.

Signed for and on behalf of Project Co's Representative

Signed for and on behalf of the Board's Representative

Receipt of Independent Tester Varied Services Letter acknowledged for and on behalf of the Independent Tester

PART 10

INDEPENDENT TESTER REPRESENTATIONS

1. No representations or comments concerning compliance of the Works forming part of Part 1 of the Schedule (Technical Schedule), Post Completion Works forming Part 5 of the Schedule (Post Completion Works) or Outstanding Works forming Part 6 of the Schedule (Outstanding Works) shall be made to the Independent Tester by either Party and Project Co shall ensure that no representations or comments shall be made by the Contractor, unless the Independent Tester requests and/or invites the Parties to make representations or comments and/or requires information from any of the Parties and/or the Contractor, and where any such request and/or invitation and/or requirement is made by the Independent Tester the Parties shall and Project Co shall ensure that the Contractor shall respond to such request or invitation and provide the information required.

2. All oral representations and/or comments to the Independent Tester on compliance of the Works with the Project Agreement (under exclusion of the Works forming part of Part 1 of the Schedule (Technical Schedule)) shall be made at meetings with the Independent Tester and such meetings to take place twice weekly, or on such other date or such frequency as may be agreed at the said meetings, or requested in writing by either of the Parties.

3. Any written submissions and/or comments to the Independent Tester concerning compliance of the Works with the Project Agreement (under exclusion of the Works forming part of Part 1 of the Schedule (Technical Schedule)) shall be discussed at the meeting immediately following issue of the written submission and or comment.

4. The Independent Tester's services in the Independent Tester's Appointment shall be varied to reflect the position outlined in Paragraphs 1 to 3 above.

Health Facilities Scotland

NHS National Services Scotland

Scottish Health Technical Memorandum 03-01 (Interim Version – Additional guidance related to COVID 19 to be added in an update in 2022)

Specialised ventilation for healthcare premises
Part A: The concept, design, specification, installation and acceptance testing of healthcare ventilation systems

February 2022
Interim Version 3.0

A46676816

Contents

Executive Summary

Scottish Health Technical Memorandum 03-01 – 'Specialised ventilation in healthcare premises' is published in two parts:

Part A: The concept, design, specification, installation and acceptance testing of healthcare ventilation systems.

Part B: The management, operation, maintenance and routine testing of existing healthcare ventilation systems.

The documents give comprehensive advice and guidance on the legal requirements, design implications, maintenance and operation of specialised ventilation in healthcare premises providing acute care. The use of these premises is very intense, the occupancy level high and the patients may be particularly susceptible to airborne infection risks. Their condition may also require close control of the environment.

The ventilation of non-healthcare facilities within the hospital curtilage should be designed to suit the application and specific guidance relating to the activity should be followed, for example pharmacy, central decontamination unit, etc. However, as they are on the hospital site, the means of providing ventilation should not adversely impact upon the hospital (for example, evaporative cooling towers should not be installed, sound levels should be appropriate and if the facility is within or attached to an area accessed by patients, their needs and the risk of airborne contamination should be considered).

In other types of healthcare facility that are outside of the hospital curtilage, for example GP practices, health centres, minor injuries units, dental, ophthalmic and podiatry clinics, mental health facilities, respite and long stay care homes and hospices, a risk assessment of the nature of the treatment being delivered, condition of the patients and intensity of use needs to be undertaken by those responsible for the facility in order to determine the extent to which this guidance will be applicable.

The guidance contained in Part A of this Scottish Health Technical Memorandum applies to new installations and major refurbishments of existing installations and should be considered as the standard to be achieved.

The guidance contained in Part B of this Scottish Health Technical Memorandum applies to all ventilation systems installed in healthcare premises irrespective of the age of the installation and should be considered as the standard to be achieved.

Scottish Health Technical Memorandum 03-01 (2022) supersedes all previous versions of Scottish Health Technical Memorandum 03-01 – 'Specialised ventilation in healthcare premises' (2014). It also supersedes SHTM 2025 (1994) and DV4 (1983).

Who should use this guidance?

This document is aimed at specifiers, designers, suppliers, installers, estates and facilities managers and operations. Elements of the document will also be relevant to

managers concerned with the day-to-day management of healthcare facilities and senior healthcare management.

Main changes since the 2014 edition

- design information for specific healthcare applications has been revised and information on the reason for ventilation given. For example, endoscopy rooms may now be either negative (to contain and remove odours and manage airborne risks to staff) or positive pressure (to maintain a higher level of cleanliness where it is intended to puncture body membranes with the endoscope). These endoscopy-specific risks (i.e. waste anaesthetic gases and pathogenic material (for example, multi-drug- resistant tuberculosis) discharged by the patient during the procedure being undertaken) were identified prior to the SARS-CoV-2 pandemic. As with other elements in Part A, the application of this change is not retrospective but applies to new installations and major refurbishments (see Preamble above);
- the client's needs and legal requirements are more clearly explained;
- this edition of Scottish Health Technical Memorandum 03-01 introduces the concept of the Ventilation Safety Group in healthcare organisations (similar to the Water Safety Group in Scottish Health Technical Memorandum 04-01 and the Electrical Safety Group in Scottish Health Technical Memorandum 06-01). This is a multidisciplinary group whose remit will be to assess all aspects of ventilation safety and resilience required for the safe development and operation of healthcare premises;
- the SHTM introduces a standard method of identifying and labelling ventilation systems and the creation of an inventory of installed systems;
- the issues of resilience and diversity are addressed;
- guidance is provided on refurbishments or when changing the use of an existing installation;
- guidance is given on lifecycle and the updating of mid-life plant;
- design information for specific healthcare application has been extensively revised;
- issues around rooms where anaesthetic agents are used are addressed;
- airflow rates are more tailored to the applications to take advantage of new fan and control technology and so reduce energy consumption;
- revised air quality and filter standards are given;
- new and emerging technologies are catered for;
- advice is given on installation standards and the appointment of an independent validator;
- more detailed information is given on the commissioning process;
- validation acceptance standards and methodology has been completely revised;
- routine inspection and maintenance guidance has been revised and updated.

Net Zero Carbon

Scottish Health Technical Memorandum 03-01 supports UK legislation to bring all greenhouse gas emissions to net zero by 2045, and promotes sustainable methods of ventilation in healthcare facilities.

SHTM's core principle is that the default method of ventilation should as far as possible be natural ventilation followed by mixed mode (natural with mechanical ventilation), with mechanical ventilation being the last option.

The energy consumption of ventilation systems should be further minimised by specifying solutions with the lowest lifecycle environmental cost. The basic objective of energy-saving strategies in this SHTM is to provide the required ventilation service using the minimum energy. To this end, Scottish Health Technical Memorandum 03-01 recommends switching a system "off" when not required to be the most energy-efficient policy. If the system is needed to maintain a minimum background condition, reducing its output by "setting back" to the minimum necessary to achieve and maintain the desired condition is the next best option.

Fans represent an enormous potential for energy savings to reduce carbon emissions, as they are among the largest single users of energy (they use approximately 40% of all electricity in ventilation systems). The European Regulation 1253/2014, implementing the Energy-related Products (ErP) Directive, has significantly reduced the power to drive fans. Accordingly, Scottish Health Technical Memorandum 03-01 recommends using electronically commutated fans, as these have been proven to be the most energy-efficient, while also advising that belt-driven fans should no longer be installed.

There have been many legislative changes aimed at reducing energy consumption and technical advances that have increased operational efficiency. This revised SHTM incorporates those changes and has amended many of the design parameters for healthcare ventilation. Designs that are simply repeated from previous installations designed to superseded standards and guidance will not meet the revised energy or operational standards and will not produce a compliant result.

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1. Introduction

The needs of the building occupants

1.1 Ventilation is used extensively in all types of healthcare premises to provide a safe and comfortable environment for patients and staff and control odours. More specialised ventilation is provided to help reduce airborne infection risks in areas such as operating departments, critical care facilities, isolation rooms and primary patient treatment areas.

1.2 The Health and Social Care Act places a duty of care on healthcare providers. Increased health risks to patients will occur if ventilation systems do not achieve and maintain the required standards. The link between surgical site infection and theatre air quality has been well established. If the ventilation plant has been installed to dilute or contain harmful substances, its failure may expose people to unacceptable levels of risk. Proven breaches of the statutory requirements can result in prosecution and may also give rise to a civil suit against the operators.

The building environment

1.3. Healthcare buildings are visited and used by large numbers of people. Many will be unwell or anxious so a well-ventilated environment with a fresh feel and an absence of noxious odours is essential.

1.4 Ventilation may also be installed:

- to ensure compliance with highly regulated quality assurance requirements of items processed in pharmacies and central decontamination units;
- to protect staff from airborne microorganisms and toxic substances (for example, in laboratories and anaesthetic rooms);
- to contain the spread of smoke between fire compartments as part of the fire strategy.

1.5 Healthcare buildings are continuously occupied, intensively used and because of the specialised nature of the facilities it may be extremely difficult to provide the service elsewhere if the ventilation fails. In order to ensure continuity of service, ventilation systems should be designed and installed so that they can be quickly and easily maintained. The resilience of the proposed system in the event of service outage should also be considered.

1.6 The ventilation of healthcare facilities consumes a significant portion of their energy load, so wherever possible natural ventilation is the preferred option. Where mechanical ventilation is used, sustainable design concepts allied to good-quality installation and the provision of controls that maintain the desired environment when the facility is in use will result in the minimum energy input for the maximum benefit.

Airborne risks to staff

1.7 Most healthcare staff are no more at risk from airborne hazards when at their workplace than they are when not in a healthcare environment; however, certain groups as detailed below may be exposed to a variety of airborne contaminants.

- staff who administer anaesthetic agents or who work in areas where they are routinely used will be at risk of casual exposure to these agents;
- staff who routinely work in areas where they may come into close contact with patients who have respiratory symptoms will be at risk of exposure to the microorganisms causing the symptoms;
- staff who routinely work in areas where they may come into close contact with patients that have skin lesions, an infectious disease or a dermatological condition will be at risk of exposure to the microorganisms causing the condition;
- staff who routinely process pathology specimens;
- staff who decant, mix and/or process chemicals used as reagents for the setting or processing of pathology specimens;
- staff who harvest organs, tissues and specimens at a post-mortem;
- staff who handle drugs or the components of drugs;
- staff who pre-clean used scopes, surgical instruments and equipment prior to decontamination;
- staff who may be routinely exposed to airborne hazards listed in EH40 issued under the Control of Substances Hazardous to Health Regulations (COSHH) (for example, woodworking dust, welding fumes, chemical vapours).

1.8 A well-designed ventilation system can mitigate the airborne risks to staff. It should:

- supply sufficient unvitiated air to dilute the possible contaminants;
- have air terminals located to efficiently scour the ventilated space;
- move the air from the clean to the less clean space and/or out of the building;
- supply the air at high level and remove it at low level so that the breathing zone of staff is in a clean airflow path.

1.9 Adoption of these principles will be sufficient to control the general risk to the staff identified above in their particular working environment. More specific airborne hazards should be captured at source and removed by local exhaust ventilation (LEV) systems provided under the COSHH Regulations (see paragraphs 3.3–3.5).

Airborne risks to patients

1.10 In general terms an environment that is satisfactory for staff will be satisfactory for patients. There are, however, exceptions as below:

- intensive treatment units of any type;
- haematology/oncology units;

- transplant units and units treating patients that have had their immune system compromised;
- bone marrow transplant units (BMT);
- burns units;
- cystic fibrosis units;
- operating theatres.

Patients being treated in these areas will need an environment supplied with good-quality filtered air and that is maintained at a positive pressure with respect to surrounding areas

Note: Patients who are particularly at risk from airborne microorganisms will normally be placed in an isolation room or suite that is maintained at a positive pressure. Patients who have a condition that could be transmitted to others are normally placed in a negative pressure isolation suite. When the patient's exact condition is unknown they may be placed in a neutral pressure (PPVL) isolation suite (see Health Building Note 04-01 Supplement 1 – 'Isolation facilities for infectious patients in acute settings for detailed guidance).

1.11 A more general airborne risk will result from poorly designed and constructed air handling units (AHUs) that allow water to stagnate inside; they can then become a source of microorganisms such as Legionella. If their intake is badly sited or housekeeping in the area is poor, fungal spores such as aspergillus can be drawn in. The ventilation system will then become a means of spreading these microorganisms and fungal spores around the healthcare building.

1.12 All ventilation systems should conform to the principles set out in the Health and Safety Executive's (HSE) Approved Code of Practice and guidance document HSG274 'Legionnaires' disease: the control of Legionella bacteria in water systems' and Scottish Health Technical Memorandum 04-01 – 'Safe water in healthcare premises'.

Specialist equipment environment

1.13 Imaging and other non-invasive scanning equipment will require stable environmental conditions to stay within calibration and provide accurate repeatable results. Health Building Note 06-01 and Health Building Note 10 (2021) give detailed guidance and the equipment manufacturers should be consulted.

Note: Health Building Note 26 – 'Facilities for surgical procedures' (2004) and Health Building Note 10-02 – 'Facilities for day surgery units' (2007) are under revision at the time of writing and will become Health Building Note 10-01 once updated.

Health Building Note 06-01 (2001) on diagnostic imaging and interventional radiology is also under revision at the time of writing.

Medicinal products environment

1.14 Pharmacists are required to ensure that any manufacture or preparation activities involving medicinal products undertaken in their units conform with the requirements of the Medicine Act. Processes must be carried out in a suitable facility usually termed an aseptic preparation facility. The quality of air supply and design of the ventilation cascade are essential to ensure a suitable environment for the activities undertaken.

Fire and smoke control fundamentals

1.15 Scottish Health Technical Memorandums 81 to 87 (including sub-parts) are the base documents for fire aspects. When designing a ventilation system, a fire and smoke control strategy should be developed that is relevant to the site and its function. The fire and smoke strategy should take account of the planned activity within the area, the type of patient present, staff-to- patient ratio and treatment being delivered (see also Chapters 5 and 7).

1.16 When ventilation systems are originally designed, they will conform to an agreed fire strategy. This will determine the compartmentation, provision of fire-rated ductwork, fitting of sprinklers, the siting of fire and smoke dampers and an agreed control action for the ventilation in the event of a fire. The agreed fire and smoke control strategy must be clearly set out as part of the design specification.

1.17 The fire regulations require that, if ventilation ductwork penetrates the fabric of a building, it should be designed and installed to contain the spread of fire (see Health Technical Memorandum 05-02 – 'Guidance in support of functional provisions for healthcare premises' for further guidance).

1.18 If a ventilation system is upgraded or altered to suit a change of use, it will be necessary to reassess the fire strategy.

1.19 It is management's responsibility to ensure that the fire strategy applied during the design and installation of a system is not reduced during the subsequent operation and maintenance of the equipment.

1.20 The number and location of fire and smoke dampers can be problematic. Fire- rated ductwork within fire zones will reduce the need for fire and smoke dampers. It will eliminate the need to provide access for routine damper testing and the infection control problems associate with reversed airflow paths resulting from damper failures and nuisance tripping (see also Chapter 7 for ventilation control in the event of fire).

Note: In developing a fire and smoke containment strategy the design of ventilation for infection control cannot be ignored. Over-compartmentation and poorly chosen fire lines can prevent air moving from clean to less clean areas and thus increase the infection risk. This can be a particular problem in operating departments where the desire to create a protected escape route can be at odds with the need to cascade air through a suite of rooms and out into a corridor in order to control the airborne infection risk.

2. The User Requirements

2.1 Patient treatment falls into four basic categories:

- surgical procedures – physical interventions to diagnose, repair, remove or rebuild damaged or infected tissue;
- medical care – the administering of drugs or various forms of practical, non-invasive treatment to diagnose, cure or reduce the severity of an infection or condition;
- mental health – the use of counselling, often in conjunction with drugs, to control or alleviate abnormal behavioural or false perception issues in patients;
- palliative care – treatment to temporarily or partially relieve or mitigate long-term conditions;

In all cases a patient may require treatment in one or more of the categories as either an in-patient or an out-patient.

Surgical procedures

2.2 It is thought that up to 25% of infections that occur as a result of a surgical intervention are caused by the airborne route. The source of these infections are predominantly as a result of airborne microorganisms, typically skin scales, liberated during the surgical procedure becoming airborne and landing in the wound or on surgical instruments. These then become a means of inoculating the patient with the contaminant. There are five possible routes that may result in airborne infections:

- skin scales liberated by the surgical team during the procedure;
- organic material liberated from the patient as a result of the procedure;
- microorganisms remaining from a previous use of the space becoming airborne;
- airborne microorganisms liberated outside of the space entering during the procedure;
- microorganisms in the supply air from a ventilation system that has been contaminated with biological material.

2.3 The level of airborne organic material present or biological burden (bioburden) is typically defined in terms of the number of colony forming units (cfus) present at the wound site during the procedure. It will be dependent on:

- the number of persons present;
- the completeness and effectiveness of their gowning;
- the duration of the procedure;
- the type of procedure;
- the use of air-driven power tools;
- the extent to which a patient contributes to the bioburden in the space;

- the general cleanliness of the space;
- the discipline of the surgical team;
- the measures that have been taken to prevent or control contaminants from outside sources entering the space;
- the quality and volume of the incoming supply air;
- the efficiency of the incoming air to “scour” the space;
- the means of removing contaminated air from the space.

2.4 Good surgical discipline, effective patient preparation, the cleanliness of the space and control of the entry and exit of personnel during the procedure will all contribute to reducing the bioburden present.

2.5 A well-designed ventilation scheme that provides a suitable quality of air and efficiently scours the space will further reduce the bioburden. If the ventilation maintains the space at a positive pressure to adjoining areas, the risk of contaminants originating outside of the space entering will be reduced.

2.6 In addition to controlling the bioburden, the ventilation should provide comfortable conditions for the staff and patient.

2.7 The ventilation system should also control the risks to staff from anaesthetic agents and other hazardous fumes and emissions typically found in surgical facilities (see paragraphs 1.10–1.12).

2.8 Minor procedures may be carried out in a treatment room or at the bedside so surgical procedures are not exclusive to the operating department. (See Humphreys et al (2012) for further guidance on facilities for minor surgical procedures and minimal access interventions).

Medical care

2.9 In general the main requirement will be to ensure that staff and patients are kept in comfortable conditions.

2.10 There are specific instances where staff can be at risk of contracting an illness by the airborne route from a patient. This is the case in infectious disease units where the ventilation will be designed to maintain the unit and individual patient rooms at negative pressure relative to adjacent areas. This will protect persons outside of the unit from infection by the airborne route but not staff entering and working in the unit, who may need to take additional precautions to protect themselves.

2.11 The opposite problem occurs when patients are neutropenic, that is, they have a reduced or extremely low resistance to infection. They are then at risk of infection by the airborne route from other persons such as staff and visitors. This will be the case in cancer/oncology units, critical care areas, and bone marrow and general transplant units. The ventilation in these areas will need a higher air quality and be set to maintain a positive pressure to adjacent areas.

Mental health

2.12 Any specific patient needs should be assessed and addressed. The main requirement will be to ensure that staff and patients are kept in comfortable conditions (see comments on other types of healthcare facility in the Executive Summary).

2.13 The fire risk may be considered more likely and additional steps may need to be taken to control it.

Palliative care

2.14 The main requirement is to ensure that staff and patients are kept in comfortable conditions. Temperature control may be more stringent for patients with long-term and/or end of life conditions (see the Executive Summary for further information).

2.15 Difficulties with evacuating patients in the event of fire may need to be considered.

Diagnostic and support services

Imaging and Interventional imaging

2.16 There are major advances in diagnosis and minimally invasive treatment involving imaging. It may be necessary during these invasive or non-invasive procedures to provide sedation or general anaesthesia to help with anxiety or pain. This may involve the use of inhaled anaesthetic agents and/or nitrous oxide (N2O). Staff working in these areas may be exposed to these anaesthetic agents when they are administered or subsequently when they are exhaled as the patient is recovered.

2.17 A similar situation occurs in maternity units, where a mixture of nitrous oxide and oxygen (N2O/O2) (Entonox) is used as an inhaled analgesic.

2.18 In both of the above cases ventilation should be designed to provide a clean airflow path and dilute any casual spillages of the gas. This approach will help control the casual exposure of staff to the anaesthetic agent (see paragraphs 3.3–3.5).

Post-mortem and pathology

2.19 Staff who harvest organs and specimens at a post-mortem and place them into preservative solutions may be exposed to the microorganisms present and fumes from the preservative.

2.20 Staff who section organs and prepare specimens for analysis may be exposed to the microorganisms present and the chemicals used for staining and fixing the specimens.

2.21 In both of the above situations local exhaust ventilation (LEV) in the form of downflow benches, safety cabinets and fume cupboards need to be provided to control the risk.

Pharmacy

2.22 Exposure to the active ingredients of drugs represents a hazard to pharmacy staff who are involved in their production. These activities are carried out in an aseptic

preparation facility to ensure that the drugs themselves are not contaminated. The actual production typically takes place inside an isolator so that there is a physical barrier between the hazard and the operator.

2.23 Alcohol sprays are used and staff exposure may be controlled by the provision of downflow LEV systems to remove the hazard.

2.24 Comfortable conditions are essential for staff working in preparation facilities as they need to be fully gowned, and entry and exit is restrictive.

Decontamination facilities

2.25 Staff may be exposed to airborne biological material and chemicals when handling and processing used scopes, surgical instruments and equipment as part of the decontamination process. The ventilation should provide a clean airflow path to control staff exposure. The quality, quantity and flow pattern of the air are also critical to the protection of the decontaminated items.

Estates and facilities

2.26 Staff may be engaged in welding, soldering, machining wood or paint- spraying. They may also decant chemicals in quantity (for example, for boiler treatment or hydrotherapy-pool dosage). LEV systems are routinely used to control the hazards arising.

3. Legal Requirements – Applicable Legislation

Health and Safety at Work etc. Act

3.1 The Health and Safety at Work etc. Act 1974 is the core legislation that applies to ventilation installations. As these installations are intended to prevent contamination, closely control the environment, dilute contaminants or contain hazards, their very presence indicates that potential risks to health have been identified.

3.2 The Act places a duty of care on ALL to provide and maintain a safe workplace. This includes designers and suppliers of goods or services. Those trading as competent designers or suppliers are therefore liable to provide outcomes that meet the client's needs and are without hazard to staff, patients and others who may be affected by the work activity.

Control of Substances Hazardous to Health Regulations

3.3 The Control of Substances Hazardous to Health (COSHH) Regulations 2002 place upon management an obligation to ensure that control measures are in place to protect their staff and others affected by the work activity. These methods may include both safe systems of work and the provision of a specialised ventilation system. In laboratories the requirements are often met by the provision of fume cupboards and microbiological safety cabinets.

3.4 Where specialised ventilation plant is provided as part of the control measures, there is a statutory requirement that it be correctly designed, installed, commissioned, operated and maintained. The local exhaust ventilation (LEV) section of COSHH requires that the system be examined and tested at least every 14 months by a competent person (P601 certified) and that management maintain comprehensive records of its performance, repair and maintenance.

3.5 Certain substances have workplace exposure limits (WELs) as set out in the Health and Safety Executive's (2005) Guidance Note EH40 – 'Workplace exposure limits'. This contains the list of workplace exposure limits for use with the Control of Substances Hazardous to Health Regulations 2002 (as amended). If specialised ventilation systems are provided in order to achieve these standards, they will be subject to the COSHH Regulations.

Workplace (Health, Safety and Welfare) Regulations

3.6 These state that:

- all enclosed workplaces must be ventilated by natural or artificial means;
- any plant provided under this legislation must include an effective device to give an audible or visual warning of plant failure where necessary for health and safety;
- the Regulations require that ventilation systems are maintained in an efficient state, in efficient working order and in good repair.

The Building Regulations

3.7 Approved documents L and F:

- apply to domestic and non-domestic buildings;
- clarify satisfactory methods of providing ventilation and give ventilation rates;
- set minimum standards for:
  - the protection of the supply position;
  - precautions against *Legionella;*
  - the purity of recirculated air;
  - access for service and maintenance;
  - documentation and proof of performance;
  - energy performance.

Health and Social Care Act 2008 (Regulated Activities)

Regulations 2014

3.8 Regulation 12(2)(h) of the Act decrees that registered providers must assess the risk of, and prevent, detect and control the spread of, infections, including those that are healthcare associated.

3.9 Appropriate standards of cleanliness and hygiene should be maintained in premises used for the regulated activity. DH (2015) issued 'The Health and Social Care Act 2008 Code of Practice on the prevention and control of infections and related guidance' (the HCAI Code of Practice), which contains statutory guidance about compliance with regulation 12(2)(h).

3.10 Regulation 15 of the Act states that:

All premises and equipment used by the service provider must be:

- clean;
- secure;
- suitable for the purpose for which they are being used;
- properly used;
- properly maintained; and
- appropriately located for the purpose for which they are being used.

The registered person must, in relation to such premises and equipment, maintain standards of hygiene appropriate for the purposes for which they are being used.

Note: The "registered person" means, in respect of a regulated activity, the person who is the service provider or a registered manager in respect of that activity. A "service provider" means a person registered with the CQC under Chapter 2 of Part 1 of the Health and Social Care Act 2008 as a service provider in respect of that regulated activity.

The Medicines Act 1968 and Human Medicines Regulations 2012

3.11 Pharmacy aseptic preparation facilities should conform to the requirements of EudralLex – Volume 4 – Good Manufacturing Practice (GMP) guidelines or equivalent UK legislation, and the requirements of the UK Medicines Inspectorate (MHRA) if a licensed manufacturing unit.

3.12 There are specific requirements under the Medicines Act 1968 to maintain accurate records of plant performance, room conditions and maintenance events. Such records would need to be preserved for up to 25 years as part of a quality assurance audit trail.

3.13 Specialised ventilation plant installed in laboratories dealing with research, development or testing, whether involving drugs, animals or genetically modified microorganisms, may be subject to legislation regarding their operation in addition to that mentioned above.

Indoor air quality (IAQ)

3.14 There is increasing awareness that IAQ has an important impact on health and well-being. The World Health Organization and the Royal College of Paediatrics and Child Health (2020) have produced papers on the importance of IAQ, and the National Institute for Health and Care Excellence (NICE) (2020) has issued guidelines for domestic environments. Indoor and outdoor sources of contaminants are important contributors to IAQ, and designers of ventilation systems should consider both. The Department for Environment, Food and Rural Affairs (Defra) gives data for outdoor air quality by postcode for the UK. This enables designers to choose suitable filter grades by location and application (see the Specialised Ventilation for Healthcare Society's (2018) SVHSoc.02 – 'Change in air filter test and classification standards' for further information).

Other relevant standards and sources of guidance

3.15 The Chartered Institution of Building Services Engineers (CIBSE) Guides and associated published documents (TMs) are the principal source of general ventilation specification and design guidance.

3.16 ISO 14644 and ISO 17141 provide basic information on cleanrooms used in pharmacy preparation facilities and inspection, assembly and packing (IAP) rooms for the processing of medical devices in central decontamination units.

3.17 BS EN 15780 applies to both new and existing ventilation and air-conditioning systems and specifies the assessment criteria of cleanliness and cleaning procedures of these systems.

3.18 HSG 258 issued by the Health & Safety Executive provides guidance on the design of local exhaust ventilation (LEV) systems.

3.19 Other relevant guidance is listed in the References.

3.20 The Board and their supply chain must ensure that the competence of all parties is considered at the point of their introduction and on an ongoing basis. The philosophies that are included in the HSE leaflet INDG368 (current revision), "Using Contractors" should be adopted. In addition, the outputs from the "Setting the Bar" report should be adopted as they are introduced through legislation. Evidence that the recommendations of "Setting the Bar" are being implemented in advance of the legislation would be considered to be good practice, particularly for high risk buildings. BSI Flex 8670 “Built environment. Core criteria for building safety in competence frameworks. Code of practice” should also form part of the project planning.

Note: In all cases the most recent version of any legislation, regulation, standard or guidance document should be consulted.

4. The Design and Specification Process

Project brief

4.1 The ventilation aspects of a contract will normally form part of a wider project to provide, upgrade or replace a healthcare facility. It is important that the ventilation designer closely liaises with the architect, as the layout of the facility and the adjacency of spaces within it will have a major impact on the ability of the ventilation system to achieve the client's requirements. All new major projects are required to use building information modelling (BIM) in order to ensure a coordinated design and provide information for the subsequent operation and possible future development of the facility.

4.2 The Building Services Research and Information Association (BSRIA) has produced an approach to project delivery known as "Soft landings" (BSRIA, 2018). It aims to ensure that the client's success criterion is kept in focus during the inception and briefing, design, construction, pre-handover, initial aftercare and extended aftercare phases of a project. It is strongly recommended that the client and project contractor adopt this approach.

Basis of design

4.3 This SHTM assumes that designers will be familiar with current CIBSE guidance and will use it as the basis for specifying and designing ventilation systems. However, the actual guidance contained in this SHTM may differ from the CIBSE guidance due to healthcare-specific issues and will take precedence over the CIBSE guidance where there are conflicts.

Note: Scottish Health Technical Memorandum 03- 01 Parts A and B need to be read and considered in their entirety when specifying and designing ventilation systems to ensure that the end result will comply with the client's needs.

Ventilation Safety Group (VSG)

4.4 The management of the ventilation systems of a healthcare provider should be overseen by a Ventilation Safety Group (VSG). The VSG should have clearly defined roles and responsibilities, be part of a healthcare organisation's governance structure and report to the "Designated Person" at Board level. It should be led and chaired by a person who has appropriate management responsibility, knowledge, competence and experience (for example, the Designated Person). (See Chapter 2 in Part B of Health Technical Memorandum 03-01 for further information.)

4.5 The VSG should be a multidisciplinary group and should typically comprise:

- an Authorising Engineer/independent adviser for ventilation (AE(V));
- an Infection Prevention and Control person;
- the Authorised Person(s) for ventilation services (AP(V));
- estates (operations and projects) staff;

- clinicians and specialist departments (for example, theatres, critical care areas, pharmacy, medical microbiology, nursing, decontamination);
- personnel from the finance department with accountability for capital and revenue evaluation;
- other stakeholders as appropriate;
- coopted expertise (for example, ventilation designers, consultants and suppliers).

4.6 The VSG remit should be to assess all aspects of ventilation safety and resilience required for the safe development and operation of healthcare premises. It should inform the following areas:

- the design process for new healthcare premises;
- the design process for modifications to existing premises;
- the commissioning and validation process;
- operational management and maintenance;
- annual verification and performance testing;
- prioritising the plant replacement programme;
- decommissioning and removal of redundant equipment.

Note: Where estates and facilities provider services are part of a contract (including PFI), it is essential that these providers participate fully in all those aspects of estate and facilities management that can affect patients. This includes responding to specific requests from the VSG, which may be in addition to relevant guidance and documentation.

4.7 It is important that decisions affecting the resilience, safety and integrity of the ventilation systems and associated equipment are not taken without the agreement of the VSG. The VSG should ensure that appropriate expertise and competence is available when making such decisions.

4.8 Whenever significant building work is undertaken; the VSG should consider its effects on the existing ventilation system air intakes. These may need to be protected from airborne dust during construction by the fitting of temporary additional filtration. There will also be a need to identify any risks to construction personnel who may be working in the vicinity of extract air discharges.

4.9 When construction or alteration work is undertaken inside an occupied building, its effects on the occupiers should be considered. The VSG should be consulted, and they may require that the area be sealed off from the occupied parts of the building and that a temporary extract be provided to maintain the worksite at a negative pressure to prevent the spread of dust into the rest of the building.

Derogations and alternative design strategies

4.10 Any derogations or alternative design strategies from this guidance should be subject to the scrutiny and agreement in writing by the VSG. The reason for the derogation or alternative design strategy and limits to its application should be recorded.

4.11 Designers proposing a derogation or alternative design strategy should be able to supply a body of evidence that their proposal will provide a degree of safety no less than if the guidance in this document had been followed.

Definition of clinical areas and critical systems

4.12 Healthcare ventilation may serve clinical or non-clinical areas of the estate:

- clinical areas are defined as spaces within the building where surgical or medical treatment is administered to patients. This includes patient bedrooms;
- non-clinical areas are defined as spaces where patients may be present but are not under direct treatment. It also includes staff and healthcare services areas.

4.13 Certain clinical and non-clinical areas within a healthcare establishment are considered critical to its ability to provide healthcare. Typically, ventilation systems serving the following are considered critical:

- operating suites of any type including rooms used for image-guided surgical procedures and their recovery areas;
- airborne isolation facilities, both source and protective;
- critical care areas and neonatal units;
- invasive treatment, endoscopy and bronchoscopy rooms;
- containment level 3 laboratory;
- pharmacy aseptic preparation facility;
- inspection, assembly and packing (IAP) room in a central decontamination unit;
- MRI, CAT and other types of emerging imaging technologies that require particularly stable environmental conditions to remain within calibration;
- any system classified as an LEV system under the COSHH Regulations;
- any other system that clearly meets the definition that “a loss of service from such a system would seriously degrade the ability of the premises to deliver optimal healthcare”.

Note: If any doubt exists about whether a system falls within this definition, the VSG should be consulted regarding the risk to patient safety and business continuity.

Resilience and diversity

4.14 When planning the ventilation of healthcare facilities, it is important at the outset to consider how the service will be delivered if the installed ventilation system fails or the area served has to close due to the effects of fire, flood or an outbreak of

infection. The loss of power, primary heating or cooling medium, or an integrated control system can cause the loss of ventilation to an area, so subsystem resilience is an important consideration.

4.15 Resilience in critical healthcare areas can be provided by splitting the ventilation load between two or more AHUs and/or employing a design that allows two or more AHUs to feed a common plenum with isolation dampers on individual branches to each critical zone. (Note that it is not proposed that duplicate back-up units be provided.) As an example, a large critical care area (CCA) level 2 or 3 could be split into two sections with an AHU for each. A small CCA cannot easily be split, so a decant area with a suitable level of ventilation should be pre-designated.

4.16 Diversity can be achieved by having several facilities each served by its own AHU. As an example, in an operating department, if each theatre suite is fed from its own dedicated AHU, the loss of one suite, while inconvenient, will not shut the department. The same scenario applies to isolation rooms if several of them are each independently ventilated (see Health Building Note 04-01 for further information).

Note: Providing twin ventilation fans in an AHU delays the time at which the system needs to be completely shut down in the event of a fan failure. It does not in itself provide resilience in terms of delivering healthcare (see Chapter 9 for further guidance).

New build facilities

4.17 New build healthcare facilities must be fully compliant with the requirements of all legislation in force at a date agreed when signing the contract. They should comply with the guidance contained in the current SHTM unless a derogation has been agreed with the VSG (see paragraphs 4.10 and 4.11).

Assessment of service requirements: selection of design criteria

External design conditions

4.18 The most accurate data that is available for the summer and winter conditions at the site should be used. The Meteorological Office supplies data for the United Kingdom; data is also available from CIBSE and other sources. It is essential that the designer agrees with the client as to which source of data is used and the design risk associated with the chosen external design conditions.

Note: It is essential to design to future climate projection to ensure design temperatures are maintained even in the event of prolonged heatwave conditions. CIBSE (2014) publishes design summer year weather files morphed to reflect future climate change.

4.19 Local adjustments for height above sea level, exposure factor, or other local climate peculiarities should be made as appropriate.

Internal design conditions

4.20 The design conditions selected within patient areas should strike a balance between the comfort requirements of staff and patients, who often have very different levels of clothing and activity.

4.21 Recommendations for the operative temperature and humidity of individual spaces are given in Activity Data A-Sheets (see Chapter 8 for specific requirements). Particular departmental requirements are given in the respective SHPN/HBN and room data sheets. However, the determination of the room environment must be driven by the patient cohort plus the range of procedures envisaged for that room.

Minimum fresh air requirements

4.22 In general areas and wards within healthcare premises, odour control is the main reason for providing ventilation. In the absence of other guidance, 10 L/s/person should be taken as the minimum ventilation requirement. Healthcare ventilation systems will normally be “full fresh air” either by natural, mixed mode or mechanical means, with energy recovery from the extracted air.

4.23 In non-clinical areas recirculated air systems may be considered. At least 20% of the recirculated air should be fresh. Additional filtration will be required to remove airborne particulate contamination and, if necessary, odours. This will affect running and maintenance costs and, given the high ErP rating of heat recovery devices, it will be necessary to prove that recirculating the air will be more energy- efficient overall.

Note: Ultra clean ventilated (UCV) operating theatres use air recirculation. The fresh air requirements of this specific application are given in Chapters 8 and 9.

4.24 Smoking is generally not permitted in healthcare premises, so no allowance need be made. Reference should be made to local national policy guidance.

4.25 In treatment and support areas the overriding requirement may be due to airborne infection control, hazard containment, the stability of specialist equipment or relate to a specific department’s function. Each case should be considered independently in order to determine the overriding minimum requirement for ventilation (see Chapter 8 for specific guidance).

Limiting supply air conditions

4.26 For most applications in healthcare buildings, it is the temperature differential between the supply and room air, rather than the actual temperature of the supply air, which is the critical factor. The maximum recommended supply-to-room air temperature differential is:

- summer cooling: 7 K
- winter heating: 10 K

4.27 Room air humidity should be kept below 70% in order to minimise risks associated with condensation and mould growth. There is no lower limit in unoccupied spaces.

4.28 Some types of diagnostic imaging technologies require close control of both temperature and humidity as well as the rate of change of conditions to ensure clarity of the image and accuracy of the data generated. The manufacturer’s guidance should be followed.

Air purity

4.29 In healthcare premises, the standard of filtration will depend on the activities within the occupied spaces. Except for special areas (for example, manufacturing pharmacies), the requirement for aerobiological needs is not stringent and filtration is only required to:

- maintain hygienic conditions for the health and welfare of occupants, or for processes such as centralised food preparation facilities;
- protect finishes, fabrics and furnishings – to reduce redecoration costs;
- protect equipment either within the supply air system – to prevent blocking of coils – or in the space itself to prevent dust accumulation

4.30 Given that almost all viable particles will originate from the occupants of a space and not from the incoming air, dilution is the more important factor aerobiologically. Therefore, for general areas an ISO ePM 2.5 ≥55% filter may be suitable. More critical areas would require an ISO ePM1 ≥50% filter. Efficiency or high-efficiency (EPA or HEPA) filters will only normally be required in ultra-clean systems, designated “cleanrooms” (see Chapter 9 for specific information) or for some immune-suppressed patient areas

4.31 In some inner-city areas the local airborne particulate level may be particularly high. In those special cases filters to ISO ePM1 ≥50% may be required to achieve the required indoor air quality. (See Defra’s website and the Specialised Ventilation for Healthcare Society’s (2018) SVHSoc.02 – ‘Change in air filter test and classification standards’.)

Humidity control requirements

4.32 Close control of humidification was originally required for some healthcare applications (for example, operating theatres) in order to control the risk associated with the use of flammable anaesthetic gases. The use of such gases has now ceased.

4.33 Providing humidification is expensive in terms of plant, running costs and maintenance, and therefore its use should be restricted to where it is necessary for physiological or operational reasons (see Chapter 8 and associated SHPNs/HBNs).

4.34 In general terms the humidity within an occupied building or space will naturally float between 30% and 70% RH (relative humidity). Humidity should not be allowed to rise above 70% at any time but there is no need to maintain a background minimum level when the building or space is unoccupied.

Maximum noise levels

4.35 Noise will be generated in an air distribution system by the fan, ductwork fittings, dampers and grilles. The specified maximum noise level will depend on the activities within the occupied spaces.

4.36 Attenuation should be incorporated into the ductwork system or plant arrangement as necessary to reduce noise from fans and plant items in order to achieve the acceptable limits within the rooms at the design airflows.

4.37 Plant room noise level from fans when starting up or running should not be greater than 80 dB(A), and should be reduced where the plant is near to departments sensitive to noise.

4.38 Attention should be given to the reduction of tonal components. High tonal components from air diffusers etc. can seriously disturb concentration over longer periods even when the overall noise level is low. Broadband noise causes less annoyance.

4.39 The values recommended in Table 1 are for the total noise environment of space. In general, there will be noise transmitted into the space and noise generated within the space. The designer requires knowledge of the total hospital layout and operational policies, to assign acceptance magnitudes to all the possible noise sources, in order to arrive at the correct rating.

4.40 In Table 1 the overall noise level takes account of all internal and external noise sources. The noise level is the level measured with a sound-level meter in the unoccupied room, taking account of the external noise together with the noise generated by the ventilation system. The ventilation plant design noise level is that generated by the plant alone with no other noise source being considered. The levels suggested make recognised allowance for the ingress of environmental noise which will have to be considered in the overall design, that is, in specifying the attenuation of walls, partitions, ceilings, etc.

Table 1: Interior Noise Level

Area	Room: overall noise level – dB(A)	Ventilation design value – dB(A)
Operating department all rooms including preparation, anaesthetic, scrub and utility, interventional and diagnostic imaging departments – all rooms	48	Operating department all rooms including preparation, anaesthetic, scrub and utility, interventional and diagnostic imaging departments – all rooms
UCV operating theatre and adjacent open- plan scrub only	53	–
Treatment rooms Consulting rooms Sleeping areas/rooms Recovery rooms	35	Treatment rooms Consulting rooms Sleeping areas/rooms Recovery rooms
Sanitary facilities	45	40
Aseptic preparation facility	45	40
Industrial areas	50	45
Circulation waiting areas	50	45
Plantrooms	85	80

4.41 The recommended criterion is measured as the “A” weighted sound pressure level expressed in decibels, which should not be exceeded for more than 10% of the time. See Scottish Health Technical Memorandum 08-01 – ‘Acoustics’ for further information.

4.42 The designer should also consider noise escaping to the external environment and this should not be unacceptable to occupants of adjacent buildings.

Calculation of building loads

Air infiltration

4.43 Air infiltration occurs due to a complex combination of wind pressure, thermal effects, location relative to other features and the construction standard of the building. The infiltration rate is governed by the size and number of doors and other openings in the building envelope and the complexity of internal air paths.

4.44 CIBSE guide TM52 provides information and formulae for the calculation of air infiltration in buildings. In all cases the requirements of the appropriate section of the current Building Regulations Part L (airtightness minimum requirements) must be met.

Summertime temperatures

4.45 To prevent overheating and avoid the future need for portable room air- conditioners, thermal modelling should be undertaken to ensure that internal temperatures in all areas do not exceed CIBSE Guide A guidance. Thermal modelling should be carried out whether the space is ventilated by natural, mixed mode or mechanical means. The modelling should be undertaken by a competent software user and take into account not only absolute values but also the time component.

4.46 Where thermal modelling indicates internal temperatures will exceed the recommended levels defined in CIBSE Guide A, additional measures should be explored to achieve compliance such as reducing solar and casual gains, improving building fabric performance, etc.

Peak heating load

4.47 Peak heating local calculations are necessary on all mechanical supply systems to establish the size of heater-batteries and subsequently the central plant. Note that with the introduction of the requirement to fit energy recovery set out in EU 1253, the heater-battery size will be reduced. If the energy-recovery value is ignored, the heater-battery and its control valve will be oversized and the system when put to use will be unstable and liable to hunt.

4.48 Where ventilation systems provide tempered air to spaces which have supplementary low pressure hot water (LPHW) to offset the building fabric losses, the AHU heating load should be calculated based on the external winter design temperature, the design internal air temperature, and the calculated total air volume (including a suitable allowance for leakage).

4.49 Where the ventilation system is the only means of heating a space, an increase in load equivalent to the calculated fabric heat losses from the space should be added to the ventilation load. A check of supply temperature difference should be made. If it exceeds that recommended in paragraph 4.26 the ventilation supply volume should be increased to suit.

Peak cooling load

4.50 In addition to the base data of airflow rates and temperatures, when calculating cooling loads, the designer should take into account:

- solar cooling loads;

- surface conduction cooling loads;
- internal gain cooling loads;
- air infiltration cooling loads;
- cooling loads due to high limit humidity control;
- method of control of internal conditions;
- fluctuations in internal temperatures.

Allowances must be made for all medical equipment in every space. Where the final item has not yet been selected, a unit that is reflective of the needs must be agreed with the stakeholders. A record must be included in the design documentation as to the unit which has been included in the design and the impact on all MEP systems of this unit. The stakeholders must have access to this data to ensure the compatibility of equipment and MEP systems can be checked against final medical equipment selections.

4.51 When the peak internal loads have been assessed and a suitable allowance made for non-coincidence, the supply temperature can be calculated.

4.52 Once the lowest required supply temperature of the air handling unit has been established, and an allowance made for temperature rise through the fan and ductwork (usually 1 K for low pressure systems), the off-plant enthalpy can be established from a psychrometric chart or table.

4.53 The cooling loads for all plant on the chilled water system should be calculated at each of the individual peak times in order to accurately establish the required (diversified) capacity of the chiller.

Note: Note that as with heating, the introduction of the requirement to fit energy recovery set out in EU 1253 means that the cooling-coil size will be reduced. If the energy-recovery value is ignored, the cooling coil and its control valve will be oversized and the system when put to use will be unstable and liable to hunt.

Annual energy consumption

4.54 The annual energy consumption of simple heating-only ventilation systems is simple to calculate, based on supply to external air temperature rise, and frequency of occurrence of external temperature data (see CIBSE Guide A).

4.55 Minimum air volumes are usually fixed by the room loads or fresh air requirements; however, the designer may increase airflow to some rooms or zones in order to balance loads, as detailed in paragraphs 4.63–4.68

4.56 The method of zoning and control can significantly influence energy consumption.

4.57 The nature of air-conditioning operation, that is, cooling and reheating for humidity or zonal temperature control, makes prediction of energy consumption very complex. It is imperative that these calculations are performed to ensure optimum energy efficiency.

4.58 The concept of load and plant operation charts is outlined in the CIBSE Guide TM52. The method requires the designer to establish the minimum and maximum loads on

all zones across the range of external temperatures between winter and summer design conditions. The total coil loads can be calculated taking account of the external air temperature and humidity plus the supply air conditions.

4.59 When all temperatures/enthalpies for all zones are plotted on the plant operation chart, set points and resetting schedules can be established. From this information, the outputs of individual heaters, coolers and humidifiers can be established at any given external condition. When those loads are computed against annual frequency of occurrence of external conditions as given in CIBSE Guide TM52, the annual energy consumption of individual elements, and thus the air-conditioning system, can be established.

4.60 In order to prevent surface condensation occurring, it is necessary to provide enough ventilation to maintain the maximum and ambient dew-point temperature below the lowest surface temperature, the coldest usually being the glazing.

4.61 Where this would require excessive ventilation levels, the designer should consider removal of the moisture at the source of the evaporation via an exhaust hood or similar device.

4.62 In intermittently heated buildings, it is necessary to consider the condensation risk at night set-back conditions as well as during normal operation. Calculation methods for this assessment are given in CIBSE Guide A.

Calculation of plant requirements

Air supply volumes

4.63 The minimum air supply volume for a room is determined by the greatest of:

- the minimum fresh air requirement;
- the air required to achieve the room differential pressure and provide open door protection at the key door;
- the minimum supply volume for the room load as determined by the maximum heating or cooling supply temperature differential;
- the desired air-change rate;
- the make-up air for a local extract (for example, cooker hood or LEV system).

Plant sizing

4.64 Once the design airflow has been established, the cross-sectional area of the air-handling unit can be calculated based on values given in Commission Regulation EU 1253/2014.

4.65 The fan duty should be calculated by adding the resistances of all elements that contribute to the pressure drop of the index circuit.

4.66 In order to establish the length of the AHU, it will be necessary to refer to manufacturers' literature, ensuring all necessary access panels and components are included as detailed in Chapter 9.

4.67 The designer should ensure that an allowance has been made for “dirty filter” conditions and confirm whether the fan pressure quoted is the total or static pressure.

4.68 Upon completion of the resistance calculation exercise, the designer should make allowances for calculation and construction tolerances as indicated below:

Total pressure loss margin:

- for leakage and balancing requirement =+5%
- for uncertainties in calculation = +5%

Combined total pressure loss margin =+10%.

Note: All installed ductwork whether new or reused should be subject to a leakage test on site prior to the application of any insulation. The leakage test should be to BESA DW144 but with a permissible leakage rate of not greater than 3%.

Refurbishment of existing facilities and fitting out shell schemes

4.69 When refurbishing existing facilities or fitting out “shell” schemes, every effort should be made to achieve full compliance with this SHTM and current Scottish Health Planning Notes (SHPNs). It is important that use of the space is revisited at this stage. Patient cohort, forms of treatment and all other stakeholder requirements must be compared to the capabilities of any existing system/plant and adjustments made to suit.

4.70 The physical constraints of the building may mean that some derogation in terms of layout and room dimensions are unavoidable, but it is vital that the infection control aspects, clean airflow paths, cascade of air from clean to less clean areas and fire and smoke requirements are not compromised and that the complete facility will be fit for purpose. The VSG should be consulted and agree in writing to any derogations.

4.71 A new AHU fully compliant with current standards will normally be required. The existing AHU should only be retained if it is not more than 10 years old and is (or can be made) fully compliant with current standards.

Note: The application of the ErP regulations may mean that new plant could be physically larger than that previously installed. If the replacement plant cannot be accommodated in the existing plant space, the plantroom may need to be expanded or a new plant space created. It may be that reconsidering how the ventilation load is determined, whether it can be shared, which type of AHU configuration will fulfill the design need, etc., will provide a satisfactory solution rather than just specifying like-for-like replacement plant.

4.72 The most commonly used original standard operating theatre design solutions from previous versions of this HTM have been revised and updated (see Appendix 7). They have been retained in this guidance as they will remain applicable to older theatre suites that are being refurbished within their original footprint. They may also be applicable where a pre-built “shell” is being fitted out.

Change of use of existing facilities

4.73 When a change of use of existing facilities is contemplated, the ventilation requirement should be completely revised to suit the new use (see paragraphs 4.63 and 4.69). All requirements must be agreed with the Ventilation Safety Group.

4.74 A new AHU fully compliant with current standards will normally be required. The existing AHU should only be retained if it is not more than 10 years old and is (or can be made) fully compliant with current standards.

4.75 If the ventilation load is to be increased or reduced and the existing system is retained, its output should be adjusted to suit. This will necessitate a recalculation of the heater and cooler loads and resizing of the control valves to match the new loads. It may also necessitate a change in fan size. Failure to carry out this exercise will carry an energy penalty and loss of control function.

4.76 The area/zone fire strategy should be reassessed to suit the new layout and purpose.

Computer-aided design (CAD) and building information modelling (BIM)

4.77 The design of new ventilation systems should be created using a CAD package, and the information generated should be incorporated into the BIM for the project. The client should have access to the BIM model as the project progresses; it will be transferred over to the client on completion (see paragraph 13.28 onwards)

5. Ventilation Strategies

5.1 In order to reduce energy costs and provide a more sustainable healthcare estate and support the declared zero- carbon target, ventilation selection should be as follows:

- first choice – natural ventilation;
- second choice – mixed mode ventilation;
- final option – mechanical ventilation.

Natural ventilation

5.2 Natural ventilation is usually created by the effects of wind pressure. It will also occur if there is a temperature difference between the inside and the outside of a building. The “thermo-convective” effect frequently predominates when the wind speed is low, and will be enhanced if there is a difference in height between inlet and outlet openings.

5.3 Ventilation induced by wind pressures can induce high air-change rates through a building, provided air is allowed to move freely within the space from the windward to the leeward side. However, in most healthcare applications, internal subdivisions will restrict or prevent this effect.

5.4 Current guidance restricts the opening of windows for safety reasons; also, as many designs are top-hung, their ability to permit natural ventilation is limited. Some types of window (for example, vertical sliding) can enhance single-sided air change by temperature difference, and these will improve the overall rate of natural ventilation in protected or sheltered areas where the effect of wind pressure is likely to be minimal.

5.5 Current healthcare building design philosophy suggests that windows are provided to allow light into and a view out of a healthcare building. Ventilation should be provided by purpose-made openings with appropriate consideration for thermal comfort and air quality. The airflow may need to be controlled by motorised dampers linked to temperature and/or occupancy sensors in the ventilated space.

Note: Natural cross-flow ventilation can provide reasonable air distribution for a distance of up to 6 m inwards from the external facade, provided that reasonably clear air paths are maintained. Beyond this distance – in areas where clear air paths cannot be maintained and in areas where high minimum air-change rates are specified – mechanical ventilation should be provided.

If natural ventilation is single-sided, it will usually only be effective for a 3 m depth within the space. Beyond that it should be supplemented by mixed- mode or mechanical ventilation.

5.6 With natural ventilation, it is almost impossible to maintain consistent flow rates and ensure that minimum ventilation rates will be achieved at all times. However, this variability is normally acceptable in non-clinical spaces such as office accommodation, staff areas, library/seminar rooms and dining rooms, and some

clinical areas such as level 0 and 1 care spaces and waiting and consulting rooms where risk of airborne infections is likely to be low. The design must still aim to achieve agreed limits for room temperatures and, for clinical areas, achieve the desired room air change rate with “thermo-convective” effect (at peak room temperature coincident with summer external design temperature). Where it is essential to achieve a minimum ventilation rate at all times, mixed mode or mechanical methods will be needed.

5.7 Constraints caused by a building’s shape and/or the functional relationships of specific areas will inevitably result in some measure of deep planning, thus reducing the opportunity for natural ventilation.

5.8 In all cases, for natural ventilation to be effective it will be necessary to take steps to reduce any solar gain to a minimum. Outdoor air-quality, excessive heat gain, indoor air-quality requirements or external noise are all factors that may limit or preclude the use of natural ventilation.

5.9 Further information can be found in Health Building Note 00-10 Part D – ‘Windows’, BS 5925 and CIBSE’s Applications Manual AM10 – ‘Natural ventilation in non-domestic buildings’.

Mixed mode ventilation

5.10 Mixed mode ventilation is an assisted form of natural ventilation. Fans are fitted in purpose-made damper-controlled ventilation openings. Alternatively, a separate draw- or blow-through ventilation unit may be installed. In both cases the dampers and fans are controlled by temperature and occupancy sensors to ensure a minimum airflow rate while taking advantage of natural ventilation effects when present.

5.11 Where natural or mixed mode ventilation is adopted with complex air paths, the designer should produce an airflow diagram in order to ensure correct provision of air-transfer devices. CIBSE’s Applications Manual AM13 – ‘Mixed mode ventilation’ gives guidance. Modelling of the airflows under a range of conditions should be undertaken to establish the airflow paths.

Mechanical ventilation

Central versus local plant

5.12 Mechanical ventilation is expensive so it should only be provided when the space being served requires close control of its environmental conditions.

5.13 If the ventilation loads throughout a department or building are in phase, or are not significant, a central plant with single zone control may be adopted. However, this is rarely the case, so the condition or quantity of supply air to different areas or zones of the building will be varied accordingly. This may be achieved by either providing individual plant to each zone or providing separate controls for each zone such as provided by a variable air volume (VAV) system. Where there is a high density of rooms with similar ventilation requirements in an area of a building or department, it is usually economical to combine them into a central system; however, the operational resilience should be considered.

5.14 In large buildings, a choice between a small number of large ventilation systems located in centralised plant areas, or a larger number of smaller locally distributed systems, may arise

5.15 Large distribution systems and their plant can have the advantage of lower capital costs, but because they operate to a fixed supply condition, reheating or cooling may be locally required which will reduce energy efficiency. The distribution system will require more space for vertical shafts. In general, very long runs of ducting should be avoided to prevent undue heat losses or gains, excessive leakage and difficulties in balancing during commissioning. As the pressure losses in the long runs will be greater and a higher initial static pressure will be required, this may lead to a more expensive class of ductwork.

5.16 Decentralised AHUs feeding multiple smaller distribution systems may be more expensive in capital costs but as they avoid long runs, large ducts and vertical shafts, this may reduce overall costs. They can provide a more robust service, as the failure of an individual system does not prevent the use of the rest of the building. Future refurbishment or replacement of AHUs is also simpler. See also Chapters 4 and 9.

Horizontal and vertical AHUs

5.17 AHUs may be configured as horizontal or linear units that are single or double-stacked in the case of combined supply and extract units. They may also be configured more compactly as vertical or cabinet-style units. Selection will be dependent on the plant space available and where the unit is to be located. Whichever style is selected, good access for service and maintenance is essential. See legal requirements in paragraphs 3.6 and 3.10.

Chilled beams

5.18 Active chilled beams can provide an energy-efficient means of controlling environmental conditions. They are, however, subject to increased maintenance requirements due to the need for regular cleaning if they are to remain working efficiently. Access for this will not pose problems in non-clinical and office areas, but in clinical areas and patient bedrooms, routine access will be a major problem in an operational hospital.

5.19 Chilled beams should not be installed in clinical areas without the agreement in writing of the VSG.

Note: Patient bedrooms are classed as clinical areas as treatment is often delivered at the bedside rather than in a designated treatment room.

5.20 Where chilled beams are installed in non-clinical areas, they should be positioned to ensure that cold draughts are avoided.

5.21 In order to avoid condensation on the beam coils and the potential for mould growth, the temperature of the secondary chilled water circuit needs to be kept above dew-point (usually 15ºC). With active beams the supply air may, under some outside air conditions, need to be dehumidified. Manufacturers of these devices can provide specific advice on the design limits and siting of their equipment.

5.22 Where chilled beams are installed in rooms with opening windows, the window should be fitted with a switch to automatically turn off the beam when the window is open. To avoid condensation, chilled beams should not be installed in entry lobbies that directly connect to the outdoors.

5.23 Active and passive chilled beams require regular cleaning if they are to remain efficient. They should be of a design that allows full access to the beam coils for cleaning and be positioned where they will be accessible for maintenance and not installed above fixed items of equipment.

5.24 There is no benefit in installing chilled beams if the resources to keep them in efficient working order over their entire life cycle will not be available. The maintenance aspects of using chilled beams should be discussed and the decision to use them agreed in writing with the client.

Note: Maintenance access to chilled beams will require the use of pulpit steps or wheel-around access equipment. The use of such equipment in a working hospital is very restricted.

Stand-alone air-conditioners

5.25 Stand-alone air conditioners include fan coil units, split-comfort air-conditioners, room conditioners and cassette units. All of these devices recirculate air which affects indoor air quality and may increase the risk of healthcare-associated infections (HAIs). Therefore, they should not be installed in clinical areas.

Note: Patient bedrooms are classed as clinical areas as treatment is often delivered at the bedside rather than in a designated treatment room.

5.26 Stand-alone air conditioners may be installed in suitable non-clinical areas, but they should be positioned to ensure that cold draughts are avoided. The control settings should ensure that the external elements of the units are always above dew-point. Manufacturers of these devices can provide specific advice on the siting and design limits of their equipment.

5.27 Stand-alone air-conditioners recirculate air, therefore, a primary fresh air supply of at least 20% of the room air-change rate, or that required by the Building Regulations, or 10 L/s/person − whichever is the greatest − should be provided.

5.28 Whether single or multiple systems are used, it is essential that the designer give due consideration to the source of electrical supply, location of the heat rejection unit, environmental effects and flammability of the refrigerant used, and drainage provision for the cooling-coil condensate.

5.29 Stand-alone air conditioners require regular cleaning if they are to remain efficient and not become a source of airborne bio-hazards. If they incorporate an open water drainage system, they must be risk assessed under L8/HSG274 as part of the Legionella assessment (see the Health & Safety Executive's (HSE) Approved Code of Practice and guidance document HSG274 'Legionnaires' disease: the control of Legionella bacteria in water systems'). They should be easily accessible for maintenance and should not be installed above fixed items of equipment which would make access difficult.

Notes: Maintenance access to stand-alone air-conditioners will require the use of pulpit steps or wheel-around access equipment. The use of such equipment in a working hospital is very restricted.

Traditional refrigerants are being phased down because of their effects on the environment and are becoming ever more expensive. Their replacements at the time of writing have a degree of flammability. Both these factors pose serious consideration as to whether stand-alone air-conditioners are suitable devices to choose. In scanning and control equipment rooms, the use of chilled racks, shelves and embedded panels supplied with water above dew- point would be a more suitable option.

Where the refrigerant pipework is located must be checked against the need to restrict risk. This may necessitate the need for refrigerant gas monitoring. The requirement must be checked during the design (refer to BS EN 378, using the relevant current edition for the application).

System selection

5.30 Natural ventilation is always the preferred solution for a space, provided that the quantity and quality of air required, and consistency of control to suit the requirements of the space, are achievable. This should also take account of the guidance from the WHO (Natural Ventilation for Infection Control in Health-Care Settings). If this is not the case, mixed mode or a mechanical ventilation system will be required.

5.31 Ventilation costs can be minimised by ensuring that, where practicable, core areas are reserved for those rooms that need to have mechanical ventilation. Examples are:

- sanitary facilities, dirty utilities and those rooms where clinical or
- functional requirements have specific environmental needs; and
- those rooms where – for reasons of privacy, absence of solar gain, etc. – windowless accommodation is acceptable.
- Other spaces appropriate to core areas are those which have only transient occupation and therefore require little or no mechanical ventilation (for example, circulation and storage areas).

Zoning of the building

5.32 The efficiency and effectiveness of any ventilation or air-conditioning installation depends largely on the zoning and control of the installation. The factors to consider when determining the zoning of a ventilation system for a building or department are:

- periods of occupancy;
- the service delivery resilience;
- fresh-air/ventilation requirements;
- the fire and smoke control strategy for the area.

5.33 Where the ventilation system is not merely tempering the air, but also providing the heating and/or cooling requirements (air-conditioning) the following additional factors should be considered:

- internal or peripheral location;
- orientation of windows;
- variation of internal loads;
- level of control required.

5.34 For single-zone plant in staff areas, local control (with a run-on-timer if required) is recommended, as the system can be turned off when the space is not in use, thus saving both thermal and electrical energy. Most clinical-zone supply and extract systems, conversely, are required to operate continuously while the department is occupied; thus some form of time or use control is necessary.

5.35 The control of individual plant items is covered in Chapter 9, with examples of typical control strategies in Chapters 6 and 7. For control parameters of particular critical ventilation and air-conditioning systems, see Chapter 8.

5.36 On rare occasions a duplicate standby air-handling plant may be justified. If installed, it should be provided with a gas-tight damper (see BS EN 1751) at its junction with the supply distribution duct so that no back-flow can occur. Standby plant can become sources of contamination if warm, moist air is allowed to dwell within them. Their design and control system should ensure that this cannot happen.

Note: The presence of duplicate plant should be reflected in the fire strategy.

Fire and smoke control

5.37 Within a designated departmental fire zone, the total mechanical supply and extract ventilation volumes should be approximately equal so that in the event of a fire, smoke is neither drawn into nor blown out of the zone. Note that individual sub-zones within the departmental zone may be positively or negatively pressured to suit the clinical need (for example, isolation rooms, operating theatres).

Note: In atria, stairwells and designated escape routes, dedicated smoke clearance fans may be installed to keep evacuation routes clear in the event of a fire. These together with their associated smoke dampers do not form part of the building's general ventilation system and their operation will be automatically initiated by the building's fire detection system and/or manually controlled by fire service personnel (see Health Technical Memorandum 05 Firecode).

Air-conditioning

5.38 Air-conditioning is the facility to filter, heat, cool, dehumidify and if required humidify the supply air to maintain an internal condition regardless of changes in the external conditions or internal load. It is expensive in plant and energy.

5.39 Due to capital and running costs, air-conditioning should only be used in essential areas. These include operating departments, critical care areas, manufacturing pharmacies and areas with particularly sensitive equipment. Information on system performance requirements for individual departments is given in Chapter 8.

Local exhaust ventilation

5.40 There is a statutory requirement under the COSHH regulations to prevent or control the escape of chemicals, toxic fumes, biological materials or quantities of dust into the general environment. For airborne hazards to people, control may be by the provision of an LEV system designed to the standard set out in HSG 258.

Ventilation for general areas

5.41 Chapter 8 and Appendix 2 provide recommended air-change rates, temperatures and pressures for general areas requiring mechanical ventilation in healthcare buildings.

Mechanical extract ventilation

5.42 General extract systems can vary in complexity from a single wall-mounted fan to a central ducted air system with dual extract fans.

5.43 Replacement air is provided by either a central supply system or enters the building through gaps in the structure or purpose- made openings. The design should ensure that the latter does not result in an unacceptable level of draughts occurring in winter.

5.44 If individual systems are used, the ventilation can be operated intermittently, provided it continues to run for at least 15 minutes after the room is vacated (as with light-switch-operated fans in individual toilets).

5.45 If general exhaust systems are used, filtered and tempered replacement air should be provided to adjoining lobbies or corridors, to prevent the risk of discomfort caused by the ingress of cold air. Fire compartmentation requirements should be maintained.

5.46 Information on specialised extract systems is given in Chapters 8 and 9.

Mechanical tempered-air-supply systems

5.47 Where mechanical supply systems are required, the fresh air should be tempered and filtered before being delivered to the space in order to avoid discomfort.

5.48 The majority of space air temperature heating load will be provided by the energy-recovery device with the balance from a constant or variable temperature battery. In most instances, the low pressure hot water (LPHW) heating system should offset any fabric loss so that set-back room temperatures can be maintained during unoccupied periods without the need for the ventilation system to operate.

Balanced ventilation

5.49 A balanced ventilation system is a combination of both a supply and an extract system of equal volume; either a single space or a whole building may be considered to be balanced.

5.50 A balanced system is necessary in instances where it is essential to maintain consistent air movement within an area (for example, recovery rooms).

Cascade ventilation

5.51 In operating departments, it is normal practice to supply air to the operating theatre and allow it to flow through less clean areas – corridors, utility rooms, etc (from where

it is eventually extracted). Pharmacy aseptic preparation facilities, maternity delivery rooms and treatment rooms are similar.

5.52 In negative pressure facilities it will be necessary to provide make-up air in order to promote the correct pressure cascade from the clean to the less clean (for example, supply in an outer area – to lobby to patient's room – to toilet extract). Infectious diseases units and bronchoscopy rooms are similar.

Recirculation systems

5.53 Air recirculation systems are normally used in HEPA-filtered cleanrooms where the return air is significantly cleaner than the outside supply and where odour levels are not significant.

5.54 Recirculation is also routinely used in the canopy section of ultra-clean operating theatre ventilation systems (UCV). The recirculated air is EPA filtered to ensure that biological contaminants released by the surgical team are not discharged back into the clean zone.

5.55 Recirculation may also be used for swimming and hydrotherapy pool ventilation.

5.56 Where the designer is considering the installation of an air recirculation system, due account should be taken of:

- a 20% minimum fresh air supply volume or that required by the Building Regulations or 10 L/s/person, whichever is the greatest;
- prevention of supply air contamination from vitiated return air;
- prevention of stratification occurring within plenum chambers and mixing boxes, which may result in freezing of downstream coils;
- ensuring sufficient velocities through automatic control dampers (ideally 5–6 m/s) where fitted, to provide suitable authority and good shut-off;
- modulating control of mixing to provide optimum on-plant conditions;
- the use of "free cooling" by cycling the dampers to minimum fresh air when the enthalpy of the outside air is greater than that of the extract air under conditions when cooling is required.

Note: Recirculating air can create particular problems when its ductwork breaches fire compartmentation. Designers should ensure that the system complies with the fire strategy in all modes of operation.

Dilution ventilation and clean airflow paths

5.57 In the past dilution ventilation has been used as the sole means of controlling levels of airborne hazardous substances in a space. This approach in itself is no longer considered acceptable. COSHH requires that airborne hazardous substances should be controlled at source by using a closed system (such as an anaesthetic gas scavenging unit) or a protective enclosure (such as a fume cupboard). A good level of background ventilation will assist in diluting any casual release of the substance.

5.58 In anaesthetic rooms, the casual exposure of staff to leakage or spillage when administering anaesthetic agents should be dealt with by establishing a clean airflow

path. Air should be supplied at high level above or behind the area where the staff will typically stand and extracted at low level directly behind the anaesthetic equipment position (see Figure A25 and photographs in Appendix 9).

5.59 The philosophy of establishing a clean airflow path – from the air-supply point, past the breathing zone of the staff, on to the patient or other source of airborne hazard, and out via a low-level extract – would also apply in recovery rooms, birthing rooms, bronchoscopy rooms, laboratories and post-mortem rooms. A suitable air-change rate (see Chapter 8) will provide background dilution ventilation as an additional safeguard. This approach ensures that regarding the ventilation aspects, “all reasonable steps are taken to prevent or control exposure (of staff) to the hazardous substance” as required by COSHH.

Note: In these areas the supply air should be 100% fresh and not recirculated.

5.60 In operating theatres, patients will be on a closed breathing circuit in a room with a high air-change rate. Under these circumstances, the dilution effect would be considered sufficient to control any casual exposure of staff to anaesthetic gases.

Displacement ventilation

5.61 Displacement ventilation introduces air at low level and removes it at high level. It uses the natural thermal buoyancy resulting from heat gain to achieve air movement throughout a space with minimal or no energy input. Displacement ventilation can be natural, mixed mode or mechanical with the supply untreated, tempered or fully conditioned depending on the application.

5.62 Displacement ventilation can be very energy-efficient and works well in applications that have significant casual heat gains from solar effects, people or equipment. Typical applications in a healthcare setting would be the ventilation of atria, central dining rooms, main kitchens, hydrotherapy pools, computer server rooms, lecture theatres and open- plan waiting or office areas. It is also applicable to non-interventional imaging and scanning suites where there are significant equipment-generated casual gains but no aerobiological infection risks.

5.63 Supply terminals will be located at low level, usually in the form of large perforated plate style diffusers mounted vertically. The supply air terminal face velocity is low so that it does not create draughts. It is essential that they are located in several positions so that they can ventilate the entire space. Care should be taken to ensure that fixed or movable equipment and devices cannot obstruct them. Extract will be at high level through vents or by a ducted extract system. The ventilation rate may be controlled by temperature or CO2 sensor-initiated motorised dampers with or without fan assistance at the extract points. The supply air volume is then slaved to match.

6. Energy Control Strategies

6.1 The operation of ventilation systems should be monitored through a building management system (BMS). The basic objective should be to provide the necessary service utilising the minimum energy. To this end, switching a system “Off” when not required is the most energy-efficient policy.

6.2 If the system is needed to maintain a minimum background condition, reducing its output by “Setting back”, to the minimum necessary to achieve and maintain the desired condition, is the next best option.

Note on “Set back”:

In previous times when fan motors only had two speeds, turning the system

to “Set back” meant switching to the lower fan speed. With modern fans the speed is widely variable so “Set back” is not a fixed fan speed but rather a

control strategy that reduces the system output in order to maintain a desired minimum condition. This may be related to the air velocity at a fixed point,

air-change rate, pressure differential, temperature, humidity or a combination of these parameters. Providing a dew- point sensor in an internal space that brings the system on to “Set back” is a simple way of maintaining a minimum condition.

6.3 The system should only run at full output when needed to achieve and maintain the defined “in-use” operating condition

6.4 Care should be taken when specifying plant to discover the true “in-use operating condition”. Overstating the condition will lead to oversized plant, unstable control and excessive energy consumption.

6.5 The design and selection of set points for an AHU and associated extract system will have a significant impact on the overall energy consumption and efficiency of the system as a whole (see Chapter 9 for detailed information).

Timed control

6.6 Switch the AHU “On” and “Off” at fixed times using a time clock or BMS programme. The AHU needs to come on early enough in the morning to bring the space up to temperature by the normal start time.

6.7 As above but with an “Optimum start” control that uses the outside temperature to determine the start time. In the winter, the lower the outside temperature, the earlier the AHU starts. In summer, the higher the outside temperature above that desired, the earlier the AHU starts.

6.8 As above but link the AHU to a temperature sensor in the space. If out of hours the temperature inside drops to the dew-point, typically 16ºC in winter, or rises above 25ºC in summer, the AHU will start and run at “Set back” (see definition in the Note after paragraph 6.2).

6.9 Any combination of the above or any other appropriate and applicable method that uses the least energy to maintain the specified condition is valid. Various options for the control of single- and multi-zone air-conditioning systems are given in CIBSE Guides F and H.

Occupancy control – user triggered

6.10 The ventilation system output should be linked to occupancy detectors. These may take the form of movement, CO2, passive infrared (PIR) or other sensing technologies that can detect that the area served is in use and switch the system “On” or “Off” and/or adjust the ventilation output to suit the actual load.

6.11 In intermittently used spaces such as operating suites, movement sensors (for example, PIR or similar) should be installed in the space with a “double knock” program so that if movement is detected twice within 10 minutes the AHU will switch “On” to full speed. If no movement is detected for 30 minutes, the AHU switches “Off”. Double-knock detection prevents the system from switching on in situations where a person has briefly entered a space when it is not in use.

6.12 The above may be combined so that if there is no movement for 15 minutes, the AHU switches to “Set back” (see definition in the Note after paragraph 6.2) during the working day and “Off” outside of normal hours.

Note: In Ultra Clean Ventilated (UCV) operating theatres the UCV terminal should be linked to the AHU control so that when the AHU goes to “Set back” the UCV also goes to “Set back”, and if the AHU goes “Off”, the UCV terminal fans also switch “Off”. There is no aerobiological benefit in keeping the UCV terminal fans running when the theatre is not in use, it results in wasted energy.

6.13 An alternative strategy in operating suites is to link the AHU control to the lighting. If the theatre general lights are switched “On” the AHU switches “On” in “Set back” mode. If the main operating lamp is then switched “On” the AHU goes to “Full speed”. If all the lights are out the AHU goes “Off”.

Note: There are occasions when this approach may need to be used with caution; for example, if a type of surgical procedure requires the operating or general lights to be “Off” during a part of the operation, an override timer or plant extension switch will be needed. The operating department manager and VSG should be consulted for approval before adopting this strategy.

User control

6.14 Some applications require intermittent mechanical ventilation, frequently at a high air-change rate (for example, in certain types of treatment room for odour control). Local controls to facilitate this mode of operation if required should be placed in a prominent position to encourage economical use. Specifying timers that shut the system down after a suitable operating period and need to be reset manually will reduce energy waste.

6.15 Local controls that enable the user to select more than one mode of operation should be clearly labelled to identify the particular mode selected.

6.16 Where the system allows different room pressures to be selected, a direct- reading pressure gauge should be fitted within the eye line of the users, 1.5 m above floor level, adjacent to the selector control unit to provide an independent confirmation of the resultant mode of operation. A permanent notice giving a clear description of the selectable modes of operation should be mounted adjacent to the control unit.

7. Environmental Control

7.1 The primary objective of a ventilation control system is to keep the space served within the required environmental control limits, at the appropriate times – regardless of external conditions or internal loads – and with the minimum energy consumption.

7.2 The building heating load will normally be met by a wet heating system with ventilation provided to suit the activities within it. The control of the heating system will normally be compensated to the outside air temperature. Control of the ventilation will usually be via a building management system (BMS) with “outstations” in individual plantrooms and/ or for individual AHUs.

7.3 A BMS incorporating self-adaptive control algorithms that automatically adjust the set-point to suit the usage and load is preferred. This will enable the operating conditions and control tolerances to be set and monitored. It is often not possible to accurately predict building load variation at the design stage. Information provided by monitoring the operation of the plant via a BMS will enable optimum set-points to be established and energy consumption reduced.

7.4 The BMS may also be set to log the actual energy consumed by the system together with that recovered by the energy- recovery device. This will provide a useful check on overall operating efficiency and provide evidence that energy targets are being achieved. The provision of movement sensors within the controlled space in order to determine the actual occupancy will facilitate this process.

7.5 The failure of ventilation systems serving critical areas can have grave consequences for the delivery of healthcare. Control systems should therefore be simple, robust and reliable.

7.6 Computer-software-driven control systems are now the norm in building services. However, healthcare ventilation systems need to be available for operation outside of normal working periods when software support is not available. Should the software fail, it will be left to site staff, who may have little knowledge of the control algorithms, to restart the ventilation system. It is therefore essential to ensure that a simple means of restarting critical systems in the event of a software failure is provided (see also Chapter 9).

7.7 Where BMS use “outstations” to control plant, the “outstation” should be independently able to control the plant if the BMS link is lost.

Location of controls

7.8 Whether within the plant, duct or room, sensors should be located to provide accurate measurement of the condition of the air being monitored.

7.9 Sensors and control items such as control valves should be located close to the element being sensed or plant item being controlled in order to minimise time lags within the system. These may create over- shoot of conditions beyond the design envelope and result in additional energy consumption.

7.10 Where there is a requirement for close control of air-conditioning parameters in a number of zones (for example, an operating department), separate plant should be

provided for each zone in order to avoid the need for expensive over-cooling and reheating of individual zones. The control of most multi-zone systems within healthcare premises is based on off-coil control within the central plant, with trimmer heater-batteries on individual zones.

Note: In modern buildings the cooling load is often significantly greater than the heating load and may exist all year round. Whenever possible, the design should take advantage of free cooling when available.

7.11 Facilities to start, set back and stop the plant should be provided in the plantroom. Remote start and set-back control and indication, if required, should be provided at a manned staff location (for example at the reception or staff base).

7.12 Many ventilation systems may be completely shut down when the area served is not in active use (for example, operating suites). Alternatively, where there is a need to maintain a background condition, the ventilation output may be reduced by "setting back" the system (see paragraph 6.2 and associated Note). This will significantly reduce energy consumption and extend the life of filters and other system components

Multi-zone control methods and application

7.13 Close control of all air-conditioning parameters may be difficult to achieve with multi-zone systems, since each zone will in theory require a reheater and humidifier to give total control of humidity, if that is what is required. In reality, such close control is rarely required. It is therefore usual with multi-zone systems to provide control of zonal temperature only, with humidity control, where fitted, being based on average conditions within all zones, or a minimum condition within one zone.

7.14 Designers should consider whether it is necessary for the supply and extract fans to be interlocked – either so that the supply fan will not operate unless airflow is established within the extract system, or vice-versa depending on the required pressures within the rooms being served (see also Chapter 8).

7.15 The sequence switching of units in order to prevent transient reverse airflows will be particularly important in laboratories and pharmacies that contain fume cupboards, safety cabinets and other LEV systems.

Fire aspects

7.16 The control strategy for ventilation systems in the event of a fire should be set out in an agreed fire and smoke control strategy for the site (see Chapter 1).

7.17 All supply AHUs should have a smoke sensor linked to the fire control panel and mounted in the main supply duct immediately downstream of the AHU. In the event of a fire in the AHU or smoke being drawn into the system from an outside source, it should cause the AHU to shut down and the main supply-air damper and system fire damper(s) to close.

7.18 In critical areas a ventilation control panel should be mounted at the main entrance of the area that the ventilation serves (see Health Technical Memorandum 05-02 for more detailed guidance). Access to the panel should be restricted to the fire officer and appointed site AP(V). It should include independent on/off controls and an

indication of the status of the supply and extract systems. A notice should be affixed to the control panel stressing the need to liaise with departmental staff before switching off fan units

Note: In certain critical care areas, it is preferable to maintain the supply ventilation in case of a fire within the area. For example, in an operating department, while undergoing surgery, the patient cannot always be easily moved without significant risk. In the event of a fire in a staff or support area of the department, or adjoining zone, the continued supply of air to a theatre will maintain it at a positive pressure and protect the patient and staff from the effects of smoke. This will allow time for the patient to be stabilised so that they can be safely evacuated if necessary.

User requirements

Room temperature control

7.19 The limits for room temperature set- point are generally between 18ºC and 22ºC depending on the particular application. In some specialised applications (for example, operating departments), the user may require a wider range of adjustment (see Chapter 8).

7.20 The selection of temperature set-point for each room or zone may be by a control facility in the room/zone or be carried out remotely at the control panel or BMS. Where the control device is mounted within the room/zone and is adjustable by the user, it should be marked either “raise” and “lower” or “+” and “–”. It should control within a specified temperature range to suit the user requirement with a control tolerance of ±1 K. All other control set- points should be selectable either on the control panel or at the BMS interface.

7.21 Where local control is provided, an indication of temperature will be required locally or at a staff base (if appropriate) using an analogue or digital indicator. The indicator should be large enough to be read from the normal working position (for example at the operating table in a theatre). This may be mounted in a supervisory control panel, with the signal repeated on the main system control panel or BMS. It is important that this indicator displays the actual measured temperature and not the selected temperature.

Alarms and indication

7.22 Supply and extract systems should include indicator lamps on the control panels to confirm the operational status of each system. Where the usage is on a regular daily pattern, time control with a user-operated, timed manual override should be provided.

7.23 Where a system is provided for a particular space, the indicator should be in, or immediately adjacent to, that space, and local controls should be provided with permanent labels clearly defining their function (for example isolation suites).

7.24 If room differential pressure gauges are required, they should be mounted directly adjacent to the entry door of the room to which they apply at a height of 1.5 m above floor level so that they are in the eye line of staff entering the room. If a mechanical gauge is fitted, it should have a green sector to indicate the acceptable normal

pressure range. If electronic, it should have a permanent label affixed underneath it giving the normal acceptable pressure range.

Note: For specific departmental control parameters, see Chapter 8. For plant controls see Chapter 9.

Maintaining balanced air flow rates

Consideration must be given to the method of maintaining the correct proportional balance throughout a system when in use. This becomes particularly important where duct or terminal mounted filters are to be used. As the filters soil, the pressure and flow balance of the system would change unless control measures are included to enable automatic compensation/adjustment (e.g. constant volume boxes, variable speed drives).

8. Specific Healthcare Department Requirements

General considerations

8.1 The foregoing chapters of this document contain general information on healthcare aspects of ventilation system design and specification. This chapter gives information relating to the specific design requirements for a range of healthcare applications.

8.2 The following departments will require a degree of ventilation appropriate to their function.

- the operating department;
- treatment rooms, endoscopy and minimally invasive suites;
- critical care area – levels 2 and 3;
- diagnostic and interventional imaging and cardiology suites;
- obstetrics/maternity;
- infectious diseases unit and isolation facilities;
- bone marrow and other transplant units;
- chemotherapy and oncology units;
- the pharmacy department;
- the pathology department, mortuary and post-mortem suite;
- central decontamination units;
- burns unit;
- cystic fibrosis unit;
- tissue bank, gene therapy and emerging treatment specialties;
- physiotherapy and hydrotherapy;
- estates infrastructure.

Design information for many of these applications is given below, in Appendix 2 or the relevant SHPN/HBN.

8.3 It is not possible to give definitive guidance for every healthcare ventilation application; however, the section on operating theatres contains much information that is common to other applications. Where no specific guidance is given, the principles set out below should be followed:

- the CIBSE guides and technical manuals contain basic information on ventilation design that can be applied to most applications;
- where a British or European standard exists that is specific to the application (for example, a cleanroom), it should be used as the basis of the design requirement;

- air should always move from clean to less clean areas. A hierarchy of room cleanliness is given in Appendix 3;
- differential pressure will prevent contamination between areas when doors are closed. Information on air leakage through gaps around closed doors and hatches for a range of differential pressures is given in Appendix 4;
- the flow of air will prevent contamination between areas of different cleanliness when doors are open. Information on airflow through open doors and hatches is given in Appendix 5;
- a methodology for calculating a design solution for a non-standard operating suite in terms of its room sizes, layout or number of people present is given in Appendix 8. This may be adapted as necessary to suit other less complex applications where air is required to cascade through rooms from clean to less clean areas.

Note: In all cases it is essential that the design solution adopted will ensure adequate scouring of the space being ventilated. The selected airflow rates, relative position of supply terminals, extract terminals, air transfer devices and pressure stabilisers will all have a bearing on the effectiveness of the room ventilation.

8.4 There are four routes by which airborne contaminants may appear in a room:

- shed directly by the room occupants;
- arising as a result of the work activities;
- transferred from adjacent spaces;
- through the supply air.

Particles shed directly by the room occupants can be controlled by:

- restricting access to essential persons only;
- the choice of the occupants' clothing;
- the room air-change rate.

Particles arising as a result of the work activity can be controlled by:

- enclosing, semi-enclosing or otherwise controlling the work-based source;
- the room air-change rate.

The transfer of particles from adjacent spaces can be controlled by:

- a differential pressure between spaces when doors are shut;
- airflow paths flowing from clean to less clean spaces when doors are open.

Particles entering with the supply air can be controlled by the selection of a suitable filter.

When designing ventilation for a healthcare application, the sources of airborne contamination, their degree of hazard to patients and/or staff and the ability of ventilation to control them should be taken into account. For any particular healthcare

application, the ventilation safety group (VSG) should be able to give advice on any specific risks to patients and staff.

8.5 The supply of air to a room has the following main functions:

- to dilute airborne contamination;
- to control air movement within such that the ingress or discharge of airborne contaminants from or to adjacent areas is minimised;
- to control the temperature and, if necessary, the humidity of the space;
- to aid the removal of and dilute fumes, odours and waste gases.

8.6 The supply air volume flow rate for any particular application will be that required to:

- achieve the application's recommended air-change rate;
- provide closed and/or open-door protection;
- achieve comfort or application-specific room conditions;
- replace (make up) that removed by an installed extract system;
- meet the fresh air requirement relating to the number of people anticipated to be present;
- achieve the minimum fresh air requirement if air is recirculated.

Whichever is the greatest amount.

Note: Air-change rates are given in Appendix 2. These figures have been found to give enough dilution of airborne contaminants, provided the mixing of room air is reasonably uniform. Closed and open door protection volumes are given in Appendices 4 and 5. Fresh air requirement is at least 10 L/s/person. Minimum fresh air volume if recirculated is 20%, whichever is the greater.

8.7 Natural and/or mixed mode ventilation should be used wherever possible. Where mechanical ventilation is chosen, a downward displacement turbulent air distribution is generally preferred, though displacement ventilation may be used if appropriate.

8.8 The supply and extract terminals should be positioned to ensure that all parts of the room are actively ventilated and that where necessary the staff will be in a clean airflow path. Extract and air-out paths via door gaps, transfer grilles, pressure stabilisers and low-level active extract should be evenly distributed to encourage efficient scouring of the room. (See paragraphs 8.37–8.40 and 9.161–9.172 for additional guidance on location and types of terminal.)

8.9 Horizontal flow room air distribution with or without a coanda effect (see paragraph 9.162) can be a source of draughts and difficult to set up correctly. Its use should be confined to non-critical areas or situations where ceiling-mounted diffusers could be obstructed by movable equipment support tracks (for example, in imaging rooms). Alternatively, a displacement ventilation scheme may be considered.

Temperature and humidity control

8.10 Supply flow rates to achieve the required room conditions are calculated conventionally, taking account of all heat and moisture gains and losses, and of maximum permissible temperature differences between the room and supply air. In most applications the base heating load will be provided by a heating system. In critical systems the room or suite being considered will be within the heated building envelope so the ventilation will be sized to suit the casual gains or losses.

8.11 Temperature differences between supply and room air of up to 10 K for winter heating and 7 K for summer cooling should not be exceeded.

8.12 Room air humidity should be kept below 70% in order to minimise risks associated with condensation and mould growth. There is generally no lower limit in unoccupied spaces; however, see application-specific guidance.

Ventilation where anaesthetic agents are present

8.13 During treatment, anaesthetic gas or anaesthetic agents may be delivered to the respiratory tract of a patient either directly or using a carrier gas. Anaesthetic gases and agents are subject to workplace exposure limits and while beneficial to the patient are harmful to staff. Waste anaesthetic gas should be contained and removed by a suitable anaesthetic gas scavenging system (AGSS). Some leakage from the anaesthetic equipment and the patient's breathing circuit will occur with all systems, particularly during connection and disconnection and from the interface with the patient. In recovery areas the patient will exhale the anaesthetic agent directly into the room air. The room ventilation scheme should ensure that any leakage or exhaled anaesthetic agents are diluted and removed.

Note: Staff tend to be standing and patients lying down when anaesthetic agents are delivered; also anaesthetic agents are slightly heavier than air, so locating the supply terminal at high level behind where staff normally stand, with an extract at low level adjacent to the source (for example, the anaesthetic gas terminal units), will ensure that staff are in a clean airflow path.

8.14 The design primary air supply to an operating suite anaesthetic room that is equipped with a N2O terminal or in which an anaesthetic agent is delivered to the respiratory tract of a patient using a carrier gas, or an operating department recovery room, should be 15 ac/h.

8.15 In delivery rooms the intake of anaesthetic gas is controlled on demand by the patient, who will then exhale directly into the room air. Locating the supply air at high level at the foot end of the bed with extract at low level at the head end will establish a clean airflow path and reduce the casual exposure of staff to the waste gas.

8.16 The primary air supply to any other room that is equipped with a N2O or N2O/O2 (Entonox) terminal or in which an anaesthetic agent is delivered to the respiratory tract of a patient using a carrier gas or in which the patient is subsequently recovered, where the anaesthetic is employed for the purpose of pain relief or sedation but not full anaesthesia, should be 15 ac/h. However, subject to risk assessment, consideration may be given to reducing this to no less than 10 ac/h, only where use of the anaesthetic gas release into the space will be both very infrequent and in very small quantities.

Note: Staff employed in operating suite anaesthetic rooms and an operating department recovery room will potentially be exposed to anaesthetic agents for the duration of their working day. In other areas (for example, maternity, imaging, treatment rooms), anaesthetic agents are only used for pain control and/or sedation. The strength, quantity and frequency of use may be significantly less, hence the the option to carry out a risk assessment.

Door protection

8.17 Air should flow from the cleaner to the less clean areas as shown in Appendix 3 and Figure A23 in Appendix 8. There are several factors that affect the likelihood of a reverse airflow through doorways:

- when a person passes through a doorway, both the passage of the person and the movement of the door flap cause a transfer of air between the areas separated by the door;
- when a door is left open, there is a transfer of air between the two areas separated by the doorway. This is caused by air turbulence, but is greatly increased by any temperature differential between the areas (a 1.4 m wide doorway may allow the transfer of 0.19 m3/s of air in each direction when there is no temperature difference, but when the temperature differential increases to say 2 K, the volume transferred may increase to 0.24 m3/s). This may be a problem if for example the heat gain from a fluid warming cabinet is not allowed for.

8.18 In order to reduce the likelihood of contamination of a clean area by a reverse airflow from a less clean area two methods of door protection are used:

- closed door protection – a pressure differential is created across a closed door so that any air leakage is from the clean to the less clean area. Appendix 4 gives details of closed door leakage rates for a range of differential pressures;
- open door protection – the pressure differential drops when a door is opened (see Appendix 6) and is effectively replaced by a flow of air through the doorway from the clean to the less clean area. The flow of air needs to be sufficiently large to ensure that significant reverse airflow cannot occur and will be related to the relative cleanliness of the areas being considered. Appendix 5 gives airflow rates for open-door protection related to door/opening size and the classification of the adjoining area.

8.19 Pressure stabilisers enable the room differential pressure to be set when the doors are shut, thus providing closed-door protection. When a door is opened, the stabilisers will close, forcing air to be directed through the doorway, thus providing open-door protection. Provided that the dilution criteria in Appendix 3 are met, the occasional small back-flows created (when two doors are opened simultaneously; or when there is a high temperature difference across an open door) will have little effect on the overall air cleanliness of the affected room.

8.20 In applications where it is critical to maintain a specific airflow and/or pressure regime, for example isolation rooms, all windows in the zone should be locked shut or sealed. Trickle vents, if fitted, should also be sealed.

8.21 The design of the ventilation system for an area depends on the overall configuration of the department. Where the department is served by more than one AHU the

control of the units may need to be interlocked so that reverse airflow patterns do not occur.

8.22 Extract grilles should be sited and balanced to promote air movement in the desired direction.

8.23 Transfer grilles enable air to pass in either direction between rooms of equal class and pressure. Pressure stabilisers operate in one direction only; they allow excess air to be directed to the area desired and assist in maintaining room pressure differentials.

8.24 The relative locations of supply and extract terminals and their design air volume rates will determine the basic airflow between adjacent spaces. Transfer grilles and pressure stabilisers will permit and control the flow of air between spaces, ensuring a flow from the clean to less clean areas of the suite. Failure to provide such devices will lead to uncontrolled airflows when personnel move between rooms and doors being held partially open by air pressure.

Air handling unit

8.25 AHUs should be to the standard set out in Chapter 9. The extent of the system served by an individual AHU should reflect the operational need and required resilience of the application.

Fire aspects

8.26 When considering the overall airflow movement, careful thought needs to be given to the operation of the ventilation system to limit smoke spread in the event of a fire.

Operating department

General

8.27 An operating department will consist of one or more operating suites, a recovery area, sterile pack and equipment stores, entry/exit/service corridors, office, staff changing and support facilities. Each operating suite will typically comprise a preparation room, operating theatre, anaesthetic room, scrub area and a utility room. In order to ensure satisfactory conditions and the correct movement of air, the entire department will usually be mechanically ventilated.

8.28 The information given in this section relates to conventional operating suites used for general surgery. It will be applicable to other types of operating suite such as maternity whose layout and dimensions conform to the principles of Health Building Note 26 (see Note below). Additional information for UCV theatres is given in paragraphs 8.75 onwards.

Note: Health Building Note 26 − ‘Facilities for surgical procedures’ (2004) and Health Building Note 10-02 − ‘Facilities for day surgery units’ (2007) are under revision and will be replaced by a single document: Health Building Note 10-01. It will provide guidance on the planning and design of infrastructure for in- patient and day-patient surgical services in the UK.

8.29 For other types of operating suite, the standard values may need to be adjusted to reflect non-standard room sizes, pressure regimes and air-change rates. A method of obtaining a design solution for non- standard theatres from first principles is given in Appendix 8 (see also paragraph 8.3 and accompanying Note).

Standard air movement control schemes

8.30 In all previous versions of this guidance, standard air-movement control schemes were given that provided a range of design solutions for typical operating- suite layouts. Improvements in the technology of ventilation control systems coupled with the ability to accurately sense and control real-time fan output has enabled operating-suite ventilation parameters to be tightened. These now more accurately meet the airborne- infection-control requirement (see the Lidwell Report). The previous standard design solutions have therefore been fully revised to take advantage of the technological advances and benefit from the reduced energy consumption and plant size they allow.

8.31 A new set of standard operating suite design solutions extensively amended to conform to the guidance contained in this edition of Scottish Health Technical Memorandum 03-01 are given in Appendix 7. They contain diagrams that show the relationship of rooms and the various doors and transfer devices between them but should not be regarded as architectural layouts. The schemes have been developed using the methodology described in Appendix 8.

These design solutions should be used for new projects and when refurbishing or upgrading existing operating suites.

8.32 Any other scheme may be used, and the standard solutions applied, if the following conditions are met:

- room relationships in air network terms are as shown in the plans;
- room sizes and shapes approximate to those given in Health Building Note 26 (under revision at the time of writing and to become Health Building Note 10-01);
- door gaps approximate to those given in the designer's notes in Appendix 4;
- casual heat gains are accounted for;
- a trimmer battery is installed in the air supply to the anaesthetic room and lay-up prep room;
- leakage through the structure is kept to a minimum. Note that theatre suites will be subject to an air permeability test at first-fix and final validation (see Chapters 10 and 12).

It is recommended that every effort should be made to adopt one of the schemes described above.

Ventilation design requirement

8.33 The need for ventilation of the individual rooms and areas within the operating department will be as follows:

- Preparation room – to protect sterile packs and instruments from pre-contamination;

- operating theatre – to control the airborne infection risk, remove airborne contaminants and prevent the ingress of airborne contaminants from adjacent areas;
- anaesthetic room – to protect staff from casual exposure to anaesthetic agents and maintain a suitable environment for patients;
- scrub – to remove aerosolised microbiological contamination and moisture released when staff scrub- up;
- utility (also known as sluice or disposal) – to contain any airborne hazards arising from the initial processing of biological material, contaminated instruments and general waste and prevent it entering the operating theatre or adjacent spaces;
- entry/exit/service corridors – to remove vitiated air cascading from the operating suite(s);
- sterile pack/ Layup Prep and equipment stores – to prevent airborne contamination of the packs and equipment;
- staff changing, shower and toilet facilities – odour control and moisture removal;
- staff rest room – moisture and odour control;
- office and general areas – comfort conditions;
- recovery – to protect staff from casual exposure to exhaled anaesthetic agents and maintain a suitable environment for patients.

The ventilation requirement for each space will be met by the desired air-change rate, room pressure differential, relative position of the room supply and extract, comfort requirement or a combination of all elements.

8.34 **Preparation room – sterile pack store (SPS)** - The preparation room is used simply as a store; sterile packs are set out on trolleys but not opened. They are then transferred to the operating theatre and opened as required. The nominal room pressure can therefore be the same as that of the operating theatre and the air allowed flow between the rooms in either direction. Air supplied to the preparation room should be directed into the operating theatre either through a door-mounted transfer grille or if no door is fitted, through the opening. It should not flow via a pressure stabiliser or transfer grille into the corridor.

8.35 **Preparation room "lay up"** – When the preparation room is used as an instrument "lay up" room (that is, sterile packs are opened and their contents exposed ready for transfer to the operating theatre), it should be regarded as being of greater cleanliness than the operating theatre. The preparation room should be at 10 Pa above the operating theatre to minimise the transfer of air and prevent pre-contamination of the instruments. The design air supply volume should relate to the door protection factors (for example, open door to theatre and closed door or hatch to corridor, where provided) and result in not less than 22 ac/h. Air should discharge into the operating theatre through a pressure stabiliser fitted with a stand-off baffle plate on the theatre side (see photograph). It should not flow via a pressure stabiliser or transfer grille into the corridor. The volume of supply air being discharged through the pressure stabiliser may be used to offset the volume of supply air to the operating theatre.

Where the unpacking of the instruments involves not only the removal of the protective packing but also the opening of the sterile barrier, the supply air to the room must be delivered via a terminal HEPA filter (H12 grade). The system must include constant volume and variable speed controls to ensure that the air flow rates remain constant as the HEPA filter soils. In this case it is also necessary to design a specific air flow regime to enhance the cleanliness of the environment. The supply air must be delivered from the ceiling in a manner which directs that air down into the zone where the sterile barriers are to be removed. Air will then be relieved from the room at low level with an air pressure stabiliser into the theatre.

8.36 **Operating theatre** – The supply of air to an operating theatre has four main functions:

- to dilute airborne microbial contamination – this will arise from the surgical activity and microbiological material shed by staff;
- to aid the removal of and dilute fumes, odours and waste anaesthetic agents;
- to control air movement so that the airborne contaminants from other less clean areas do not enter;
- to control the temperature and if necessary, the humidity of the room.

Design notes

- an air-change rate of 22 ac/h will control (a) and (b) above. When calculating the air volume required to achieve the air-change rate, the physical volume of the operating theatre will be based on whether the scrub does or does not form part of it. See Note to paragraph 8.46 for further information;
- the room to corridor differential pressure and amount of air required to give door protection will control (c). Door protection is calculated on the basis that during use, only one door or a single leaf of a double door will be open transiently, and all the rest will be closed. The designated “open” door will be the worst case (for example, typically that between the operating theatre and utility). The volume of supply air can be calculated from the flow rates for open and closed door protection given in Appendices 4 and 5. The smaller the number of rooms (and therefore doorways) leading from the operating theatre the better, as traffic is reduced, and a less complicated air movement control scheme is required;
- the supply air volume to control (d) temperature and humidity conditions can be calculated conventionally, taking account of all heat and moisture gains and losses resulting from equipment, lighting and number of occupants. Supply to room air temperature differences of up to 10 K for winter heating and 7 K for summer cooling should not be exceeded. Room humidity should not exceed 70% saturation.

The design supply air volume for an operating theatre will be whichever of the above calculations yields the greater figure.

In the case of an operating suite with a “lay up” preparation room, the actual air volume supplied by the operating theatre terminals will be the design air volume determined above minus that entering via the preparation room pressure stabiliser.

Note: In the majority of operating theatres the air-change rate will be the dominant factor; however, for small operating theatres the door protection factor may dominate.

8.37 The supply and extract terminals should be positioned to ensure that all parts of the operating theatre are actively ventilated. The ceiling should be divided into four quadrants and a supply terminal positioned at the centre of each quadrant and along the lines that join them as necessary to ensure that all parts of the room are equally supplied. In a large theatre, additional terminals around the centre point may be necessary to promote efficient scouring and achieve satisfactory air movement at the operating table level. This will help create in ventilation terms a well-mixed space and ensure good dilution of any airborne contaminants. Extract and air-out paths via door gaps, transfer grilles, pressure stabilisers and low-level active extract should be evenly distributed to encourage efficient scouring of the room. A minimum of three and preferably fourair-out paths, approximately equally spaced, should be provided.

Note: In order to ensure correct air distribution, it is essential that the supply terminal locations are not displaced by light fittings or ceiling-mounted pendants and articulated booms. Ideally the supply terminals should alternate with light fittings along the quadrant lines described above.

8.38 Supply terminals should be ceiling- mounted circular “air master” style, square “four-way blow” or perforated plate style that produce a downward displacement, turbulent airflow (see paragraph 9.170 onwards). Multi-section plenum-style perforated-flow diffusers with a footprint that encompasses the operating site are acceptable but may be prone to buoyancy effects as a result of temperature difference. Manufacturers’ type test data should be consulted to ensure that the terminal will achieve the required performance envelope. Note that these are not true laminar flow systems in the strict sense of the word but produce a downward displacement parallel flow style of air distribution.

Note: Where an operating theatre requires a higher than normal air-change rate (for example, cranial surgery, which may specify 35 ac/h), the volume of supply air means that four-way blow diffusers would be noisy and probably cause unacceptable draughts. A UCV terminal would deliver too much air, which could result in exposed tissue drying out during the procedure. A multi-section, plenum-style perforated flow diffuser with a footprint that encompasses the operating site would be the most suitable option.

8.39 The diffuser equipment chosen should not cause “dumping” and provide an air velocity 1 m above floor level at the operating position of between 0.2 m/s and 0.3 m/s.

8.40 Horizontal flow distribution should not be used in new installations; however, space constraints may force its retention when refurbishing existing installations. Where fitted, the supply grilles will require a means of directional adjustment that is lockable in position to prevent casual alteration in future when being cleaned.

8.41 Anaesthetic room – Anaesthetic gas or anaesthetic agents will be delivered to the respiratory tract of a patient either directly or using a carrier gas. Anaesthetic gases and agents are subject to workplace exposure limits and while beneficial to the patient are harmful to staff. Some leakage from the anaesthetic equipment and the

patient's breathing circuit will occur with all systems, particularly during connection and disconnection, and from the interface with the patient. The room ventilation scheme should ensure that any leakage is diluted and removed, and that staff are in a clean airflow path. Locating the supply terminal on the ceiling in a position behind where the anaesthetist will normally stand, and the extract terminal at low level adjacent to the medical gas pipeline terminals, will encourage a clean airflow path past the breathing zone of the anaesthetist, thus reducing their casual exposure to airborne anaesthetic agents (see information in Appendix 9).

8.42 An operating theatre suite anaesthetic room that is equipped with a N2O terminal or in which an anaesthetic agent is delivered to the respiratory tract of a patient using a carrier gas should have a design primary supply and extract flow rate to achieve 15 ac/h.

8.43 In order to maintain the core temperature of patients being anaesthetised, a trimmer heater-battery should be provided in the anaesthetic room supply. It is also important that the location of pressure stabilisers and transfer grilles does not cause draughts across the patient.

8.44 The anaesthetic room will be at an intermediate pressure between the operating theatre and corridor.

8.45 **Scrub** – This may be a separate room or a bay within the operating theatre. If the scrub is a separate room, a door between the scrub and operating theatre is an inconvenience to scrubbed staff and may be replaced by an opening that is larger than a normal single doorway. If a door is fitted between the scrub and operating theatre is should have a transfer grille in its lower half. In either case there should be an active extract at low level under the end of the scrub trough most remote from the operating theatre, or a low-level pressure stabiliser that discharges onto a corridor at the end of the scrub room most remote from the operating theatre (see figure 1). If the scrub has an outside wall and/or is particularly large, additional extract terminals may be required to ensure air movement throughout the entire space and prevent surface condensation and mould growth.

Figure 1 Scrub room with extract under trough

8.46 Where the scrub is a trough on the wall or in an open bay within the operating theatre, it should have low-level extract under it.

Note: If the Scrub is in effect a separate room that is open (no door) to the operating theatre and it has a low-level pressure stabiliser discharging onto a corridor or an active low-level extract at its far end, so that air has to travel through the scrub to leave the operating theatre, the volume of the scrub will not be counted as being a part of the operating theatre room volume.

If the scrub is a trough on the wall or in an open bay within the operating theatre, the volume of space it occupies will be considered part of the operating theatre room volume for the purpose of calculating the operating theatre air supply.

8.47 **Utility (sluice or disposal)** – The room is kept at negative pressure with respect to the operating theatre so that contaminants contained in the surgical waste do not re-enter the operating theatre. A utility opening onto a clean corridor is considered to pose a greater risk than one opening onto a service corridor and so has a greater differential pressure. A utility may be shared between two operating theatres or be centralised to serve a group of operating suites.

8.48 **Entry/exit corridor** – Air cascading from the operating suite should be removed in the adjacent corridors. Note that though design flows may be calculated, the actual extract airflows may need to be adjusted at commissioning in order to achieve the design room differential pressures.

8.49 **Service corridor** – If materials to be disposed of are placed in impervious material for transportation, it is not necessary to have a separate corridor for this purpose. However, a service corridor has many operational advantages in terms of the flow of materials through the operating suite. It provides a heated envelope around the operating suite, thus obviating the need to run the theatre ventilation out of hours to maintain its temperature above dew-point, so significantly reducing energy consumption. Lastly it permits access for routine service and maintenance, and the eventual refurbishment of an operating suite without compromising the use of adjacent suites.

8.50 **Sterile pack store** – The central operating department sterile pack and prosthesis store should be supplied with 6 ac/h and be at a positive pressure to their corridor. It is important to coordinate the position of the supply air terminals with any racking so that the terminals are accessible for annual airflow measurement with a balometer.

8.51 **Equipment store(s)** – Supply air ventilation only to keep them at positive pressure to the corridor.

8.52 **Staff changing, shower and toilet facilities** – ventilation as per building regulations and for moisture control.

8.53 **Staff rest room** – Ventilation for kitchen area and general comfort.

8.54 **Office and general areas** – Ventilation as per building regulations and comfort.

8.55 **Recovery room** – Anaesthetic agents will be exhaled by patients while recovering; they are subject to workplace exposure limits and are harmful to staff. Anaesthetic gas scavenging systems (AGSS) will be provided but the room ventilation scheme should ensure that any leakage is diluted and removed.

8.56 The supply air terminals should be ceiling-mounted above the foot end of the recovery bed positions. Extract should be at low (bed height or below) level behind the bedhead positions or in the corners of the bed bay. This will establish a clean airflow path so that staff do not inhale anaesthetic agents exhaled by recovering patients (see the COSHH Regulations).

8.57 In an operating department recovery room, the design primary air supply will be 15 ac/h with a balanced airflow.

General notes

8.58 Supply flow rates for the main rooms of the operating suite are given in Appendix 7. For the other areas where room sizes and activities vary from site to site, air-change rates are given in Appendix 2 and Tables 2–7 in this chapter. These figures have been found to give enough dilution of airborne microbial contaminants, provided the mixing of room air is reasonably uniform.

8.59 For conventionally ventilated operating theatres, the primary air supply would be filtered in the AHU. Terminal filters, EPA or HEPA, are not required.

8.60 Air extracted from operating suites should not be recirculated as it may contain malodorous contaminants.

Note: Where thermal wheels are used for energy recovery, the small leakage across them from extract to supply should not cause odour problems and is not considered aerobiologically significant. In any event, all the air supplied will pass through the final filter.

Operating suite pressure regime

8.61 When designing the ventilation scheme the room pressure differentials given in Appendix 7 should be used. However, when the suite is balanced and commissioned these values are not to be taken as immutable but rather as desired orders of magnitude. What is important is the direction of airflow between rooms when doors are closed. Specifying doors of a laboratory standard that close and sit against a seal or have drop seals on their bottom edge is not necessary and will be counterproductive of the aim to allow air to flow from clean to less clean areas.

Note: Fire officers often require that doors are fitted with cold smoke seals as standard. These will significantly reduce the door- leakage rate and increase the differential pressure when new and undamaged. It is therefore recommended that provision for the design door leakage be factored into the sizing of the appropriate transfer grille or pressure stabiliser.

Temperature and humidity control and indication

8.62 In an operating theatre the temperature should be adjustable within the range 18ºC to 25ºC by the staff at the theatre control panel. The ventilation system should be capable of maintaining an internal temperature of 20ºC at summer outside design and 22ºC at winter outside design in all but the most extreme outside conditions. There may be instances where these temperatures may not be appropriate (for example, children and patients with a low body mass). The internal design temperatures should then be discussed with the VSG and agreed in writing.

8.63 Theatre temperature and humidity control sensors should be actively ventilated. They would typically be located in a sampling extract duct mounted in or adjacent to the theatre control panel, positioned at normal working height (1.5 m above finished floor level). Alternatively, they may be mounted in one of the operating theatre's low-level extract ducts. Whichever location is chosen they should be accessible for cleaning, and removable for periodic calibration and replacement.

8.64 Passive wall-mounted temperature and humidity sensors are not recommended.

8.65 Controls should be provided to enable operating department ventilation plant to be closed down when the operating suites are unoccupied (see also Chapter 9).

8.66 When in the "off" mode, to provide dewpoint protection the control system should switch the ventilation "on" to "Set back" if the space temperature falls below 16ºC.

8.67 All operating theatres and rooms where surgical interventions are carried out should have a control panel mounted on a wall with its screen centre at 1.5 m high and in the direct line of sight of staff standing at the normal operating position. The theatre control panel should include plant status indication, clearly readable temperature and humidity indicating gauges, and a means of adjusting the set point for temperature. Theatre ventilation plant status indication should also belocated at the operating department staff control base (see the Specialised Ventilation for Healthcare Society's (2017) SVHSoc.01 – 'Operating theatres: energy control strategies and the surgeon's panel' for further details).

8.68 The following indicators should be incorporated in the theatre control panel and their functions clearly labelled.

- a readout sufficiently large (25 mm) to be clearly visible from the operating table that shows the temperature of the air in the theatre;
- a readout sufficiently large (25 mm) to be clearly visible from the operating table that shows the relative humidity of the air in the theatre;
- a red indicator light that will illuminate when either the supply AHU fails or is switched off or is in "Set back" (legend: "Theatre not to be used in this condition");
- a green indicator light that will illuminate when the supply AHU is operating at full speed (legend: "Conventional theatre mode").

Note: In touch-screen panels, the red indicator should be a band across the screen with the statement "Theatre ventilation not operational. Do not use". The green indicator may be moving arrows representing airflow with the legend "Ventilation operational".

8.69 The humidity within the operating department when in use should fall within the range 35% to 60%. Where it is considered necessary to fit a humidifier, it should be selected to humidify to 40% saturation at 22ºC during the design winter outside conditions. The cooling coil should be able to remove sufficient moisture so that 60% saturation at 20ºC is not exceeded during the design summer outside conditions.

Note: When not in use the humidity may be allowed to fall below 35% but should not be allowed to rise above 70%.

8.70 The automatic control of ventilation in operating suites needs to be simple and robust. Over-reliance on complex room pressure and flow relationships linked to automatic fan speed control are unnecessary and in the long term have been shown to be unreliable. Complex software algorithms that can only be accessed and interpreted by off-site specialists should not be used. Whichever control strategy is chosen, it is important that on-site staff have the facility to override the control system and keep the ventilation operating at least until the surgical procedure is complete (see also Chapter 9).

Operating suite air handling unit

8.71 Each conventional operating theatre suite should have its own dedicated AHU to the standard set out in Chapter 9. To ensure operational flexibility and permit routine maintenance, an air handling unit should not be shared between suites.

8.72 In retrofit installations, site conditions may preclude individual AHUs for each suite. In these circumstances, subject to VSG approval, an AHU may be shared between not more than two operating suites providing each suite has its own control of temperature. An accessible airflow measurement test point should be provided in the supply branch duct to each theatre suite so that the primary air volume to each can be determined. In addition, the branch supply and extract should be capable of being physically isolated and the main airflow rate reduced so that either suite can be taken out of use without detriment to operating conditions in the other.

Note: An AHU provided under paragraph 8.72 may be shared between two conventional operating suites, but not between a conventional and a UCV suite

8.73 The AHU supply and extract fans should be interlocked so that the supply starts up first and shuts down last, thus preventing reverse airflows. If the extract plant fails when the theatre is in use, it may continue to be used but a warning should show on the BMS and theatre control panel. If the supply fails when the theatre is in use the extract should shut down to prevent reverse airflows and an alarm should sound and show on the theatre control panel.

Fire aspects

8.74 When considering the overall airflow movement, careful thought needs to be given to the operation of the ventilation system to limit smoke spread in the event of a fire. However, this is a highly staffed department with a low fire risk/load status and these factors need to be recognised when developing the fire strategy. Operating departments typically comprise a series of linked rooms with multiple exits. Over-compartmentation can lead to difficulties in establishing clean airflow paths and room air dilution rates. This will lead to an increased risk of healthcare- acquired infections. Staff areas within the department should be treated as a subcompartment.

Ultra-clean ventilation system

General requirements

8.75 The design philosophy of a conventionally ventilated operating suite is based on the need to dilute contaminants and control both the condition and movement of air in an operating suite. Ultra-clean ventilation (UCV) is a means of significantly increasing

the dilution effect by providing a large volume of clean filtered air to the zone in which an operation is performed, and sterile items are exposed. Air is discharged above the operating zone and while not truly laminar, its downward displacement purges the clean zone of contaminants and particles generated by the activities within it. The airflow in and around the clean zone also serves to prevent particles originating outside the zone from entering it. The resulting reduction in contaminants has been shown to significantly reduce post- operative sepsis following certain orthopaedic procedures.

Note: The number of microorganisms that are present in the air at the wound site and exposed surgical items is dependent on the operating team, their procedural discipline, choice of clothing and the type of UCV system. Ultra-clean air is defined as that containing not more than 10 colony forming units per cubic metre of air (10 cfu/m3) present at the wound site during a surgical procedure. In practice levels of only 1 cfu/m3 are often attained.

8.76 UCV systems are very successful in reducing contaminants at the wound site so it is often considered that there is no need for complex air movement control schemes in the rest of the suite. However, when designing the ventilation scheme, it should be noted that the users may switch the UCV terminal to “low speed” when non-orthopaedic surgery is taking place. This is because the high airflow rates can cause increased moisture evaporation of exposed tissue which may be detrimental to the surgical outcome. In recognition of this, the ventilation scheme should be capable of providing operating conditions to at least a “conventional” theatre standard throughout the suite with the UCV in “low speed” mode. It should also be remembered that suitable levels of ventilation will always be required in the peripheral rooms.

8.77 UCV systems can be designed and built from first principles or a range of bespoke modular units of varying shapes and sizes are available, with each manufacturer having a slightly different approach to UCV design. Notwithstanding any variation in their design philosophy, all UCV systems will be required to completely achieve the performance standard set out in Chapter 12.

8.78 As with conventional theatres, each UCV operating suite should have its own dedicated AHU to the standard set out in Chapter 9. To ensure operational flexibility and permit routine maintenance, an AHU should not be shared between suites.

8.79 In retrofit installations, site conditions may preclude individual AHUs for each suite. In these circumstances, subject to VSG approval, an AHU may be shared between not more than two UCV operating suites providing each suite has its own control of temperature. An accessible airflow measurement test point should be provided in the supply branch duct to each theatre so that the primary air volume to each UCV canopy can be determined. In addition, the branch supply and extract should be capable of being physically isolated and the main airflow rate reduced so that either suite can be taken out of use without detriment to operating conditions in the other.

Note: An AHU provided under paragraph 8.79 may be shared between two UCV operating suites, but not between a conventional and a UCV suite.

8.80 An inherent feature of a UCV system is its large airflow so it is essential to recirculate the air supplied to the operating theatre and/or to recover its energy in order to optimise operating costs.

8.81 The primary fresh air volume supplied to a UCV operating suite will be the same as for a conventional suite and it should be dispersed to the rooms in the suite in the same manner. The UCV canopy will typically incorporate recirculation fans. In order to prevent these fans “robbing” the air supply to the rooms, the primary air supply to the UCV theatre suite should be split into two ducts each with a volume control damper, one duct to feed the UCV canopy and the other for the anaesthetic and preparation rooms (which will be subdivided to accommodate heater batteries before they serve their respective room).

8.82 “Laying up” instruments in the clean zone is preferable microbiologically and considered best practice by the Royal College of Orthopaedic Surgeons, so an SPS preparation room should be provided. A transfer grille will be needed in the door between the theatre and preparation room.

8.83 If the client requires a “lay up” preparation room, a pressure stabiliser will be required between the preparation room and theatre. It should be fitted with a baffle on the theatre side to prevent air transfer interfering with the airflow distribution under the UCV canopy (see figure 2). Where space planning permits, consideration may be given to a location of the lay up preparation room in which the air pressure stabiliser discharges from it into the theatre at a point beyond the end of the canopy.

Figure 2 Pressure stabiliser fitted in preparation “lay up” room with stand-off baffle in theatre

8.84 Separate scrub-up or disposal facilities are not necessary for air cleanliness, although operational policy may prefer such a provision. A separate anaesthetic room should however be provided.

Types of UCV system

Remote plant systems

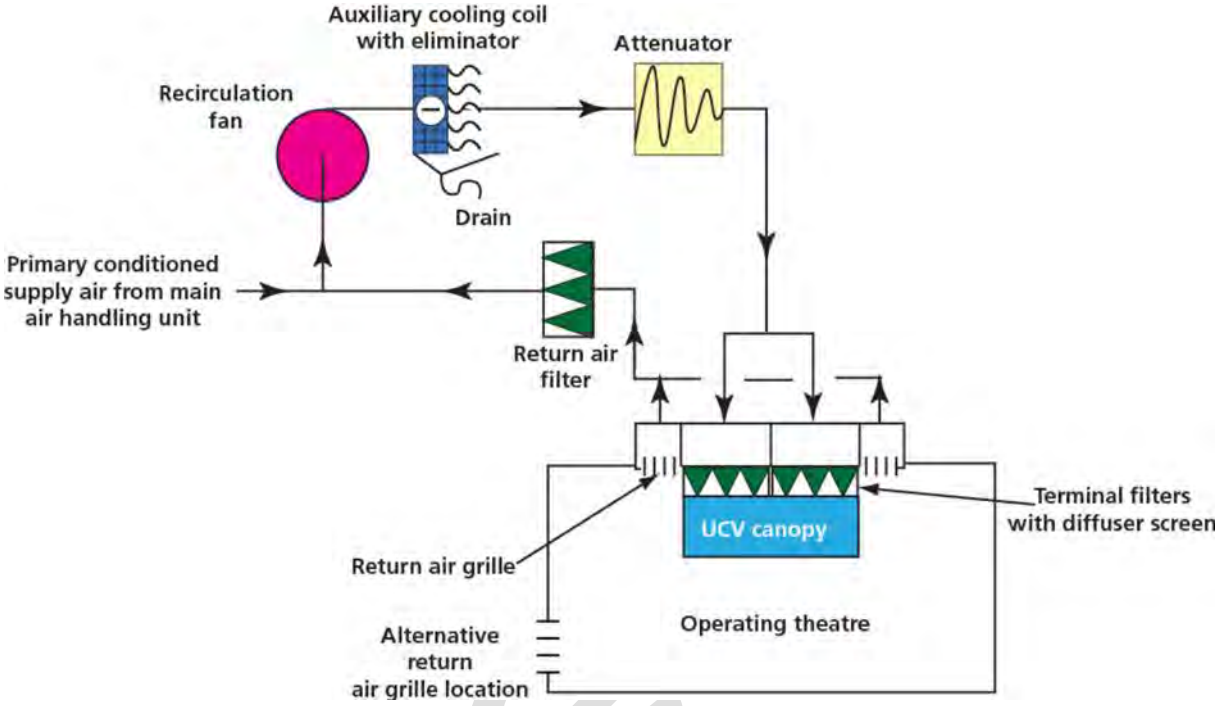
8.85 In a remote plant system, all the air- conditioning equipment is located outside of the operating theatre, except for the unidirectional airflow terminal, terminal filter, air diffuser and the return air grilles (see Figure 3).

8.86 This arrangement has the following advantages:

- the recirculation fans are out of the theatre, thus reducing noise. Multiple recirculation fans may be replaced by a single fan unit.
- casual heat gains from recirculation fan(s), canopy lights, equipment and people within the theatre can be removed by a cooling coil in the return air stream. This will prevent heat build-up in the theatre.

- the return air filters can be changed without needing access to the theatre, making routine maintenance more feasible.
- the opportunity exists to locate the EPA filter in the primary supply duct rather than the theatre terminal. This will reduce the number of filters required and allow them to be changed without entering the theatre.

Figure 3 Remote plant UCV systems



Modular systems

8.87 Vertical-flow modular units comprise a ceiling-mounted canopy containing return air filters, final filter and air diffuser. Primary air is supplied by a remote air- conditioning unit at the volume and to the standard required for a conventional operating suite. The UCV-canopy return-air fans may be within the unit or mounted independently of it in the ceiling void or wall space (see Figure 4).

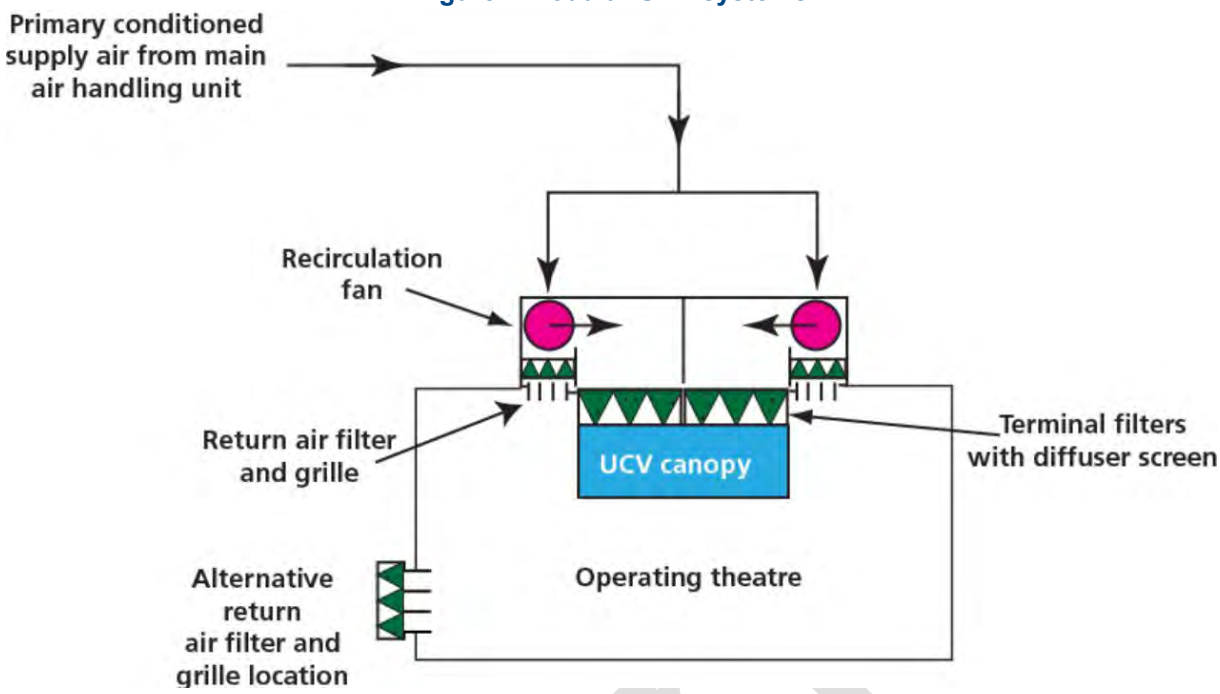
8.88 Modular units have the following advantages:

- as they are produced in a modular form, installation is generally more straightforward;
- they can be used to upgrade an existing conventional operating suite to a UCV suite without the need to change the AHU;
- all the UCV elements are in one place, making maintenance simpler.

8.89 UCV systems can be designed and built from first principles, or a range of bespoke modular units of varying shapes and sizes are available, with each manufacturer having a slightly different approach to UCV design. Whichever system is used, in order for the UCV terminal to produce the desired airflow within its footprint without entraining non-filtered air, the physical outside edge of the UCV canopy unit should not be less than 1 m from the operating theatre wall.

Notwithstanding any variation in their design philosophy, all UCV systems will be required to completely achieve the performance standard set out in Chapter 12.

Figure 4 Modular UCV systems



Vertical flow UCV systems

8.90 Vertical flow systems are effective at reducing infection risks (Lidwell et al., 1982). Some systems have no walls and use auxiliary fans to create an air curtain around the clean zone. Partial wall systems have side screens that terminate 2 m above floor level and full wall UCV have side screens that terminate 1 m above floor level.

8.91 Full wall systems provide a physical barrier between the operating team and other theatre occupants and guide the air down to the operating table level. They can therefore work at a lower air velocity.

8.92 Siting the return air grilles around the periphery of the theatre at low level will help control short-circuiting and give an improved airflow path. In any event there should be an “air out” path on each face or in each corner of the theatre. These may be provided by combination of pressure stabilisers and passive or active low-level extract grilles. Failure to provide “air out” paths on all faces of the theatre may result in the surplus air causing entrainment into the clean zone.

8.93 Vertical systems should have a clean zone large enough to encompass the operating site and all instrument trays likely to be needed for the procedures to be undertaken. Where the surgical site is small, a 1.4 m circular or rectangular terminal may be provided. For major orthopaedic procedures, a minimum size of 2.8 m × 2.8 m will be required. This is the area projected on the floor under the supply air terminal within the full walls, partial walls or air curtain. Any air outside this zone cannot be guaranteed to be ultra-clean although given the dilution factor, the level of microbiological contamination will be much lower than the general level in a conventional operating theatre. Having a contrasting coloured area on the floor delineating the extent of the “clean zone” will assist staff and is therefore essential.

Note: The entire “clean zone” footprint of the UCV canopy will be designated by a contrasting coloured inlay in the floor covering. A line marked on, or cut into, the floor covering is not sufficient and will not be accepted at validation.

8.94 When upgrading an existing conventional theatre to an ultra-clean standard the only solution may be the installation of a modular system. In these units, the heat gains from the return air fans may warrant the inclusion of supplementary cooling within the module. However, issues of cooling-coil drainage, condensate removal and maintenance access within the space constraints of the module may make this option impracticable. The additional cooling load should then be catered for by conditioning the primary air to compensate.

8.95 If an existing AHU is to be retained, it may require modification to ensure that it achieves the standards set out in Chapter 9 of this document (see also paragraph 4.73). The fan may need re-rating to accommodate the change in system resistance. The cooling coil may also need to be upgraded to cater for the increased load resulting from the return air fans and terminal lights. Failure to make adequate provision for this may make the theatre unusable during prolonged warm spells.

8.96 A factor affecting the airflow pattern is the supply/room air temperature difference. When the supply air temperature is significantly above room temperature, buoyancy effects will reduce the volume of air reaching the operating zone. This can occur at start-up in a large theatre where the temperature when not in use has dropped below 18ºC. If it is anticipated at design stage that this will be a regular occurrence, a system incorporating full walls should be used. Demountable extensions that convert a partial wall to a full wall unit are available.

8.97 Convection up-currents from the surgical team and operating lamp tend to counter the movement of clean air towards the operating site, hence the air velocity reaching the operating level is critical. The minimum velocity given below has been selected to take account of these factors and is greater than the theoretical minimum value. For all vertical UCV systems the design discharge velocities will be as follows:

- air velocity 2 m above floor level:
  - no side wall system = 0.38 m/s average;
  - partial wall system = 0.38 m/s average;
  - full wall system = 0.30 m/s average.
- air velocity 1 m above floor level:
  - all systems = 0.2 m/s minimum within the inner operating zone.

Chapter 12 gives details of the method of measurement.

8.98 Variable speed recirculation fans with differential pressure control may be the most suitable solution for maintaining consistent performance and energy saving. The recirculation fans should be accessible for replacement without the need to disturb the fabric of the operating suite.

UCV filters

8.99 The AHU primary and secondary filters should be to the standards and in the location set out in Chapter 9.

8.100 Terminal filters should be provided within the UCV canopy or in the air supply to it. Efficiency particulate air (EPA) filters grade E10 as specified in BS EN 1822 will be required as a minimum. There is no aerobiological benefit in fitting filters of a higher grade than this.

8.101 In some modular UCV units their manufacturers state that the terminal filter is used as a pressure equaliser to balance airflow so a grade higher than E10 is fitted. The increased resistance may affect the velocity of air reaching the operating level and there will be penalties in terms of installed fan power, energy consumption and higher noise levels.

8.102 The final filters should be installed in a leak-proof housing in a manner which allows the terminal unit, filters and their seals to be validated. The UCV canopy and its terminal filters will be scanned with a light scattering airborne particle counter (LSAPC) during validation to prove the effectiveness of the complete installation.

8.103 Where UCV units are constructed in sections, a means of measuring the pressure drop across the terminal filters in each section should be provided. The pressure test points should be located outside of the partial wall, capped to prevent air leakage and accessible within the theatre without the need to open the unit inspection panels. Alternatively, direct-reading non- electronic pressure gauges (of the minihelic type) may be fitted.

8.104 The UCV system will require a return air filter to capture the relatively coarse particles which would otherwise significantly reduce the life of the final filter. This should be at least an ISO 16890 Coarse 60%. In remote recirculation systems there may be advantages in fitting a higher- grade return air filter as it will reduce the load on the terminal EPA filters and extend their life.

Noise level

8.105 If sound-attenuating material is used to line any portion of the inside of the UCV unit it should be non-particle shedding and non-combustible.

8.106 The maximum noise level in an operating theatre fitted with a UCV terminal of any type should not exceed 53 dB(A). Chapter 12 gives details of the method of measurement.

Lighting and operating lights

8.107 The position of the UCV light fittings and style of partial walls, where fitted, should neither adversely disturb the airflow nor result in significant spatial variations in illuminance levels.

8.108 In vertical units, specialised task lighting should be provided by toroidal, cruciform or small multiple dome-shaped luminaires as they have good aerodynamic properties. The ideal luminaire will have a minimal effect on the airflow regardless of where it is positioned. Large diameter saucer-shaped luminaires should not be used in vertical

flow systems as they will occlude the airflow in the critical central zone. It is important to consider the suitability of existing luminaires when retrofitting UCV systems.

8.109 In vertical UCV installations the distance between the UCV canopy diffuser screen and the floor should be between 2.75 m and 3 m. This will allow space for the operating lamps and their articulation arms, and ensure that air at the correct velocity arrives at the operating level. When parked the lowest point of the central light stem, luminaire, monitor, camera, their associated articulation arms and any other ceiling-hung equipment should never be less than 2 m above floor level.

Note: The traditional means of light support is a central column that passes through the UCV canopy and is rigidly fixed to the building structure. The position of the support therefore prevents air being supplied at the centre of the canopy. Separate supports displaced from the centre of the clean zone would lead to improved airflow. This approach was advocated in the 1994 version of this guidance but at the time of writing no UK manufacturer has chosen to adopt this solution. Alternatively, equipping the operating team with battery- powered headset lamps may remove the need for traditional operating lamps and their supports.

Controls and instrumentation

8.110 The functions of the supply AHU and extract ventilation should be continuously monitored by a BMS control unit and interlocked with the UCV terminal control and monitoring functions. The room temperature sensor should be located in the re-circulated air return path. The controls and instrumentation for the main plant are set out in Chapter 9.

8.111 UCV systems will additionally require a low speed facility that can reduce the air supplied through the UCV canopy to a volume that equates to not less than 22 ac/h of the operating theatre gross volume or that required for door protection, whichever is greater, whilst still leaving the supply AHU operating at full speed. In this operational mode the theatre may be used as a conventional operating suite. A means of switching between conventional and UCV mode will be provided on the theatre control panel and its function clearly labelled (see the Specialised Ventilation for Healthcare Society's (2017) SVHSoc.01 – 'Operating theatres: energy control strategies and the surgeon's panel' for further details).

Note: UCV theatre ventilation may be completely switched off when the theatre is not in use, but the room temperature should not be allowed to drop below 18ºC (see paragraph 8.96). The AHU and UCV control should be interlocked so that when the AHU goes to "Set back" the UCV also goes to "Set back", and if the AHU goes "Off", the UCV terminal fans also switch "Off".

There is no aerobiological benefit in keeping the UCV terminal fans running when the theatre is not in use, it results in wasted energy.

8.112 The following indicators should be incorporated in the theatre control panel and their functions clearly labelled. In retrofit installations, an auxiliary panel for the UCV may be the most practical option. If fitted it should be mounted adjacent to the theatre panel and their control functions interlocked.

- A readout sufficiently large (25 mm) to be clearly visible from the operating table that shows the temperature of the air at the UCV canopy.
- A readout sufficiently large (25 mm) to be clearly visible from the operating table that shows the relative humidity of the air at the UCV canopy.
- A red indicator light that will illuminate when either the supply AHU or the UCV canopy fails, or either or both are switched off or the AHU is in “Set back” (legend: “Theatre not to be used in this condition”).
- An amber indicator light that will illuminate when the UCV canopy is at low speed and the supply AHU is running at full speed (legend: “Conventional theatre mode”).
- A green indicator light that will illuminate when both the supply AHU and UCV canopy are operating at full speed (legend: “UCV theatre mode”).
- A blue indicator light that will illuminate when the UCV canopy airflow, as detected by a differential pressure sensor, falls below 80% of the design flow rate (legend: “UCV requires service”).

Note: In touch screen panels the red indicator should be a band across the screen with the statement “Theatre ventilation not operational. Do not use” The amber indicator may be moving arrows representing airflow with the legend “Conventional Theatre mode”. The green indicator may be moving arrows representing airflow with the legend “UCV Theatre mode”. The blue indicator may be a band across the UCV terminal mimic stating “UCV requires servicing”.

8.113 When a system is designed to have partial walls with full wall extensions, a volume control facility may be incorporated to allow the system to be run with reduced velocity when the demountable full walls are in place. It would be the responsibility of the user to ensure correct operation of the system. To assist the user, an explanatory notice should be included on the theatre control panel.

8.114 The UCV unit manufacturer’s control box should be located in an accessible position preferably in the operating department adjacent to the operating theatre that it serves. A service corridor, if provided, is an ideal location. The control box should be clearly labelled with the identity of the operating theatre that it serves.

Barn and semi-barn theatres

8.115 There is no aerobiological reason why two or more UCV systems should not be installed in a common area if adequate spacing is provided. These are known as barn theatres and require special design considerations and operational discipline. The relative positions of the UCV units, temperature control range and location of doors and openings to other areas will all significantly affect the airflow at the operating positions.

8.116 A barn theatre has two or more operating positions each ventilated by a UCV canopy all in one open operating theatre. There may be a common scrub trough, SPS preparation room and shared utility, all of which reduce the facility’s footprint. For reasons of privacy and dignity, there is usually a separate anaesthetic room for each operating position. The operating positions may be separated by glass screens to

prevent bone fragments being propelled from one position to another when high-pressure air-driven surgical tools are being used.

8.117 A semi-barn theatre is very similar but would have a full-height dividing wall between the operating positions. The wall will not extend across the full width of the room, only its middle section. This creates a degree of physical separation between the operating positions but allows staff to walk from one to another around the ends of the dividing wall.

8.118 It is important that the physical layout and ventilation strategy of the barn or semi-barn are in harmony if the installation is to work successfully. The following points should be resolved with the architect and VSG when considering the design:

- in order to reduce the risk of pre- contamination, surgical instruments should not have to pass one operating position in order to get to the one that they are destined for;
- staff having scrubbed should not have to pass one operating position in order to get to the one that they are destined for;
- waste material being cleared from an operating position should not pass another when being removed from the operating theatre;
- the operating positions and their UCV canopies should be placed in line and not staggered or offset, otherwise their airflow patterns will interfere with each other;
- while barns and semi-barns have, from the staffing and space utilisation point of view, many advantages, they can create problems with temperature control and energy efficiency. It is not advisable to shut their ventilation off at night or weekends as if the operating theatre temperature drops it can take a considerable time for the ventilation to achieve the required air velocity at the operating position (paragraph 8.96). Because the barn is a large open space, when it becomes cold the warm air supplied by the UCV canopies tends to rise and stratification occurs. As a result, although from the user's point of view the ventilation appears to be running, the air being delivered does not actually have enough velocity to reach the operating table;
- access for service, maintenance and future upgrades or refurbishment will be restricted as this can only be carried out when none of the operating positions is in use.

8.119 Ventilation of each UCV canopy and associated anaesthetic room will be by a dedicated AHU; ventilation of the shared spaces and perhaps recovery area would either be shared between the operating position AHUs or provided by a separate AHU.

Hybrid theatres

8.120 A designation given to operating theatres that contain scanning equipment on a robotic arm. Major surgical procedures are carried out and the patient is scanned as necessary during the procedure. The scanning equipment may be floor-mounted or ceiling-hung and there will be one or more large monitors, a variety of screens and the medical gas terminal units all ceiling-hung on articulated pendants. The number of pendants and their supporting steelwork can reduce the space available to install

ventilation ductwork and compromise the location of the supply air terminals. Liaison with the architects at an early stage in the project design is essential to ensure a satisfactory ventilation solution.

8.121 Hybrid theatres tend to be significantly larger than conventional theatres and may have a radiation protected control room and an equipment room to house the servers for the scanning equipment and its robotic arm in addition to the standard operating suite of rooms. The ventilation load will therefore be larger and standard solutions should be adapted to suit or the designer will need to return to first principles (see Appendix 8).

8.122 Because of the increased airflow requirement, the AHU will be larger than for a standard conventional operating suite.

8.123 In all other respects the ventilation design and theatre control panel will be as for a conventional operating suite as above.

Neutral pressure theatres for infectious patients

8.124 The client may have a requirement for an operating suite for surgery on infectious patients. This may be a dedicated neutral-pressure operating suite or a standard operating suite that is designed to be easily convertible to a neutral-pressure suite. If airborne microorganisms liberated from a patient during a surgical procedure are allowed to cascade out into the adjacent corridors, they could infect other patients or the staff in the operating department.

8.125 The room provision and layout will be as for a conventional operating suite with the following variation to the ventilation scheme:

- the operating theatre will have a balanced supply and extract so that it is at the same pressure as the corridor;
- air should not cascade from the theatre to the surrounding rooms, so pressure stabilisers and/or transfer grilles should not be fitted. In the case of a convertible operating suite, permanently fitted hinge-down blanking plates with clamps should;
- be provided to close the pressure stabiliser/transfer grille openings when required;
- the preparation room may be dispensed with to avoid having stock that could become pre-contaminated. Sterile packs, instruments and consumables would be delivered to the theatre on a case by case basis. If a preparation room is required, it should be maintained at 10 Pa to both the theatre and corridor;
- the anaesthetic room should have a supply in excess of extract so that is maintained at 10 Pa above both the corridor and the theatre. There should be a pressure stabiliser between the anaesthetic room and the corridor but no transfer device between the anaesthetic room and the theatre;
- the scrub should have an active extract as for a conventional operating suite but no pressure stabiliser between it and the corridor;
- the utility should be at negative pressure of not less than –5 Pa to the theatre and its corridor;

- the corridor extract will be sized to cater for the air leakage from the preparation and anaesthetic rooms.

Overall, the ventilation scheme should ensure that all air supplied to the operating theatre is removed in the theatre. The theatre should be neutral (at the same pressure) to the corridor so that when the theatre exit door is open there is effectively no interchange of air between them. When the preparation or anaesthetic doors are opened, air flows from them into the theatre and not the other way.

8.126 The theatre control panel, automatic control strategy and air handling unit will be as for a conventional operating suite.

Interventional imaging suites

8.127 Interventional imaging refers to rooms in which surgical interventions are carried out guided by imaging equipment. The risk of infection by the airborne route is low as the surgical site is small, and sterile instruments tend to be unwrapped immediately before use. Anaesthetic gas or agents are used for pain relief or sedation Patients requiring full anaesthesia will normally be treated in a hybrid or conventional operating suite. The VSG should advise on the likely scope of use.

8.128 An interventional image suite may simply be a room containing the imaging equipment, an adjoining radiation protected control room or bay for staff and an equipment room for the imaging server. Support rooms for patient changing, sit recovery, toilets and a utility may also be needed.

8.129 Ventilation of the imaging room would be 10 ac/h with the room at a positive pressure to the corridor. Ceiling- mounted steelwork to support the imaging equipment may reduce the space available to install ventilation ductwork and compromise the supply terminal locations. This may mean that sidewall linear terminals are the only viable option. If fitted, their discharge velocity should not cause draughts and the direction vanes should be fixed or capable of being locked to prevent alteration during routine cleaning. Alternatively, a displacement ventilation scheme may be considered.

8.130 A full “theatre style” control panel is not required, but a green light to show the ventilation is operational and a red one to show it is not should be provided.

8.131 Radiation shielding and warning notices may be required to ductwork where it penetrates ceilings, walls or floors to plantrooms or adjacent spaces to which staff may need access.

Other application-specific design guidance

Application: Bronchoscopy, Endoscopy, Dental and General treatment facilities

Table 2: Treatment and procedure facilities

Area/zone	Reason for ventilation	Typical design factors
Bronchoscopy procedure room	Control of exposure of staff to airborne pathogenic material discharged by the patient e.g. multi-drug-resistant tuberculosis (MDR-TB) during the procedure being undertaken. (COSHH Regs) Control of exposure of staff to waste anaesthetic agents when used. (COSHH Regs)	Establish a clean airflow path – Supply terminal at high level at foot end of patient's chair/couch and extract terminal at patient's head level behind the chair/couch. Design parameters Air change: 15 per hour Pressure regime: Where patient membranes are breached and the procedure would present an infection risk to the patient, the pressure should be +10 Pa to the corridor. In Bronchoscopy and all other Endoscopy procedure rooms –5 Pa to corridor shall be established. (NOTE The decision as to the preferred pressure regime for each room must be made at design stage. They must not be designed and set up as switchable pressure rooms) Noise level: 40 d(B)A Temp range: 20 to 25ºC must maintain any selected set point in the range via BMS Humidity: Floating; max 70%RH Air quality: BS EN 16798 - SUP2 Extract discharge – Discharge in safe position away from people or open windows. If no suitable position available treat the discharge in the same way as a LEV with a discharge stack at a minimum of 3 m above the roof line.
Endoscopic procedure room	As above and odour control	
Dental treatment room	Control of exposure of staff to airborne pathogenic material discharged by the patient during the procedure being undertaken. (COSHH Regs) Control of exposure of staff to waste anaesthetic agents when used. (COSHH Regs)	Establish a clean airflow path – Supply terminal at high level and extract terminal at low level near patient's chair/ couch. Design parameters Air change: 10 per hour Pressure regime: Neutral to corridor Noise level: 40 d(B)A Temp range: 20 to 25ºC must maintain any selected set point in the range via BMS Humidity: Floating; max 70%RH Air quality: BS EN 16798 - SUP2
Emergency department resuscitation room	As above	
General treatment room	Comfort conditions only	

All of the above rooms are suitable for aerosol-generating procedures (AGPs)

Applications: Level 2 and 3 critical care areas, bone marrow transplant (BMT), oncology, organ and tissue transplant units

Table 3: Airborne protective facilities

Area/zone	Reason for ventilation	Typical design factors
Note: Level 2 & 3 Critical care areas should be treated identically in terms of service provision as their only difference is the staff- to-patient ratio.		
Level 2 or 3 critical care individual room	Protection of patients from airborne organisms and fungal spores	Supply only in patient's room and cascade air out via door undercut, transfer grille or pressure stabiliser through rooms of a lower classification. Design parameters Air change: ≥10 per hour Pressure regime: +10 Pa to general area Noise level: 35 d(B)A Temp range: 20 to 25ºC must maintain any selected set point in the range via BMS Humidity; Floating; max 60%RH Final filter; BS EN 1822 – EPA10
Level 2 or 3 critical care open bays	As above	
Bone Marrow Transplant (BMT) unit	Protection of patients from airborne organisms and fungal spores Note: Patient(s) will have a very poor immune system (neutropenia) so will be particularly vulnerable to infection by the airborne route.	Supply only in room and cascade air out via door undercut, transfer grilles or pressure stabilisers through rooms of a lower classification. Design parameters Air change: ≥10 per hour Pressure regime: +15 Pa to corridor Noise level: 35 d(B)A Temp range: 20 to 25ºC must maintain any selected set point in the range via BMS Humidity: Floating; max 60%RH Final filter: BS EN 1822 – EPA12
Haematology/Oncology ward	As for BMT	
Organ and Tissue Transplant unit	As for BMT	

Applications: Isolation rooms category 2 & 3, Infectious disease units, Containment level 3 rooms

Table 4: Airborne isolation facilities

Area/zone	Reason for ventilation	Typical design factors
Category 2 isolation room	Protection of staff and all other building occupants from airborne organisms dispersed by a patient with an infectious disease. See Scottish Health Planning Note 4 Supplement 1	Extract only in patient's room and en-suite. Supply air from corridor passing into room via door undercut, transfer grille or pressure stabiliser. Alternatively the patient's room may have a supply and extract provided they are interlocked to ensure that the room is always at –ve pressure with regard to the corridor. Design parameters: Air change: ≥10 per hour Pressure regime: –5 Pa to general area Noise level: 35 d(B)A Temp range: 20 to 25ºC must maintain any selected set point in the range via BMS Humidity: Floating; max 60%RH Air quality: BS EN 16798 – SUP2
Category 3 isolation room		

Area/zone	Reason for ventilation	Typical design factors
Positive pressure ventilated lobby (PPVL) isolation room Universal isolation facility	Protection of building occupants from patients who may be infected and protection of patients who may be immunocompromised and protection for patients with both conditions. See Scottish Health Planning Note 4 Supplement 1	Supply in lobby flowing through a pressure stabiliser to patient's room and on via a door undercut or transfer grille to an extract in the en-suite. Design parameters: Bedroom air change: ≥10 per hour Lobby pressure: +10 Pa to corridor Bedroom pressure: Neutral En-suite pressure: –ve Comfort parameters as above Air quality: BS EN 16798 – SUP2 With facility to fit BS EN 1822 – EPA12
Containment level 3 laboratory	Protection of occupants in adjoining spaces from airborne bio-hazards	For design details see the Medical Research Council's "Standards for containment level 3 facilities"
Category 4 facility	Design advice will be provided by the client	

Application: Obstetrics theatre, delivery rooms, nursery, neonatal intensive care and special care baby units

Table 5: Maternity facilities

Area/zone	Reason for ventilation	Typical design factors
Obstetrics theatre	Protection of patients from airborne organisms and fungal spores. Control of exposure of staff to waste anaesthetic agents (COSHH Regs)	Ventilation design parameters as for a conventional operating suite. System should normally be at "set back" with a minimum temperature of 18ºC and be able to attain full operating conditions within 5 minutes of triggering the system
Delivery room	Control of exposure of staff to waste anaesthetic agents. (COSHH Regs)	Establish a clean airflow path – Supply terminal at high level at foot end of bed and extract terminal at low level at head end of bed. Design parameters: Air change: 15 per hour Pressure regime: Neutral to corridor Noise level: 35 d(B)A Temp range: 20 to 25ºC must maintain any selected set point in the range via local control Humidity: Floating – max 70%RH Air quality: BS EN 16798 – SUP2
Delivery room with birthing pool	As for standard delivery room above	
Specials delivery room	As for standard delivery room above	
Nursery	Comfort conditions only	
Neonatal intensive care unit or special baby care unit (SCBU)	Protection of neonates from airborne organisms and fungal spores. Neonates are kept in incubators but may be removed for feeding, changing etc. so local temperature control and ensuring a draught-free environment is essential.	Standard supply and extract Design parameters: Air change: 10 per hour Pressure regime: +5 Pa to corridor Noise level: 45 d(B)A Temp range: 20 to 28ºC must maintain any selected set point in the range via local control Humidity: Floating – max 70%RH Air quality: BS EN 16798 – SUP1 (Filter grade depends on ODA category – see the Specialised Ventilation for Healthcare Society's (2018) SVHSoc.02)
N.B. This is a critical healthcare facility and consideration should be given to system resilience and/or how suitable alternative accommodation may be provided in the event of a ventilation system failure.		

Applications: pharmacy aseptic suite, gene therapy, radiopharmacy, support rooms

Table 6: Pharmacy facilities

Area/zone	Reason for ventilation	Typical design factors
Aseptic suite Cleanroom	Protection of product during and after processing. Protection of the wider environment from cytotoxic agents and antibiotics. EUGGMP standards (European Commission, 2011) apply and the Medicine Act if the facility is licensed. Control of exposure by the airborne route to staff of substances during and after processing products. (COSHH Regs). Note: While this application is a critical facility, it is usual to have a plan in place to decant to another site in the event of a ventilation system failure	Supply only in cleanroom and cascade air out via pressure stabilisers through rooms of a lower classification or where there are multiple cleanrooms, a balanced supply and stable cascade out. Thimble extract may be provided for class 3 safety cabinets depending on the location of room within the building. Note: Advice from the client's lead pharmacist should be sought prior to engaging in detailed design. Design parameters: Air change: ≥20 per hour Pressure regime: +15 Pa between unclassified rooms and +10 Pa between classified rooms Noise level: 45 d(B)A Temp range: 20–24ºC must maintain any selected set point in the range via BMS Humidity: Floating – max 60%RH Final filter: BS EN 1822 – HEPA14
Gene therapy cleanroom	As above, plus protection of the wider environment from product	As per cleanroom above plus negative-pressure access lobby and controlled exhaust
Radiopharmacy cleanroom	As for standard cleanroom with additional requirements of the Ionising Radiation (Medical Exposure) Regulations	As per cleanroom above
Non-sterile stores and support rooms	Comfort conditions only	

Application: decontamination facilities

Table 7: Decontamination unit

Facility	Applicable Standards
Central Decontamination Unit	These are highly regulated production facilities dictated by:- Planning note - Scottish Health Planning Note 13 Part 1: 2010 Decontamination Facilities: Central Decontamination Unit. HFS, 2011 Mandated by compliance document - Requirements for Compliant Central Decontamination Units Version 2 – GUID 5014, HFS 2019 Equipment manufacturer's design and installation instructions
Local Decontamination Unit	These are highly regulated production facilities dictated by:- Planning note - Scottish Health Planning Note 13 Part 2 Decontamination Facilities: Local Decontamination Units, HFS 2008 Mandated by two compliance documents - Compliant Dental Local Decontamination Units in Scotland Version 2 – GUID 5005, HFS 2019 and Provision of Compliant Podiatry Instruments – GUID 5007 Version 3.0, HFS 2020. Equipment manufacturer's design and installation instructions

Facility	Applicable Standards
Endoscope Decontamination Unit	These are highly regulated production facilities dictated by:- Planning note - Scottish Health Planning Note 13. Part 3 – Decontamination Facilities: Endoscope Decontamination Units, HFS 2010 Mandated by compliance document - Requirements for Compliant Endoscope Decontamination Units, v2 – GUID 5013 HFS 2014 Equipment manufacturer's design and installation instructions

Hydrotherapy: general requirements

8.132 In a hydrotherapy suite, heat recovery should be via a heat pump.

8.133 In general, the quantity of supply air should be calculated as 25 L/s/m2 wetted surface, with the wetted surface taken as 110% of the pool water surface area. (See the Swimming Pool and Allied Trades Association (SPATA) for detailed guidance.)

8.134 A recirculation plant is recommended, with fresh air make-up to the standard required by the Building Regulations Part F – Non-domestic Buildings. In practice this may need to be increased to control condensation.

8.135 As far as practicable, recirculated pool air should be provided to the ancillary changing and recovery accommodation, with the only extract from the toilets, laundry/utility room and pool hall.

8.136 Supply air to the pool hall should be introduced at high level and directed towards the perimeter to mitigate condensation, with extract air taken from directly over the pool.

8.137 The ceiling void above the pool may need to be ventilated to prevent condensation.

Control of hydrotherapy pool installations

8.138 The supply and extract fans should be interlocked so that the supply fan does not operate until flow is established within the extract system.

8.139 Time-clock control should be provided, with a local override switch to extend the normal operating period as required.

8.140 Night set-back temperature (in the range of 21–25ºC) and high humidity control (in the range of 60–75% sat) should be provided to override the time clock in order to prevent condensation. The exact set points should be ascertained post- installation.

8.141 A remote indication panel should be provided in the pool hall, giving a visual display of the pool water and pool air temperature.

Extract systems

LEV systems

8.142 Devices that use an inflow of air to control exposure of staff to hazardous substances are classified as local exhaust ventilation (LEV) systems under the COSHH

Regulations. Note that the supply or make- up air to a room containing an LEV system may itself be considered to be a part of the LEV system.

8.143 An LEV system may comprise a self- contained unit incorporating its own carbon filter such as a simple bench-top fume cupboard. Alternatively, it may be a complete “ventilation system” comprising a make-up air supply, multiple exhaust protected workstations, branch and central extract ductwork, duplex extract fans and a high-level discharge terminal. It may also incorporate a special filtration system appropriate to the hazardous substance being controlled. Such systems could be required for workshops containing woodworking machinery or large centralised pathology laboratories housing multiple safety cabinets, cut-up benches, fume cupboards and specimen stores.

8.144 It is important to recognise at the design stage whether an extract is being provided for comfort, to remove odours or as an LEV system. Typical LEV systems in healthcare include:

- microbiological safety cabinets and containment level 3 rooms;
- fume cupboards;
- welding fume extracts;
- woodworking-machinery duct collectors;
- lead-acid battery charging-bay extracts;
- powered plaster and bone saws;
- pharmaceutical preparation cabinets and tablet machines;
- dissection benches, cut-up tables and some specimen stores;
- medium- and high-risk infectious diseases isolation facilities;
- dental furnaces, grinders and polishers.

Note: Post-mortem tables may incorporate downflow peripheral ventilation but unless otherwise specified by the equipment supplier, their ventilation is only provided to control odours.

8.145 Information on the design of ductwork, fan and discharge stack arrangements will be applicable to all types of LEV system and is given in Chapter 9.

8.146 LEV systems are statutory items that will be subject to an independent examination and test at least every 14 months by a competent person holding an in-date P601 certificate.

Note: For AGSS, see Scottish Health Technical Memorandum 02-01.

Bench extract systems

8.147 Bench extract ventilation is required in departments such as pathology and mortuary, where activities involve the release of malodorous or toxic fumes which should not be inhaled. They may also be required in central decontamination units and wash-rooms within endoscope reprocessing units to remove airborne biological material liberated when the used items are given a preliminary clean.

8.148 In all cases bench extract systems that create an airflow from the front to the rear are preferred over those that rely on a downflow of air through a perforated surface, as the airflow is easily obstructed when in use.

Typical arrangements

8.149 Each ventilated position will usually be accommodated in a continuous run of benching, which should not be more than 650 mm from front to rear and which should be provided with a continuous upstand at the rear. Each position should have a 1200 mm × 150 mm linear extract grille mounted on a purpose-designed plenum box (incorporating guide vanes as necessary), with its face flush with the upstand. The bottom of the grille should be as close as practicable to the level of the working surface (usually 75 mm above, to allow for cleaning). The minimum velocity across any part of the grille should be 1 m/s. The grille should be readily demountable to allow for cleaning.

Control of bench extract systems

8.150 Provided that it does not interfere with the operation of the department when not in use, the ventilation system for the bench extract and any associated supply may be shut down. However, a run-on timer with a minimum setting of 30 minutes should be provided. To this end, local control should be provided.

8.151 Processes that produce hazardous vapours, fumes, dusts or noxious vapours should be enclosed or semi-enclosed in a suitable cabinet or exhaust-protected workstation (LEV).

Microbiological safety cabinets and fume cupboards

8.152 Safety cabinets and fume cupboards are devices that have an inflow of air to control exposure of staff to hazardous substances. The units and their exhaust systems, filters, fans and discharge terminals are all classified as LEV systems under the COSHH Regulations. The make-up air system to a room that contains an LEV system may also be considered as an essential part of the system and be included in the LEV classification.

Special requirements

8.153 The supply air system should not distort the unidirectional and stable air pattern required for fume cupboards and microbiological safety cabinets. In general, supply air ceiling diffusers should not discharge directly towards fume cupboards or safety cabinets, unless the terminal velocity is such that the airflow pattern at the front of the cabinet is unaffected. The design should ensure that high air-change rates, and/or the opening and closing of doors, do not have any adverse effect on the performance of safety cabinets or fume cupboards. A damped door closure mechanism may help.

Arrangements for safety cabinet installations

8.154 The manufacture and installation of microbiological safety cabinets will be in accordance with the relevant national standards and guidance issued by the Advisory Committee on Dangerous Pathogens (ACDP).

8.155 A Class 1 microbiological safety cabinet will be specified for routine work involving Group 3 pathogens. It should be housed in a containment level 3 room. Specific

design information on containment rooms is issued by ACDP in conjunction with the Health and Safety Commission.

8.156 Siting and installation of microbiological safety cabinets are of particular importance because:

- the protection afforded to the operator by the cabinet depends on a specific and stable unidirectional airflow through the open front;
- the protection to the environment by the cabinet depends on the high-efficiency particulate air (HEPA) filters. The exhaust air should never be considered as totally free from microbiological hazard.

8.157 Microbiological safety cabinet extract is HEPA filtered prior to being discharged to outside. Current standards permit the installation of microbiological safety cabinets with integral fans, provided that the extract ductwork can be kept short (that is, less than 2 m); such an installation, however, is likely to be noisy and is not recommended for use in new buildings.

8.158 Ductwork and discharge arrangements should be as set out in Chapter 9.

8.159 Discharge should be to outside but where this is impracticable, discharge into the room via a double HEPA filter will be accepted if approved in writing by the VSG.

Arrangements for fume cupboard installations

8.160 The manufacture and installation of fume cupboards will be in accordance with the relevant national standards and associated guidance.

8.161 The primary factors which contribute to the effective performance of fume cupboards include:

- an adequate volume of supply air and its means of introduction;
- an effective exhaust system to promote the safe dispersal of waste products to atmosphere.

8.162 The air velocities through sash openings should be enough to prevent hazardous materials from entering the laboratory while avoiding excess flow rates that interfere with the investigation process. Average face velocities should be between 0.5 and 1 m/s, with a minimum at any point within 20% of the average, the upper end of the range being applicable to the containment of materials of high toxicity. The design velocity should be maintained irrespective of whether the sash opening is varied, or whether doors or windows are open or closed (see BS EN 14175).

8.163 The possibility of a fire or explosion which may not be contained by a fume cupboard should always be considered. A fume cupboard should not, therefore, be sited in a position where exit to an escape route will necessitate passing directly in front of it.

Control of extract systems

8.164 It is desirable to provide local control of safety cabinets in order to maximise the life of the HEPA filter, and to permit the sealing of the cabinet and room for fumigation if spillage occurs.

8.165 To cope with the risk of an accident or spillage outside safety cabinets, a panic button should be provided to switch off the supply to that area and to discharge all extracted air to atmosphere.

8.166 In pathology departments, it will always be necessary to have one or more microbiological safety cabinets and one or more fume cupboards available for use, including weekends; therefore, local overriding controls for all these items and any associated ventilation plant will be necessary.

Hood extract systems

Special requirements

8.167 Extract canopies will be required over steam-and-heat-emitting appliances, for example sterilisers, catering and washing equipment and for the extraction and removal of unpleasant odours. These installations are for the control of non-hazardous airborne contaminants, they are not LEV systems.

8.168 Perimeter drain gulleys and corrosion-proof grease eliminators should be provided on kitchen hoods (see BESA DW 172 – 'Specification for kitchen ventilation').

Typical arrangements

8.169 The airflow rate should be enough to ensure an adequate capture velocity in the vicinity of the process. Advice from equipment suppliers should be sought, as excessive velocities will be wasteful of power and generate noise.

8.170 The lowest edge of the canopy should be 2 m above finished floor level, with a minimum of 300 mm overhang beyond the edge of the equipment on all sides.

8.171 A compact arrangement of equipment (but with access for maintenance) will minimise the canopy area, and hence reduce the air volume necessary to achieve the optimum capture velocity.

8.172 Hoods required for the control of heat gain and vapours may be connected to the general extract system when it is convenient to do so, but where non- corrosive ductwork materials are necessary, a separate extract system is preferred.

8.173 Lighting and internal divider plates are often required to be built into the perimeter of large canopies; however, built-in shelving systems are not recommended, as they interfere with the airflow, and constitute a maintenance problem.

Control of hood extracts

8.174 Provided that it does not interfere with the operation of the department when not in use, the ventilation system for the hood extract and any associated supply may be shut down. To this end, local control should be provided.

Plantroom ventilation

General requirements

8.175 Plantrooms are required to be ventilated in order to maintain acceptable temperatures for satisfactory operation of the plant and controls, and for maintenance activities. Natural ventilation through louvred openings protected from infestation by a

mesh with openings of no less than 6 mm and no more than 12 mm are required. Powered plantroom ventilation should only be needed if natural ventilation is not adequate.

8.176 Ventilation requirements should consider all heat sources within a plantroom, and where there are large glazing areas, solar gains. The ventilation rate should limit the maximum temperature within the plantroom to 32ºC.

8.177 Air handling equipment cannot be located in a fire compartment that houses combustion equipment.

8.178 AHUs and other ventilation equipment that serve occupied areas cannot draw their intake air from a plantroom. Neither should extract ventilation plant or medical vacuum pumps discharge air into a plantroom.

8.179 Statutory regulations for plantroom ventilation are contained in the Building Regulations, and further guidance in the CIBSE Guide B2. Note the need to assess the risk of services to AHUs freezing in unheated plantrooms.

9. Equipment Selection Factors

General requirements

9.1 The following gives detailed guidance on the design and selection of ventilation equipment, the distribution system, terminals and control aspects. Designers should take note of the supporting information given in Chapters 10 and 12. Failure at the design stage to make due allowance for the standards to be achieved may mean that the installed ventilation system will not be acceptable to the client's validator at handover.

Location and access

9.2 The plant should be located so that it is remote from possible sources of contamination, heat gains and adverse weather conditions. The design should ensure that wind speed and direction have a minimal effect on plant throughput.

9.3 Safe access to and around plant is essential to facilitate inspection, routine maintenance, repair and plant replacement.

9.4 Air-handling units (AHUs) should be located in an accessible area secured from unauthorised entry. They may be grouped together in dedicated plantrooms or distributed around the building with AHUs located adjacent to or within the area that they serve. In the healthcare setting, because of the difficulty in gaining access for routine service and maintenance, mounting ventilation units of any type in ceiling voids above clinical spaces is not permitted.

Note: If it is proposed to install ventilation units of any type in a ceiling void above a non-clinical area, it should be subject to a formal risk assessment and its use being agreed by the ventilation safety group (VSG) prior to design approval. Their assessment will consider how the unit may be safely accessed and maintained.

9.5 AHUs should be located in purpose- built plantrooms or designated service spaces within a building. This will allow for routine service and maintenance (which is a statutory requirement) to be carried out at any time of day and regardless of weather conditions. It will also protect the plant from contamination by bird droppings, so reducing the risk of fungal spore contamination of the air supplied by the AHU. Control of pests and vermin will be simpler and while not in themselves a source of airborne contamination, their corpses can become a reservoir of biological material that may lead to insect infestations within the AHU.

Note: In a new building it is not envisaged that there will be any need to locate AHUs outside. The design of the building should incorporate central or distributed plant spaces of sufficient size to accommodate the plant required to service the building.

9.6 When refurbishing or changing the use of an existing building, plant space should be created to house the ventilation plant and other services. If located on a roof they should be enclosed in a plantroom with a safe means of access. If located at ground level they should be secured within a plantroom to prevent unauthorised access. Measures should be taken to exclude vehicles from the vicinity to ensure that exhaust fumes will not be drawn into intakes. Intakes for ground level AHUs should

be extended to a height and distance from contamination sources that allows them to draw in unvitiated air.

9.7 In the unlikely event that an internal or external plant room cannot be provided, and ventilation units have to be located outside, they should be fully weatherproof to IP65 and secured from unauthorised access. Protection against the elements should also be provided for personnel carrying out routine inspection and maintenance activities. As an example, when two units are outside, and they are installed with their access doors facing each other, if the gap between them is roofed over and the open ends capped, the AHUs themselves create what is in effect a plant room (see photographs).

9.8 Water will be used during routine cleaning or spilt when maintenance is being undertaken. The area around plant should be tanked to prevent water penetration to adjacent areas and adequately drained

Figure 5 AHU formed plant room (external)

Figure 6 AHU plant room (internal)

Note: Plant rooms should be provided with a sink so that glass drainage traps may be cleaned out and staff can wash their hands after handling contaminated/dirty filters. A source of domestic hot water (DHW) with a valved hose connection point will also be required so that AHUs can be washed out internally as part of their routine maintenance. Plant rooms at roof level should be served by a lift.

9.9 Fire precautions should be incorporated in accordance with the Health Technical Memorandum 05 Firecode series. Guidance is available in Chapter 1 of this document.

9.10 Combustion equipment cannot be located in a fire compartment that houses air handling equipment

Standard requirements

Identification and labelling

9.11 All ventilation systems should be clearly identified with a permanent (traffolyte type preferred) label in accordance with the requirements of Chapter 13. The label should identify both the AHU and the area that it serves. The lettering should be at least 100 mm high and be screwed or riveted onto the AHU in an easily visible place near the fan of the unit, adjacent to the local electrical isolator. Any subsystems and the principal branch ducts should be similarly labelled.

Note: The AHU identification code should conform to the plant identification system in use at the premises (see Chapter 13).

9.12 The nature of air and direction of flow should be clearly marked on all ducts using the symbols given in BS 1710.

9.13 All airflow test-points should be clearly identified with a permanent label and the design information given (for example, TPS 1 – Anaesthetic supply; 400 × 300; Design 185 L/s).

Plant minimum standards

9.14 Plant should comply with the minimum standards set out in Table 8.

9.15 External finish to be corrosion resistant and may be available in a variety of colours at no additional cost. This can aid identification by colour-coding of units in a plantroom (for example, green for general ventilation; blue for theatres; red for laboratories and isolation facilities; grey for extract).

9.16 Organic materials or substances that can support the growth of microorganisms cannot be used in the construction of the plant or its distribution system. The water fittings and materials directory list suitable materials for sealants and gaskets (see also BS 6920).

9.17 AHU internal wiring should comply with BS 7671 and be installed in a cable containment system providing suitable mechanical protection. The wiring and its containment system should not allow air bypass at the filters. The wiring, its containment system, connection boxes and fixings should permit the effective internal cleaning and inspection of the AHU.

9.18 Plastic-bladed dampers and plastic plate heat exchangers should not be fitted. This accords with the national policy to reduce the use of plastics.

9.19 Motorised spring-return low-leakage (BS EN 1751 class 3) isolation dampers should be located at the intake, supply, return air and discharge duct connections of an AHU and associated extract unit. They should be of the opposed-blade type and be fitted with end switches. They should close automatically in the event of power failure or plant shutdown to prevent any reversal of the system airflow. They will also function to isolate the plant from the distribution system when undertaking cleaning or maintenance.

Note: Internal plant dampers or provision for the fitting of shut-off plates, also known as dagger plates, between elements within an AHU are not required.

9.20 Access to elements that require routine service such as filters, fans and all types of heat-transfer device should be via hinged doors. In horizontal units the doors should be wide enough: 500 mm minimum at a unit height >1 m. For smaller units the doors need to be at least 600 mm wide, to allow easy access. Items requiring infrequent access such as attenuators may be via removable panels fitted with lifting handles, or access hatches. All doors and panels should be secured from casual access, close-fitting and without leaks.

Table 8: Plant minimum standards

AHU Element	Minimum Standard	Notes
Construction	Double metal or composite skin with sandwiched insulation to "Euroclass A" fire rating Smooth internal surface without channels or ridges No projecting spire or tech screws inside the unit.	Note: Capping projecting spire screws is not acceptable.
Internal surface finish	Non-corrodible, washable and smooth and of a colour that allows accumulations of dirt to be easily seen	Stainless steel or white powder coated mild steel or with an equivalent protective treatment; but NOT surface galvanised
Thermal transmittance	BS EN 1886 Class T2	Manufacturer's declaration
Thermal bridge	BS EN 1886 Class TB2	Manufacturer's declaration
Deflection	BS EN 1886 Class D2	Manufacturer's factory test
Factory airtightness test – pre-delivery	BS EN 1886 Class L2	Test at +700 Pa and –400 Pa
Site airtightness test	BS EN 1886 Class L2	+700/–400 Pa
Filter frame bypass leakage	BS EN 1886 Section 7	
Supply and extract intake and discharge isolation dampers	BS EN 1751 C3 (low loss)	Motorised opening and fitted with an end switch and spring return
Access doors	Secured from casual access. Fan chamber doors to be fitted with a two-stage latch	Key or similar device required to open access doors Door hinges should be adjustable to so that leakage can be eliminated on site
Specific fan power -Internal (SFPint)	Current Eco design requirement for energy-related products (ErP)	EU 1253 – 2014
Specific fan power - System (SFPsyst)	UK Building Regs	Part L2
Energy recovery	Current ErP EU 1253	Run-around coil – 68% Heat pipes – 73% Plate heat exchanger – 73% Thermal wheel – 73% Heat pump – EU 2281/201 Any other device – see standard

9.21 All access doors should be fitted with seals and have adjustable hinges so that leakage can be eliminated once the unit is installed on site. Access doors to fan chambers should have a two-stage opening sequence to prevent the door blowing violently open if it is unlatched while there is still residual pressure in the unit.

Note: Providing the AHU is located in a plantroom or area secured from unauthorised entry, its access doors can only be opened with a key or similar device, the fan door is fitted with a viewing port and a two-stage opening latch and there is a fan electrical isolation switch adjacent to the fan-chamber access door, there is no requirement to fit an internal fan chamber mesh guard.

9.22 In the healthcare setting it can be difficult to turn off AHUs in order to inspect filters and drainage trays. Viewing ports and internal illumination will therefore facilitate routine inspection of such items. Viewing ports should be at a convenient height so that temporary ladders are not required. In double-stacked units the viewing ports in the upper section will be located in the lower portion of their access doors. Internal illumination should be provided by fittings to at least IP55 rating. Light fittings should be positioned inside the unit (not on the access doors) so that they provide illumination for both inspection and task lighting. All lights in a unit should be operated by a single switch and be powered independently of the AHU main switch. LED lights are preferred.

9.23 Access to air intakes and discharges, AHUs and items in the distribution system such as filters or auxiliary trimmer batteries located in a plantroom or plant area above 1.5m should be via platforms, fixed ladders, hook ladders, pulpit style movable steps or access platforms. The method of access chosen should reflect the frequency and nature of the maintenance requirement. The installation of distribution ductwork and other electrical or mechanical services should provide sufficient clearance to allow access equipment to be moved into position.

Chiller units: heat rejection devices

9.24 The design conditions given in Chapter 8 make no allowance for the elevated temperatures that can occur on the roof of buildings. Refrigeration condensers and chiller units should, if practicable, be shaded from direct solar radiation, or the design adjusted to take account of the gain. Care should be taken to ensure that there is sufficient clearance around the plant to allow effective air movement. Allowance may also be needed for the effect of walls, obstruction or other equipment in the area and for the prevailing wind direction.

9.25 Air-cooled condensers and/or dry coolers will always be the first choice for heat rejection from any refrigeration plant. The use of heat pump systems is also an option. Wet evaporative cooling systems cannot be used in healthcare premises unless limitations of space mean that they are the only way that the cooling load can be met. If they are used, national guidance on preventing and controlling Legionella should be closely followed (see the Health and Safety Executive's (HSE) Approved Code of Practice and guidance document HSG274 'Legionnaires' disease: the control of Legionella bacteria in water systems').

9.26 Traditional refrigerants are being phased down and some of their replacements at the time of writing have a degree of flammability. The level of risk this poses should be formally addressed at the design stage and agreed with the client or their fire safety representative. The selection of a refrigerant should be made with reference to the F-Gas Regulations and should take account of the life expectancy of the plant versus the future availability and increasing cost of the refrigerant. Ultimately, choosing refrigerants with the lowest global warming potential is the ideal and will ensure that

greenhouse gas emissions are minimised. Refrigerant gas monitoring must be included where required under BS EN 378.

Chiller selection: size and resilience

9.27 There is a tendency to meet the calculated maximum chiller load by specifying multiples of a standard size of chiller (for example, the calculated load to be met by three chillers each capable of 33% and an extra chiller of the same size to achieve the N+1 resilience requirement). This approach does not lend itself to efficient operation. It is preferable to split the load with, for example, two chillers capable of 40% each and two capable of 25% each. This will give an overall minimum capacity of 90% resilience at maximum summer design conditions and allow for the actual part load demand to be met in the most energy-efficient way.

Supply AHUs and associated extract units

Typical sequence of components

9.28 The AHU should be arranged so that most of the items are under positive pressure. Cooling coils and humidifiers will require a drain and should be on the positive pressure side of the fan. The following arrangement of components is typical, although in many instances not all elements will be required:

- fresh air intake;
- motorised isolation damper;
- fog coil if energy recovery fitted or frost coil if no energy recovery fitted;
- pre-filter;
- energy-recovery device (possible location);
- attenuator1;
- supply fan;
- attenuator1;
- energy-recovery device (possible location);
- cooling coil;
- eliminator (for face velocities above 2 m/s);
- heater-battery;
- humidifier (if required);
- final filter;
- motorised isolation damper.

9.29 AHUs may be configured as horizontal, linear single or double-stacked; or as cabinet type units. For double-stacked supply/extract units, the fans should be located on the bottom deck where possible as it will make them simpler and safer to change (see Figures A1–A3 in Appendix 1 for possible arrangement.).

Intakes and discharges

9.30 Air intakes and discharge points should preferably be located at high level, to minimise the risks of noise nuisance to surrounding buildings, contamination and vandalism.

9.31 Intakes and discharges should be designed and located so that wind speed and direction have a minimal effect on the plant throughput.

9.32 Helicopter landing pads in the vicinity of ventilation intakes and discharges can result in large short-term pressure changes. This can cause pressure surges in supply systems and reverse airflows in extracts. Exhaust fumes from the helicopter may also be drawn into intakes.

Note: It is not appropriate to "plan to turn the ventilation off when a helicopter lands" as a means of permitting the location of a helipad adjacent to ventilation intakes and discharges.

9.33 Intake points should be situated away from cooling towers, heat sources, boiler flues, vents from oil storage tanks, fume cupboards and other sources of contaminated air, vapours and gases and places where vehicle exhaust gases may be drawn in.

Note: Attenuators may be located in the intake and discharge duct if they are of a suitable type and provided with cleaning access both sides (see paragraph 9.116).

Note: Steps should be taken to prevent birds landing or roosting in the vicinity by removing ledges or fitting anti-pigeon spikes.

9.34 On the rare occasions where intakes have necessarily to be sited at or near ground level, the surrounding area should be paved or concreted to prevent soil or vegetation being drawn in. In addition, intakes should not be situated near established gardens/trees so as to avoid intake of environmental microorganisms. They should be caged or located within a compound to restrict unauthorised access and prevent rubbish being left in the vicinity. The likely proximity of vehicle exhausts should also be taken into account when determining the protected area around the intake and additional filtration may be required. The VSG should be consulted about the standard of air quality required. There should be a minimum 4 m clear zone around the intake (see paragraph 9.50 and paragraphs 9.63–9.64).

9.35 The discharge from an extract system will be located so that vitiated air cannot be drawn back into the supply air intake or any other fresh air inlet. Ideally, the extract discharge will be located on a different face of the building from the supply intake(s). At all times, there has to be a minimum separation of 4 m between them, with the discharge mounted at a higher level than the intake.

Note: Ventilation intakes and discharges cannot face each other across a passageway or courtyard even if they are 4 m or more apart.

9.36 Each intake and discharge point should be fitted with a corrosion-resistant weatherproof (BS EN 13030 class B) louvre or cowl to protect the system from

driving rain. Louvres should be sized based on a maximum face velocity of 1.5 m/s in order to prevent excessive noise generation and pressure loss.

Note: If there is a bend in the ductwork directly behind a louvre, it will affect the air velocity through the louvre. This may result in moisture carry-over or increased noise.

9.37 The inside of the louvres should be fitted with a mesh of not less than 6 mm and not more than 12 mm to prevent infestation by vermin.

9.38 The duct behind a louvre should be self-draining. If this is not practicable, it should be tanked and provided with a drainage system.

9.39 Cleaning access should be provided either from the outside via hinged louvres or by access doors in the plenum behind the louvre. Where a floor-level common plenum is provided, cleaning access should be via a walk-in door. High-level plenums should be able to be safely accessed by temporary or permanent means

Note: Builders' work plenums or intake ducts will need to have a smooth finish and be surface-sealed to prevent dust shedding (see paragraph 10.5).

Fans

9.40 Direct-drive electronically commutated (EC) fans are the preferred choice for ventilation systems. If necessary, resilience and an increased capacity can be achieved by installing two or more EC fans with gravity or motorised dampers to prevent backflow.

Note: At the time of writing the concept of a "fan wall" made up of multiple small variable speed fans all controlled as a single unit was under development. This concept has several advantages as the failure of one fan can be accommodated by speeding up the rest. Because the fans cover the full area of the duct, it will result in a more uniform air velocity downstream at the battery face. This will increase the heat transfer efficiency and may allow a reduction in battery size. Nothing in this document will preclude the use of such innovation that improves resilience and reduces energy usage.

9.41 For an application outside of the capacity range of EC fans, direct-drive plug fans controlled by an inverter mounted externally to the air stream may be selected.

9.42 In either case, the fan motor will be protected with a high-temperature safety cut-out.

9.43 Whichever type of fan is selected, if it serves a critical area it will be fitted in a way that allows it to be changed within 20 minutes. Mounting the fan unit on slide rails with plug and socket connections for power and control cables will facilitate this. Whenever possible, both supply and extract fans should be located on the bottom deck of a double-stacked AHU.

9.44 Selecting fans from a preferred size range will reduce the number of spares held.

9.45 Belt- and pulley-driven fans should not be installed in healthcare ventilation systems.

9.46 Supply fans should be positioned to blow through the central plant so that the cooling coil and humidifier drains (when fitted) will be under positive pressure. The energy-

recovery device may be either side of the fan and should have a drainage system on the extracted air discharge side.

9.47 In extract systems where the air is potentially contaminated, explosive, aggressive or has a high moisture content, the extract fan motor will be located outside the air stream and be capable of being changed without the need to access or change the fan impeller.

Control

9.48 Where two or more fans are fitted in a fan wall, the preferred normal operation is all fans running in parallel. In case of a single fan failure the remaining fan(s) should provide at least 80% of the design output.

9.49 For most healthcare applications, the fan output should be set to give a constant volume of air. This should be controlled by measuring the pressure drop across the fan suction nozzle using a sensing ring and associated volume controller that will automatically integrate the fan K factor to determine and control the preset output air volume. The fan output will then in air volume terms remain constant regardless of changes of system resistance. The actual volume delivered will be related to the air-change rate for the application.

Note: Measuring the air pressure in the main supply duct and using that to set the supply fan speed as a percentage of its rated output and using that to set the extract fan speed as a percentage of the supply fan speed is not a satisfactory, accurate or an acceptable way of controlling the desired supply and extract air volumes.

Filters

9.50 The purpose of filtration is to reduce the level of airborne contamination in an air stream. It is generally carried out in stages

9.51 Filters should be securely mounted in well-fitting frames designed so that the airflow pushes the filter into its housing to minimise air bypass. Vertical supports with seals should be provided to master the joints between filters and eliminate bypass. Mounting frames that withdraw so that the filter can be changed without having to reach into the unit are preferred.

9.52 Filters need to be readily accessible, so a hinged access door should be provided. The upstream side of the filter should be visible for inspection through a viewing port with internal illumination.

9.53 For AHUs, provided that each filter's pressure drop is monitored by a sensor linked to the BMS, direct reading gauges or manometers will not be required. Capped pressure tappings should be provided so that a portable manometer can be connected for diagnostic purposes when necessary.

9.54 General air filters (see Table 9) are divided into four categories, related to the size of particle (in microns (μm)) that they can remove as a percentage of the load.

- coarse filters – remove less than 50% of 10 μm particles;
- PM10 medium filters – remove 50 to 95% of 10 μm particles;

Table 9: General filters: typical healthcare selections

ISO 16890 Class	Notes and typical healthcare
ISO Coarse 60%	May be used as temporary addition filtration at an air intake when building or demolition works are being undertaken in the vicinity
ISO ePM10 ≥50%	Panel pre-filter or return air filter to protect the energy-recovery device
ISO ePM2.5 ≥50%	Supply air filter for areas with temporary occupancy
ISO ePM1 ≥50%	Supply air filter for areas with permanent occupancy

- PM2.5 medium filters – remove 50 to 95% of 2.5 µm particles;
- PM1 fine filters – remove 50 to 95% of 1 µm particles.

Note: Ventilation filters can only remove particles from the incoming air. Most particles that could cause an infection originate from the occupants and activities within the building. In AHUs the pre-filter and return air filter will keep the energy-recovery device, cooling coil and heater-batteries clean and working efficiently. The secondary filter will keep the distribution ductwork and supply air terminals clean.

Note: For additional information on filter selection and indoor air quality, see the Specialised Ventilation for Healthcare Society's (2018) SVHSoc.02 – 'Change in air filter test and classification standards'.

9.55 In areas of high atmospheric pollution, a higher standard of filtration may be required in order to meet the indoor air quality standard (IAQ).

9.56 Compact filters are preferred, because bag filters are often incorrectly oriented and prone to damage when changed.

Efficiency and high efficiency particulate air (EPA and HEPA) filters

9.57 These filters are designed to provide filtration of particles in the sub-micron size range. EPA and HEPA filters self-select the particle that they are least able to trap and are graded against that "most penetrating particle size" (MPPS) (see Table 10):

- efficiency particulate filters (EPA): three grades E10 to E12;
- high efficiency particulate filters (HEPA): two grades H13 to H14;
- ultra-low particulate air filters (ULPA): three grades U15 to U17.

Table 10: EPA and HEPA filters: typical healthcare selections

Typical healthcare application	Minimum filter grade to BS EN 1822 - 2019	% Efficiency @ MPPS
UCV theatre terminal	EPA – E10 – (EU10)	85
No standard healthcare application	EPA – E11 – (EU11)	95
Immunosuppressed and neutropenic patient rooms or wards	EPA – E12 – (EU12)	99.5

Typical healthcare application	Minimum filter grade to BS EN 1822 - 2019	% Efficiency @ MPPS
No standard healthcare application	HEPA – H13 – (EU13)	99.95
Pharmacy aseptic preparation facility supply Containment level 3 room extract	HEPA – H14 – (EU14)	99.995
*Incorporates ISO 29463 tests methods.		

Note: ULPA filters are designed to remove particles below a size that is either surgically or aerobiologically significant. There would have to be exceptional circumstances in order to justify their use in a healthcare ventilation system.

9.58 EPA and HEPA filters are expensive, so their use should be kept to a minimum. When used they should be of the replaceable panel type with leakproof seals and installed in a manner that permits the validation of the filter and its housing (see Chapter 12).

9.59 In supply systems an EPA or HEPA filter will have a non-shedding metal case.

Return air and extract air filters

9.60 Return air filtration will always be required where heat recovery devices are installed. Return air filters are also used to reduce the load on EPA filters in recirculating applications such as ultra clean operating suite ventilation canopies and pharmacy aseptic preparation facilities. They should be the same grade as their AHU pre-filter.

9.61 EPA or HEPA filters are sometimes fitted in extract systems to capture hazardous substances or organisms. Design provision should be made for the subsequent safe handling of contaminated filters by maintenance staff. This may be achieved by:

- sealing the hazardous substance into the filter before it is removed;
- providing a system to fumigate the filter to kill any organisms;
- housing it in a “safe change” unit that permits the filter to be ejected into a bag and sealed without personnel having to come into direct contact with it.

Notes:

1 In view of the costs and problems associated with placing EPA or HEPA filters in extracts, it is essential that a full risk assessment be carried out at the design stage. This should include defining the true need for a filtered extract, the validation of its performance at installation, the method of safely changing a contaminated filter, and its subsequent disposal.

2 General extracts from mortuaries and post-mortem rooms may contain odours, but these are not in themselves hazardous to health and do not require filtration prior to discharge. In high-risk post-mortems (for example, known or suspected tuberculosis cases), the infected organs will be removed and then dissected in a class 1 microbiological safety cabinet provided under the COSHH Regulations.

Extracts from infectious disease Isolation rooms or wards do not normally require filtration prior to discharge. However, if the discharge cannot be made in a safe location and it is likely that the vitiated air could be drawn back into the building or there are people in its vicinity (for example, a discharge into a courtyard), filtration would be required

9.62 Extract EPA or HEPA filters should have a particleboard or plywood case so that they can be incinerated.

Activated carbon filters

9.63 Activated carbon filters can remove gases and vapours from an air stream and are graded according to the range of substances they can remove. They are not normally fitted in air-conditioning supply systems. They are occasionally fitted retrospectively because an air intake has been poorly sited and is drawing in noxious fumes or the outdoor air quality is exceeding WHO levels for NOX/O3 or SOX. Where used they should be protected by or incorporated into a particulate air filter.

9.64 Activated carbon filters are more commonly used in specialised fume extraction systems when the location of the discharge means that dilution cannot be relied upon to disperse noxious fumes.

Energy-recovery devices

General requirements

9.65 Energy recovery will be fitted to all supply and extract healthcare ventilation systems. It may be omitted only where permitted by the current ErP Directive EU 1253/2014.

9.66 For most systems in healthcare premises, a plate heat exchanger, “run- around coil” system or thermal wheel would be appropriate. Selection should be based on the relative locations of the supply and extract units, ease of maintenance and practicality. Cleaning access will be required to both sides of any energy-recovery device.

Note: Plate heat exchangers are the preferred option as they require the least maintenance to retain their energy transfer efficiency. Thermal wheels may be used, as the degree of air transfer from extract to supply is not sufficient to cause aerobiological problems and in any event the air will be filtered before being supplied to the user. Run-around coils are used when the supply and extract units are separate or in case of space problems.

9.67 At the time of writing, the following are the minimum energy transfer efficiencies required under EU 1253 for devices handling equal air volumes:

- run-around coil – 68%;
- plate heat exchanger – 73%;
- thermal wheel – 73%;
- heat pipe – 73%;
- heat pump or any other device – see specific regulations.

Note: These efficiencies are regularly reviewed and are likely to be increased periodically.

9.68 If a plate heat exchanger is chosen, the plates should be constructed of metal; in coastal areas stainless steel is preferred. Plastic should not be used for the plates, internal bypass dampers or gears. (This is in keeping with the reduction in the use of single use plastics.)

9.69 If a thermal wheel is selected, only a sensible heat wheel should be used that incorporates a purge sector. In order to reduce bypass leakage, brush seals should not be used; enhanced airtightness seals should be fitted.

9.70 Whichever energy-recovery device is chosen, the extract side should be protected by at least an ISO ePM10 ≥50% filter and provided with a drainage system as described in paragraphs 9.105−9.112, to remove condensate. Note that most condensate will occur at intermediate rather than at extreme outside air conditions.

9.71 The energy-recovery device should be located downstream of the fog coil and pre-filter, before the cooling coil and main heater-battery. It may be on either side of the supply fan.

9.72 It is essential to consider the set points and control of the fog coil, energy- recovery device, cooling coil and heater- battery in order to achieve the most efficient operation for the maximum time. The primary energy provided by the fog coil will directly reduce the heat exchange of the energy-recovery device. To this end, the off-coil setting of the fog coil should be the minimum possible to keep the pre-filter dry (2 to 3 K above intake air temperature) (see paragraph 9.75 onwards for further guidance).

9.73 The energy-recovery device should be controlled in sequence with the main heater-battery and should incorporate a control to prevent the transfer of unwanted heat when the air-on condition rises above the required plant set-point.

9.74 In instances where the plant is cooling the air, it may be possible to remove heat from the supply air at high ambient conditions, under the dictates of enthalpy sensors in the intake and extract ducts.

Heater-batteries

General requirements

9.75 Fog coils are installed to protect the downstream filters from low temperature, high humidity intake air conditions. They should raise the incoming air temperature by 2 K so that it is above its dew-point when it arrives at the filter. As they handle unfiltered air they should be constructed of plain tubing without fins and be as near to the outside as possible to minimise condensation during cold weather. Access for cleaning should be provided to both sides of the coil. In order to prevent them freezing they should be controlled as constant flow variable temperature devices.

9.76 Traditionally frost coils were set to raise the incoming air temperature to between +2ºC and +5ºC to protect the batteries downstream. All new AHUs should be equipped with an energy-recovery device (see paragraph 9.65); the greater the temperature difference across this device, the more heat will be recovered. Also, the

device will now provide the frost protection. Where an energy-recovery device is fitted, the frost coil will be replaced by a fog coil.

9.77 Where steam coils are used for a fog or frost coil, they may be constructed using spiral finned copper tube. As they will be prone to fouling, the tube layout and spacing should permit easy access for regular cleaning.

9.78 Main and branch heater-batteries should be constructed of solid drawn copper tube coils with copper fins, generally connected in parallel. In coastal and particularly exposed areas the client may require an anti-corrosion treatment.

9.79 Where there is a wet heating system in the areas served, the main heater-battery should be sized, in conjunction with the energy-recovery device, for the ventilation requirements only and not for the building fabric loss. Ventilation should only be used for heating the building fabric if the room specification precludes the use of heat emitters and it is not within the heated volume of the building (for example, a cleanroom or operating theatre with external walls).

9.80 Access for cleaning will be provided to both sides of all fog coils and heater-batteries.

9.81 Main heater-batteries may be water or steam. Electric heaters are expensive to operate, and their efficiency is particularly dependent on the air velocity through them. Their use should be restricted to branch trimming control.

9.82 Where steam supplied heater- batteries are used, their control, venting and trapping systems should be designed so that a vacuum cannot occur within the coil. The condensate drainage arrangements should not allow pressure to build in the condensate main as this will result in a back-up of condensate in the battery.

9.83 Where possible, wet trimmer heater- batteries should be located in plant areas.

9.84 Where it is necessary to locate heater- batteries in false ceilings etc, consideration should be given to the use of electric heaters (note that additional fire detection may be required). If this is not practicable and a LPHW system is used, a drip-tray should be installed under the control valve assembly to protect the ceiling. A moisture sensor and alarm should be fitted in the tray. In any event, to facilitate maintenance access, they should be located above corridors or other non-clinical areas and never above patient-occupied spaces

9.85 Auxiliary fan coil units are not to be installed in the ceiling above a patient- occupied space. They should be accessible for routine maintenance and cleaning without the need to cause significant disruption to the operation of the area that they serve.

Cooling coils and drift eliminators

9.86 Cooling coils supplied with chilled water are the preferred option. For small loads, or where chilled water cannot be made available, direct expansion (DX) coils may be used.

Note: For DX coils, it may be necessary to divide the chiller circuits unevenly in order to achieve efficient operation under part-load conditions. The turn- down ratio should allow stable control down to 10% of the peak load.

9.87 Cooling coils should be periodically decontaminated so the fin spacing needs to be ≥2.5 mm and the fins rigid enough to withstand cleaning (for example, ≥0.25 mm thick). Hinged access doors with viewing ports and illumination inside the AHU or duct should be provided both sides of the coil.

9.88 In an AHU when the cooling-coil face velocity is greater than 2 m/s a drift eliminator will be required downstream of the coil. The eliminator will be an entirely separate device mounted on slide rails so that it can be easily removed without the need for tools. If the size of the AHUs precludes the use of slide rails, and the eliminator is constructed in sections which maintenance personnel will have to enter the unit to remove, each section should have lifting handles. In order to reduce the use of plastics, alternative materials should be considered for the eliminator elements.

Note: For small DX coils and in fan coil units, the eliminator may take the form of a joggled extension of the fins.

9.89 All cooling coils are to be fitted with their own independent drainage system as specified in paragraph 9.105 onwards. A baffle or similar device should be provided in the drip-tray to prevent air bypassing the coil. The tray should be large enough to capture the moisture from the coil headers and drift eliminator.

9.90 Where coils are greater than 1.8 m high and the air velocity is >2 m/s, either intermediate drip-trays will be required or the fin spacing should be increased to ≥3 mm.

9.91 In order to minimise electrolytic action resulting from condensation on the air side, cooling coils constructed from copper tubes with copper fins and electro- tinned after manufacture are preferred. Aluminium fins should only be used if vinyl- coated.

9.92 All parts of the coil and its associated ductwork in contact with moisture will be manufactured from corrosion-resistant materials. Pressed steel coil headers, even if treated, have been shown to be prone to corrosion over time and should not be used. Steel mounting frames and casings present similar problems so stainless steel is preferred.

9.93 Where a cooling coil has to be located above a ceiling, a drip-tray should be installed under the battery and control valve assembly to protect the ceiling from leaks and condensation drips. A moisture sensor and alarm should be fitted in the tray. To facilitate maintenance access, they should be located above corridors or other non-clinical areas and never above patient- occupied spaces. The air velocity should be below 2 m/s to avoid the need for a drift eliminator. All drainage piping should be rigid type not flexible hose.

9.94 Auxiliary fan coil units should not be installed in the ceiling above an occupied space. They should be accessible for routine maintenance and cleaning without the need to cause significant disruption to the operation of the department that they serve. The drainage of such items is often problematic. If a suitable fall in the drain line cannot be achieved, a pump out system should be provided. Drainage piping should be rigid type (not flexible hose).

Humidifiers

9.95 Humidification was originally required for some healthcare applications in order to control the risk associated with the use of flammable anaesthetic gases. The use of such gases has now ceased. Humidification is therefore no longer required unless there is a very specific application requirement (see Chapter 8 and associated SHPNs/HBNs).

Note: In an operating theatre, if high humidity is required to help prevent tissue drying during surgery, it should be provided when required using sterile water in a disposable nebuliser driven by medical air, and not from a humidifier installed in the ventilation system. In that way the quality of the moisture delivered will be assured.

9.96 If it is unclear at design stage whether humidification is required, provision for retrofitting in terms of space provision and a capped drainage system may be provided either in the AHU or in a zone branch duct. The need for such provision and the amount of space allowed for it should be agreed in writing with the client.

9.97 If a humidifier is required, the manufacturer's instructions regarding selection, capacity, installation and control need to be followed. Incorrectly sized, installed or operated humidifiers can become a source of fungal and microbiological contamination within a ventilation system. This may result in a significant airborne infection risk to patients and staff.

9.98 Only steam injection manifold-type humidifiers are considered suitable for use in health building air-conditioning systems. The injected steam will be generated locally either by mains steam or electricity, within or adjacent to the humidifier. Water-curtain, water mist or spray humidifiers of any type cannot be used.

Note: Jacketed lance mains steam humidifiers will always be a source of heat within the system during the cooling season unless completely isolated when not required.

9.99 All parts of the humidifier and its associated ductwork in contact with moisture should be manufactured from corrosion-resistant materials. Stainless steel is preferred.

9.100 For self- and locally-generated steam humidifiers, the cleanliness of the water supply is essential for their safe operation. The water supply should be derived from a wholesome source or demineralised supply. Chemical treatments cannot be added to the water supply to humidifier units. The electrodes of self-generating electrode boiler-type humidifiers should be stainless steel.

9.101 If the quality of the water supply to a self-generating humidifier unit cannot be assured, an ultraviolet (UV) system to control microbiological growth may be installed. However, given the limitations of UV systems, this will require high-quality water filtration to ensure the effectiveness of exposure of organisms to the UV irradiation. As with all water treatment systems the unit should be of proven efficacy and incorporate UV monitors so that any loss of transmission can be detected.

9.102 Provision should be made for draining down supply pipework and break tanks for periodic disinfection and cleaning during the seasons when they are not required in service. The humidifier branch water supply isolation valve will be located at the junction with the "running" main to prevent the creation of a dead leg. All parts of the system should be capable of being cleaned or disinfected as necessary. Hinged

access doors with viewing ports and internal illumination should be provided. A label warning that the device emits live steam and should be isolated prior to opening should be affixed to the access door.

9.103 A zone humidifier, if required, may be installed in a supply branch. The ductwork in which the humidifier is mounted and for at least 1 m downstream should be stainless steel.

9.104 All humidifiers wherever installed will be fitted with their own independent drainage systems as detailed in paragraph 9.105 onwards and be completely accessible for cleaning.

Drainage

9.105 All items of plant wherever located that could produce moisture should be provided with a drainage system. The system will comprise a drip-tray, glass trap, air break and associated drainage pipework.

9.106 The drip-tray should be constructed of a corrosion-resistant material (stainless steel is preferred) and be so arranged that it will completely drain. To prevent “pooling”, it is essential that the drain connection should not have an up-stand; and that a slope of approximately 1 in 20 in all directions should be incorporated into the drain outlet position.

9.107 In AHUs that have access doors large enough for a person to enter, the drip-tray should be easily accessible for inspection and cleaning.

9.108 In AHUs with access doors too small for a person to enter, the complete drip- tray should be capable of being withdrawn. It should be clamped into the AHU with thumb screws so that it can be removed without the need for tools (see photograph).

Figure 7 Removable AHU drainage tray

9.109 Each drip-tray should be provided with its own drain trap. The drain trap should be of the clear (borosilicate) glass type. This permits the colour of the water seal to be observed, thus giving an early indication of corrosion, biological activity or contamination within the duct. The trap should have a means for filling and incorporate couplings to facilitate removal for cleaning. It should be located in an easily visible position where it will not be subject to casual knocks. The pipework connecting the drainage tray to the trap should have a continuous fall of not less than 1 in 20.

9.110 Traps fitted to plant located outside or in unheated plant rooms need to be trace heated in winter. The trace heating should not raise the temperature of water in the trap above 5ºC.

9.111 Water from each trap will discharge directly via a clear air gap of at least 15 mm above the unrestricted spill-over level of either an open tundish connected to a foul drainage stack via a second trap, or a floor gully (or channel). A support should be provided to ensure that the air gap cannot be reduced. More than one drain trap may discharge into the tundish providing each has its own air-break.

9.112 Drainage pipework from the tundish may be thermoplastic, copper or stainless steel. Glass should not be used. The pipework should be a minimum diameter of 22 mm and have a fall of at least 1 in 60 in the direction of flow. It should be well- supported and located so as not to inhibit access to the AHU.

Note: In the case of fan coil units, the glass trap and air-break may be omitted and a pump out system fitted. The unit drainage should connect to the main drainage system via a waterless trap that does not allow discharged water to return. The drainage tray itself will be easily removable for routine inspection and cleaning.

Attenuators

9.113 Provided care is taken in the design and construction of low pressure systems to avoid significant noise generation in the ductwork, attenuation should only be needed to absorb fan noise

9.114 Fans radiate noise through both the inlet and outlet connections, and it may be necessary to provide attenuation to limit the noise from both of these connections. It is always preferable and more economic to control noise and vibration at source, or as close to source as possible. It should be noted that attenuators offer a resistance to airflow and by causing turbulence can be the cause of regenerated noise in a system.

9.115 A thorough assessment of the design should be made to assess the potential noise problems. It should consider the following factors:

- fan and plant noise generation;
- airflow-generated noise in ductwork fittings and dampers;
- noise generated at grilles, diffusers and other terminals;
- noise break-in and break-out of ductwork;
- cross-talk and similar interference;
- the noise limitations for the building and surrounding areas;
- external noise generation.

A method of assessment of these factors and the sound attenuation requirements of ductwork systems is given in CIBSE Guide B

Note: Attenuators fitted in distribution ducts can themselves become a source of regenerative noise if the air velocity through them exceeds their tested performance value.

9.116 Attenuator units with a sound- absorbing in-fill suitable for the quality of air being handled and protected by a perforated sheet metal casing are the preferred option. Absorption of moisture, dirt and corrosive substances into the “in- fill” and the release of fibrous particles into the airstream should be prevented using a membrane with a declared service life of at least 25 years. If these conditions can be met, the attenuator may be located in the supply ductwork downstream of the final filter. Cleaning access should be provided at both ends of the unit.

9.117 Sound-absorbing material should not be applied to the inside surface of a duct.

9.118 End of line mixing and VAV boxes may be supplied lined internally with sound-absorbing material. The material will be non-particle-shedding, protected from casual damage during maintenance and be fire-resistant.

9.119 See paragraph 9.149 onwards for guidance on distribution and point of use noise control.

Note: Developments in “dynamic attenuation” may replace the more traditional physical attenuators and overcome noise “break in” and point of use noise regeneration issues.

Recirculation – minimum fresh air requirement

9.120 Where return air is recirculated, fresh air should be introduced equivalent to at least 20% of the supply air volume, or that required by the Building Regulations, or at least 10L/s/person, whichever is greater.

Distribution system

9.121 The CIBSE guide B2 provides the standard design Information for ventilation systems, their ductwork and terminal devices. The guidance in this SHTM highlights the specific factors that are required for or excluded from healthcare ventilation installations.

9.122 For normal applications in healthcare buildings, low velocity systems are recommended; velocities below 2 m/s are unlikely to be justified.

9.123 The site will often dictate the main routing of ductwork systems, as will the location of the AHU relative to the load. Grouping AHUs in centralised plantrooms results in large vertical service shafts and long main duct runs. Decentralising AHUs into service spaces adjacent to the load results in a more compact duct layout.

9.124 Whichever option is chosen, the design should seek to make the layout as symmetrical as possible; that is, the pressure loss in each branch should be as nearly equal as possible. This will aid balancing and may reduce the number and variety of duct fittings that are needed.

9.125 Main distribution ductwork should not be routed above sleeping areas. Where there is no alternative route, additional external acoustic insulation may be required.

9.126 Where auxiliary air-conditioning units, fans, filters or trimming devices are installed in the distribution system, they will be independently supported and fitted with a suitable drainage system where appropriate. If they are a source of vibration, they should be linked to the distribution ductwork via flexible connections.

Ductwork materials and construction

9.127 The choice of duct material should take account of the nature of the air or gas being conveyed and the environment in which the duct will be placed.

9.128 Galvanised sheet steel is suitable for normal ventilating and air-conditioning applications. Its inherent mechanical strength renders it resistant to casual damage both during the construction phase and throughout its service life when mechanical and electrical services around it are accessed. It may also readily withstand the impacts sustained when rotary equipment is used to clean it internally.

9.129 In instances where moisture levels and/or corrosive elements in the air being conveyed are very high, aluminium, stainless steel, PVC or GRP ducts should be used. Stainless or black steel are the only suitable materials for high temperature ductwork.

9.130 Where other ductwork materials are considered, care should be taken to ensure that the material is satisfactory for the application having regard to the likely service life, possibility of mechanical damage and performance in the event of a fire. Where used it will be installed strictly in accordance with its manufacturer's instructions.

9.131` Rectangular ducting with an aspect ratio of 1:1 is preferred but ratios of up to 3:1 are acceptable where there are space constraints. Circular spiral-wound or flat- oval are also acceptable providing they meet the leakage standard when tested (see Note after paragraph 9.136). Flexible ductwork is not suitable for air distribution in healthcare applications. In situations where solid ductwork cannot be used, flexible ductwork may be used to make the final connection to a terminal providing it does not exceed 0.5 m in length, is extended as far as possible and is never used in lieu of a bend (see paragraph 9.160).

9.132 The inside of the ductwork should be free from structural projections and as smooth as possible. Flanged gasketed joints between sections are preferred for rectangular ductwork, blind-riveted mastic- sealed slip-joints for circular and flat-oval.

9.133 In inherently wet areas, such as the base of fresh air inlet ducts and some extract systems, the ductwork may require draining to prevent a build-up of standing water. The layout of the drains should be as specified in paragraph 9.105 onwards.

9.134 Where builders' work plenum chambers or ducts are employed, all internal surfaces should have a smooth finish and be sealed to prevent dust shedding.

9.135 All types of ductwork should be manufactured and installed to the appropriate current BESA specification.

9.136 Ductwork should be supported with threaded rod and channel. Note that sheet metal ductwork cannot use bolt-through supports. Gripple wire may only be used for circular galvanised spiral-wound or flat-oval ductwork.

Note: All installed ductwork whether new or reused should be subject to a leakage test on site prior to the application of any insulation. The leakage test will be to BESA DW144 but with a permissible leakage rate of not greater than 3%.

Fire aspects: damper types and locations

9.137 It is essential that all relevant fire aspects of ducting systems are agreed with the fire officer before the design is finalised (see paragraph 1.15 onwards).

9.138 Ductwork will be fire-stopped where it penetrates fire compartment walls, floors and enclosures, cavity barriers and subcompartment walls or enclosures, and provided with weatherproof collars where roofs or external walls are penetrated.

9.139 Fire and smoke dampers should be provided at the locations required by the Health Technical Memorandum 05 series of documents. The damper mounting frame should be securely attached to the building fabric strictly in accordance with the manufacturer's tested details. Where a fire and smoke damper is not mounted directly in a fire compartment wall, it must be correctly supported and the ductwork between it and the fire wall must possess the same fire rating as the fire wall that it penetrates. The fire-rated portion of ductwork must not be penetrated by test holes or inspection hatches (see also BESA DW145).

9.140 Any non-standard fire duct or damper arrangement should be agreed in writing by the client's fire advisor and subsequently tested and signed off by the installer.

9.141 An access hatch should be provided adjacent to each fire and smoke damper so that its correct operation can be directly observed. The hatch will be as large as necessary to permit inspection, testing and maintenance. The damper test switch should be mounted adjacent to the inspection hatch so that the routine test and visual confirmation of the damper operation can be carried out by a single person. For circular ductwork, rectangular saddle mounted hatches should be fitted (see BESA DW144).

9.142 Smoke-diverting dampers will be provided on recirculation air systems to automatically divert any smoke-contaminated return air to the outside of the building in the event of a fire. It should be arranged so that the normally open diverting damper in the return air branch to the input unit closes and all the return air is exhausted to outside (see paragraph 5.53 onwards).

Duct sections

9.143 When sizing ductwork, the designer should consult the CIBSE B2 guide.

9.144 All fittings should conform to the current BESA specification. Wherever possible, long radius bends, large radius main branches, not more than 45º angle sub-branches and long taper transformations should be used.

9.145 Bad design in relation to airflow can lead to vibration of flat duct surfaces, an increase in duct-generated noise, pressure loss in ductwork, unpredictable behaviour in branch fittings and terminals, and adverse effects on the performance of installed plant items, such as trimmer batteries.

Thermal insulation

9.146 In order to reduce energy consumption, achieve efficient energy recovery and prevent condensation in service voids, all supply and return air ductwork should be thermally insulated. Insulated ductwork runs outdoors should be weatherproofed.

9.147 The thermal insulation of intake and discharge ductwork will be dependent on its location in heated or unheated plant spaces and risk of surface condensation.

9.148 In normal circumstances, the insulation thickness for heat resistance is sufficient to prevent surface condensation, but in extreme conditions the insulation thickness for vapour resistance may be greater than that for heat resistance. When cold ducts pass through areas of high dew- point, carefully selected vapour barriers should be applied externally to the insulation.

Noise generation within the ductwork

9.149 Noise is generated in ductwork at sharp edges, by tie rods, damper blades, duct obstructions, sharp bends, etc. This airflow-generated noise becomes an important factor if it is about the same or greater level than the upstream noise level. Airflow-generated noise is often referred to as regenerated noise.

9.150 The noise level generated by airflow in ductwork is very sensitive to the velocity. The sound power of this noise is approximately proportional to the sixth power of the velocity; that is, a doubling of the duct velocity will increase the sound power by a factor of 64 (or about 18 dB). The duct velocities should therefore be kept as low as possible. In general, duct fittings which have lower pressure loss factors in similar flow conditions will generate less noise.

9.151 Ductwork serving quiet areas should not be routed through noisy areas, where noise break-in can occur and increase the noise level in the ductwork.

9.152 Grille register and louvre noise should be kept to the minimum by selecting types having low noise-producing characteristics, without high tonal noise; and should be fitted with acoustically treated external inlet and outlet louvres.

9.153 Cross-talk attenuators may be necessary where noise intrusion between adjacent spaces can arise and where individual room confidentiality is required. They will normally be of the “through-the- ceiling, up-and-over” type and may include a fire and smoke damper.

Volume control damper locations

9.154 In order to be able to carry out a full proportional balance, manually operated dampers are typically needed:

- in branches of zone ducts;
- in sub-branch ducts serving four or more terminals;
- in dedicated sub-branch ducts serving a room;
- at terminals not covered by any of the above.

9.155 Dampers integral with terminals are to be avoided for final trimming of air volumes, as they often create noise and air distribution problems.

9.156 Dampers in rectangular ducts should be opposed-blade multi-leaf type. In circular ducts, iris-type dampers are recommended. Dampers should be accessible, incorporate a position indicator and means of locking in the commissioned position. They should be installed with the adjusting handle or knob at the lower vertical edge

so that they are accessible for the commissioning team once the ceilings are in place. Dampers should be located as far away as possible from adjacent branches or plant items.

Duct cleaning and access door locations

9.157 Cleaning and access doors are required to facilitate access to plant items and ductwork components for inspection, maintenance, cleaning and replacement, and should be of sufficient size to permit safe access for the required functions.

9.158 Recommended locations for access doors are given in the current BESA TR/19 specification and are generally provided to give access to:

- every regulating damper;
- every fire-and-smoke, and motorised damper;
- filters (to facilitate filter withdrawal);
- both sides of trimmer cooling/heating coils;
- zone humidifiers;
- auxiliary fans;
- ducts, where required for cleaning.

9.159 Care should be taken when siting access doors to ensure that no other services to be installed will prevent reasonable access.

Flexible ducting

9.160 Flexible ductwork can only be used to make the final connection between rigid ductwork and a terminal in exceptional circumstances where a solid connection is not possible. Where used it will cause a significant frictional loss and may be difficult to clean, so it should take the most direct route and be as short as possible, never exceeding 0.5 m in length. It can never be used in lieu of a bend and will possess the same fire rating as the ductwork it is connected to.

Terminal fittings selection and sizing

9.161 The effectiveness of all ventilation and air-conditioning systems depends on the methods by which air is introduced to, and vitiated air is removed from, the space. The usual results of poor air-terminal selection and/or positioning are:

- draughts;
- stagnation;
- poor air quality;
- large temperature gradients;
- excessive noise.

9.162 Air can be supplied to a space in a number of ways, although any device can be broadly placed into one of two categories:

- that producing a diffused supply;

- that producing a perpendicular jet.

Diffusers may be radial or linear, and normally utilise the coanda effect (that is, adhesion of the air stream to an adjacent surface) to reduce the risk of excessive room air movement. A perpendicular jet is formed by discharging air through grilles, louvres or nozzles, which are generally adjustable.

9.163 Supply air terminals can be incorporated into any room surface, for example, floors, walls (high or low level), desktop.

9.164 As they operate on the jet principle, the use of sidewall and linear grilles is restricted to areas where air-change rates are low, that is, less than 10 per hour.

Perforated rectangular diffusers can provide acceptable conditions within the occupied zone at up to 15 ac/h. In areas where a higher air-change rate is required, square or circular ceiling-mounted diffusers should be used.

9.165 The performance of supply air terminal devices is based on three criteria – throw, spread and drop:

- throw is defined as perpendicular or parallel distance from the terminal to the point at which the air velocity is;
- 0.5 m/s isovel;
- Spread is defined as the width of the;
- 0.5 m/s isovel;
- Drop is defined as the vertical distance from the centre line of the terminal to the bottom edge of the 0.25 m/s isovel.

9.166 It is necessary to consider each of these parameters in both summer and winter conditions to ensure satisfactory operation of the air terminal device, as warm jets behave very differently from cold jets.

9.167 A warm jet tends to rise until it attaches itself to a horizontal surface, while a cold jet falls. Care should be taken to ensure that this does not lead to unacceptable temperature gradients in winter, or excessive air velocities in the occupied zone in summer.

9.168 In order to ensure satisfactory air movement within a space, it is necessary to consider interaction between air movement from adjacent terminals, and ceiling-mounted fixtures (light fittings, etc), as well as interaction between air movement and room surfaces.

9.169 If the supply and extract terminals are too close, short-circuiting may occur, while if they are too far apart, stagnant zones may be formed. Where two opposing air streams meet, the individual velocities should not be greater than 0.25 m/s. Further guidance on the selection of grilles and diffusers is given in the CIBSE Guide B

9.170 In operating theatres, the supply terminals should be able to produce a movement of air in the operating zone 1 m above floor level of between 0.2 and 0.3m/s:

- ceiling-mounted diffusers with fixed directional vanes that provide a downward turbulent airflow are the preferred option: 600 × 600 four-way blow or circular “air-master” style;
- plenum boxes fitted with perforated screens to produce a laminar downflow are also acceptable;
- linear ceiling-mounted diffusers that provide a downward-flowing air curtain around the operating theatre may also be used (additional supply terminals may be located within the area bounded by the linear diffusers to provide ventilation within the;
- air-curtained zone).

9.171 The following terminal types are not suitable for use in operating theatres because they do not produce an appropriate pattern of air distribution:

- swirl diffusers;
- single- or multi-outlet adjustable directional nozzles or jets of any type;
- sidewall-mounted linear diffusers that utilise the coanda effect to send air across the ceiling and “droop” it into the operating zone.

9.172 Extract terminals should be of an easy-to-clean design and, in order to assist identification when commissioning and subsequently measuring, be of a different design style to the supply terminals. Extract terminals mounted at low level should be of the spring clip retained, pull off face type to enable ease of cleaning. The terminal should be mounted on an angled face to prevent it becoming occluded by movable equipment or stores (see Appendix 9 for examples). Perforated plates are not to be fitted in extract terminals or extract plenums as they quickly become blocked with lint. Extract terminals do not need any directional adjustment so fixed-vane or “egg-crate” styles are preferred.

UCV terminal canopy

9.173 UCV canopies should be fitted with one or more non-electronic, mechanical, direct reading pressure gauge(s) to indicate the pressure drop across either a representative terminal EPA filter or the pressure in each zone of the canopy.

9.174 If a UCV canopy incorporates a method of adjusting the air discharge direction so that the canopy can be “tuned” to the room in which it is installed, the directional adjustment device(s) are to be capable of being locked in position once commissioning is complete to prevent future casual alteration.

9.175 Ceiling-mounted canopy diffusion screen(s) can become contaminated with blood spatter when in use. If the UCV canopy is fitted with perforated diffusion screens the blood spatter can penetrate, so the screens should be capable of being hinged down for cleaning between theatre cases. The screen retaining mechanism will have a double action to release the screen. Mono-filament diffusion screens should be retained by clip-in profiles or an alternative system that allows them to be easily removed when necessary.

9.176 For the validation of UCV terminal canopies, see Chapter 12.

Transfer grille: size and location

9.177 Air transfer grilles in walls, partitions or doors form an integral part of the building's air distribution system. Modern door sets have very low leakage rates so cannot be relied upon to permit even quite small airflows. Failure to make adequate provision for air to move from room to room will result in excessive pressure differentials and "door whistle".

9.178 Transfer grilles are required in locations where there is a significant imbalance between the supply and extract rates in a room. They will relieve any pressure differentials which may affect the operation of the spaces and/or the ventilation system and permit airflow in a known direction.

9.179 Care needs to be taken to ensure that the positioning of transfer grilles does not interfere with the fire or smoke integrity of the building. In general, the air transfer grilles should not be installed within fire- resisting boundaries, although if this is unavoidable, they should be fitted with fire or smoke dampers.

9.180 Where installed, transfer grilles should be of the non-vision type, sized for a maximum face velocity of 1.5 m/s.

Note: Cross-talk attenuators may be necessary where noise intrusion between adjacent spaces can arise and where individual room confidentiality is required.

Pressure stabilisers: size and location

9.181 Pressure stabilisers are required in areas where it is necessary to maintain a pressure differential between adjacent rooms and to prevent reversal of airflows for example, in operating suites, isolation facilities and cleanrooms (see paragraph 8.24).

9.182 Fire precautions for pressure stabilisers are the same as for transfer grilles. If the pressure stabiliser is fitted with a fire and smoke damper, the damper test switch should be easily accessible from, in airflow terms, the least clean side of the damper.

9.183 Pressure stabilisers should be of the balanced blade type, with the facility to make fine adjustment of the pressure setting. They should be silent in operation and give a seal as tight as practicable when closed. The materials of construction and method of assembly should allow for cleaning and disinfection.

9.184 Pressure stabilisers should be wall- mounted in a visible location so that their operation can be readily observed. For sizing criteria, refer to the manufacturer's information. When fitted at low level, they may require a stand-off cage to prevent occlusion (see photograph).

Figure 8 Pressure stabiliser with stand-off cage

9.185 Pressure stabilisers may need to be fitted with a stand-off baffle on their discharge side to prevent a sight line in situations where a laser will be used, and may be lead-lined for radiological protection if required (see photograph after paragraph 9.184). Baffles may also be needed to preserve privacy or prevent discharge air causing draughts within an anaesthetic room or bedroom. A stand-off baffle will always be needed on the theatre side of the pressure stabiliser between a “Lay-up” preparation room and a UCV theatre to prevent perturbation of the UCV canopy air pattern

Note: Baffles should be easy to clean and where radiological or laser protection is not required can be made of a rigid transparent material so that the action of the pressure stabiliser can be easily observed.

Distributed air-conditioning elements

Active and passive chilled beams

9.186 See paragraph 5.18 onwards for information on the use of these devices in healthcare premises and CIBSE Guide B for technical guidance.

Constant volume boxes

9.187 These are units fitted in or at the termination of ductwork that contain a mechanism to maintain a constant output air volume regardless of variation in the air pressure to the supply side of the unit. Where fitted they should be accessible for maintenance as the internal mechanism that controls the constant output will need periodic cleaning.

Variable Air Volume (VAV) boxes

9.188 Variable air volume systems are all-air systems which achieve local control by varying (throttling) the amount of air being supplied to each space, room or zone.

Standard type VAV systems deliver air that has been cooled to a set temperature (usually 13ºC) and then control the temperature in a space by varying the quantity of air supplied rather than the supply air temperature – which is kept constant.

VAV boxes are used as terminal devices at the supply end of ductwork to modulate the quantity of supply air to the space.

There are variations to standard VAV systems which allow air supply temperatures to modulate upwards with the aim of:

- reducing energy usage by allowing higher air supply temperatures at part-load conditions;
- improving ventilation effectiveness at part-load by having higher airflows
- – VAV can be as low as 10% of peak at low-load conditions depending on the equipment used;
- allowing the system to operate using warm air in winter for pre-heating warm-up in well-insulated buildings where heating is only used in very cold weather and for building pre- heat.

9.189 In most critical areas of a hospital a fixed air-change rate is required when they are in use. VAV is therefore generally limited to non-clinical applications.

Stand-alone air-conditioners

9.190 See paragraph 5.25 onwards for information on these units. The ceiling void should never be used as a plenum either for the primary air supply or fan coil supply or return air paths. (See CIBSE Guide B for installation notes.)

Powered air terminal filter units

9.191 This is an air-distribution-supply terminal box fitted with a fan and EPA or HEPA filter. Their use in the healthcare setting would be confined to spaces where a high air quality is required for a single room in an area supplied by a general AHU (for example, a local cleanroom).

9.192 They are not suitable for use in patient bedrooms due to the fan noise and maintenance access issues.

AHUs: automatic control

9.193 Chapter 6 of this document gives guidance on energy control strategies and Chapter 7 gives guidance on the point of use factors. Chapter 8 contains guidance to specific healthcare departments and their environmental and functional requirements. This section gives guidance on the control of the AHU and its subsystems. When developing a “controls specification”, the designer should consider the guidance given in all of these chapters.

9.194 Various options for control of single- and multi-zone air-conditioning systems are given in CIBSE Guide B.

General requirements

9.195 The basic requirements for an automatic control system are as follows:

- plant start, run, set-back and stop sequence;
- control of the volumetric airflow;

- control of the system or room pressure;
- temperature control and indication;
- humidity control and indication;
- devices to monitor and indicate the plant's operating state;
- alarms to indicate plant failure, low airflow, and filter state;
- the facility to collect data of actual usage and energy consumption.

The control functions actually provided will depend on the purpose of the ventilation system.

9.196 The designer should consider whether it is necessary for the supply and extract fans to be interlocked, either so that the supply fan will not operate unless airflow is established within the extract system, or vice-versa depending on the required pressures within the rooms being served.

9.197 The sequence switching of units in order to prevent transient reverse airflows will be particularly important in laboratory and pharmacy areas that also contain fume cupboards, safety cabinets and other LEV systems.

9.198 There will also be a need to determine the control strategy in the event of a fire either within the zone being served or within an adjoining zone and as detailed in the fire alarm cause and effect statement (see paragraph 7.16 onwards).

9.199 All supply AHUs should have a smoke sensor linked to the fire control panel and mounted in the main supply duct immediately downstream of the AHU. In the event of a fire in the AHU or smoke being drawn into the system from an outside source, it should cause the supply air fire damper to close and shut down the AHU.

Note: In certain critical departments, it is preferable to maintain the ventilation in the case of a fire within the area. For example, in an operating department while undergoing surgery the patient cannot always be easily moved without significant risk. In the event of a fire in a staff or support area of the department or adjoining zone, the continued supply of air to a theatre will maintain it at a positive pressure and protect the patient and staff from the effects of smoke.

This will allow time for the patient to be stabilised so that they can be safely.

Location of controls

9.200 Facilities to start, set-back and stop the plant should be provided in the plantroom. Remote start and set-back control and indication, if required, should be provided at a manned staff location, for example, at the reception or staff base.

9.201 Many ventilation systems may be completely shut down when the area served is not in active use. Alternatively, where there is a need to maintain a background condition, the ventilation output may be reduced by "setting back" the system. This will significantly reduce energy consumption and extend the life of filters and other system components. Controls to facilitate this should be triggered by the actual occupancy of the area rather than by a fixed time program (see paragraph 6.2 and associated Note).

Start up and shut down control sequence

9.202 The AHU should start and shut down in a pre-determined sequence. It should ensure that the fan does not start until the main dampers are open and the energy- recovery device is operational. On shut down there may be a need for a “run on” time to purge the area served before stopping the fan and closing the main dampers. Whether the supply or extract fan should start first and stop last will be determined by the pressure regime for the area served.

Set-back control

9.203 In previous times when fan motors only had two speeds, turning the system to “Set back” meant switching to the lower fan speed. With modern fans the speed is widely variable so “Set back” is not a fixed fan speed but rather a control strategy that reduces the system output in order to maintain a desired minimum condition. This may be related to the air velocity at a fixed point, air-change rate, pressure differential, temperature, humidity or a combination of these parameters. Providing a dew-point sensor in an internal space that brings the system onto “Set back” is a simple way of maintaining a minimum condition.

AHU running controls

Fog/frost coil control

9.204 Fog coils supplied by low pressure hot water (LPHW) should be controlled using the Proportional mode. Their sensor should be located downstream of the coil to give “closed loop” control. The coil should raise the incoming air temperature by 2 K in order to ensure that air entering the pre- filter is above its dew-point, thus keeping it dry. The greater the energy put into the incoming air by the fog coil, the lower will be the efficiency of the energy-recovery device.

9.205 If the temperature downstream of the fog coil, as sensed by a serpentine thermostat, falls below the required set point over any part of the coil, the plant should automatically shut down in order to prevent damage to the other batteries. The serpentine thermostat cannot be in direct contact with the coil and should cover the entire coil face.

9.206 Steam-supplied fog or frost coils should be operated as an on/off device to ensure that there is no standing condensate at the base of the coil. They should be fitted with a serpentine sensor mounted upstream of the coil but not in contact with it. This will give “open loop” control; a set point of +1ºC is recommended.

Energy-recovery device

9.207 The energy-recovery device is normally controlled by sensors in the air intake downstream of the supply fan, before the cooling coil and the extract duct from the ventilated space.

Supply & extract fans

9.208 The ErP Directive 1253/2014 requires a means of adjusting the fan speed. For plug fans this is provided by a separate inverter unit; for EC fans the control is integral to the fan motor. It should be remembered that most healthcare applications require known amounts of air to be delivered while the system is in use. Constant volume systems that deliver specified air-change rates are therefore the norm. Duct- or room-

pressure-controlled variable-volume systems have a limited application in healthcare. However, fan-speed control is beneficial when “setting back” the system.

9.209 Inverters should not be mounted inside the air stream within the AHU. Ideally, they will be mounted on a frame with the control valves. Where inverters are mounted inside a control box with a safety master switch to cut the power supply when the box is opened, the inverter control and indicator pad will be located on the outside of the box. This will allow on- site staff to view the operating parameters and switch the system to manual control if a fault occurs with the automatic control system.

9.210 It is necessary to ensure that should the computer control system or its software develop a fault, the fan can be switched to manual operation. This is particularly important for critical systems serving operating suites, high dependency care units of any type, patient isolation facilities, laboratories and pharmaceutical production suites.

Note: In the healthcare setting it is important to recognise that “off-site” software support is no substitute for the ability of “on-site” staff to override the automatic control and keep the system operating in an emergency. Under these circumstances actions that may shorten the life of the plant are considered of secondary importance to that of preserving the health and safety of patients and staff.

Heater-batteries

9.211 The main heater-battery should be controlled in the same manner under the dictates of an off-coil temperature sensor, or a room temperature sensor, or the return air temperature depending on the plant configuration and method of control. Trimmer heater-batteries are generally controlled by a temperature sensor within the room, or by averaging temperature sensors within a zone.

9.212 Heater-battery control valves should drive closed on system shutdown or fan failure. The control system should then automatically set to provide frost protection.

Cooling coils

9.213 There are two basic methods of control for cooling coils:

- off-coil control – used in multi-zone systems or single-zone systems where close humidity control is required, to provide a constant maximum off- plant condition which satisfies the temperature and humidity requirements of the zone with the highest load;
- sequential control – used in single- zone systems, or multi-zone systems with averaging sensors where close control is not required. A room or duct temperature sensor controls the cooling coil and heater-battery in sequence to maintain constant room conditions.

9.214 The advantage of off-coil control is that accurate humidity control can be provided without relying on humidity sensors, which are prone to inaccuracy and drift. Off-coil control is expensive to operate in terms of energy consumption because of the lack of feedback of room loads. As a result, at low loads and in systems where there are large zonal variations, significant over-cooling and reheating will occur.

9.215 The control logic should prevent the cooling coil and heat recovery and/or heater-battery being on at the same time.

Humidifier control

9.216` Accurate humidity control can only be provided on single-zone systems, or multi-zone systems with zonal humidifiers. In the above systems, humidity sensors control the humidifier for low-level humidity control, and override the temperature controls to open the cooling-coil valve for high-level humidity control.

9.217 Multi-zone systems are more usually controlled by a minimum humidity sensor located in the supply duct(s) following the last heater-battery.

9.218 Overriding controls separate from the normal plant humidistat should be installed. Their purpose is to prevent excessive condensation in the conditioned space when starting up. A time delay should be incorporated into the humidifier control system such that the humidifier does not start until 30 minutes after the ventilation/ plant start-up. In addition, a high limit humidistat should be installed to limitthe output of the humidifier so that the saturation in the duct does not exceed 70%. This humidistat is to control the added moisture; it is not necessary to install a dehumidifier to reduce the humidity of the incoming air if it already exceeds 70% (part load control).

9.219 The humidifier control valve should close when the ventilation system is in “set back”. In addition, on system shutdown, low airflow or fan failure, the humidifier should be isolated.

9.220 In a self-generating humidifier, if the humidifier is unused for a period exceeding 48 hours, it should automatically drain its water content, including that contained in the supply pipework, right back to the running main and leave itself empty.

9.221 With certain types of steam humidifier, it may be necessary to install a thermostat in the condensate line from the humidifier’s steam supply, to ensure that the steam at the control valve is as dry as possible before it is injected into the air supply.

9.222 The humidifier control system should ensure that it is switched off with the fan. It is preferable to design the control system so that the humidifier is isolated for an adequate time before the fan is turned off to purge humid air from the system.

Control valves: general

9.223 The fog/frost battery control valve should fail-safe, that is open in the event of power or airflow failure. All other valves will stop in their current position in the event of power failure and should drive closed in the event of airflow failure.

9.224 Control valves should be located in an accessible position. Isolation valves should be provided to enable the control valve to be removed for service or replacement without the need to drain down the system

9.225 Care should be taken to ensure that the installation of control valves and their associated pipework do not obstruct access to the AHU inspection doors, removable drainage trays, eliminator units and access hatches.

Note: There are practical advantages in locating all control valves for an AHU in a bank (at a convenient height) at one end of the unit. (This should not result in an

additional control lag.) The bank will hold the control valves and actuators, and fan inverters/controllers as necessary, and can be constructed “off site” (see also paragraph 9.209).

Monitoring and alarms

9.226 Monitoring of the plant performance should be via a BMS to the estates and maintenance department.

9.227 The “plant failure” and “low airflow” alarm should be initiated by a sensor located in the main air supply duct. This should operate when the air quantity fails to reach or falls to around 80% of the design value and will give indication of fan failure, damper closed, access door left open, or any other eventuality that could cause a reduction of air quantity. Monitoring the current drawn by the fan motor is not a substitute for a sensing device that is directly affected by the airflow. The sensing ring fitted to plug and EC fans will fulfil this function.

9.228 The “filter fault alarm” should be initiated by a predetermined increase of pressure differential across the filters, thereby indicating a dirty filter. The filter fault indication and alarm is information for the maintenance department; it should not appear on any point of use indicator or control panel.

9.229 Visual indication that the AHU is operating within its prescribed parameters should be provided in critical areas at a manned staff location, for example, the reception or staff base. These need only take the form of a green light to show the system is operational and a red light to show that it is not.

Room temperature control

9.230 The limits for room temperature set point are generally between 18ºC and 25ºC depending on the particular application, and in some specialised instances (for example, operating departments) are adjustable within a predetermined range by the user.

9.231 The selection of temperature set point for each room or zone may be by a control facility in the room/zone, or remotely at the control panel or BMS. Where the control device is mounted within the room/zone and adjustable by the user, it should be marked either “raise” and “lower” or “+” and “–“. It should control within a specified temperature range to suit the user requirement with a control tolerance of +1 K. All other control set points should be selectable either on the control panel or at the BMS interface.

9.232 Where local control is provided, an indication of temperature will be required locally, or at a staff base (if appropriate), using an analogue or digital indicator. The indicator should be large enough to be read from the normal working position (for example, at the operating table in a theatre). This may be mounted in a supervisory control panel, with the signal repeated on the main system control panel or BMS. It is important that this indicator displays the actual measured temperature and not the selected temperature.

Local exhaust ventilation (LEV)

9.233 Devices that use an inflow of air to control exposure of staff to hazardous substances are classified as LEV systems under the COSHH Regulations.

9.234 An LEV system will typically comprise a unit where the airborne hazard is captured, ductwork to convey the extract air to the fan and a discharge stack. The extract air may be filtered or centrifugally separated to remove any particulate material prior to discharge. HSG 258 produced by the Health & Safety Executive gives detailed guidance.

9.235 It is important to recognise at the design stage whether an extract is being provided for comfort, to remove odours or to remove hazards, in which case it will be an LEV system. Chapter 8 lists typical devices used in healthcare applications.

9.236 The quantity and location of the terminals supplying the make-up air is an important factor in the design of LEV systems.

9.237 LEV systems are statutory items that will be subject to an independent examination and test at least every 14 months by a competent person.

Extract ductwork and fan

9.238 Extract ductwork for an LEV system should, where possible, be installed outside of a building. Where it has to be inside, it should take the most direct route through, with as few bends or changes of direction as possible.

9.239 All ductwork joints should be sealed and ideally there should be no access hatches. Where access hatches have to be provided, they should be of a type that has a hermetic seal.

9.240 Some substances are particularly corrosive, so the choice of material for the ductwork, and type of extract fan fitted, should reflect the nature of the substance being conveyed.

9.241 The ductwork should either be fire rated or fitted with intumescent collars where it passes through fire compartments within the building. This will ensure that the extract system is unobstructed and always open to atmosphere up to the discharge point.

9.242 Some LEV systems (for example, microbiological safety cabinets) HEPA-filter the extract air within the cabinet unit, but it should not be assumed that the exhaust air will be totally free from microbiological or other hazardous material.

9.243 The extract ductwork should as far as practicable be kept under negative pressure while inside the building. The extract fan should be located outside of the building or if this is not practicable, as close as possible to the outside so that any ductwork on the discharge side inside the building is kept to an absolute minimum.

9.244 The extract fan drive motor should be out of the airstream and it should be possible to change the motor without disturbing the fan or its casing.

9.245 Duplex fans are only required when several LEV systems share a common extract system (for example, multiple fume cupboards in a large pathology department where it can be anticipated that at least one cupboard will always be in use or need to be

available for use). In such a situation each cupboard should be fitted with a non-return damper at the point that it joins the common system and be capable of being isolated from the common extract system. The common extract duct should be large enough to handle the combined extract volume from all the systems that feed into it.

9.246 If extract filters are fitted in the ductwork the system design should allow them to be changed safely.

9.247 Current standards permit the installation of microbiological safety cabinets with integral fans, provided that the extract ductwork can be kept short (that is, less than 2 m); such an installation, however, is likely to be noisy and is not recommended for use in new buildings.

LEV discharge stack arrangements

9.248 Roof-level discharge, wherever practicable, is preferred since it removes much of the uncertainty over air re- entering the building through ventilation inlets or windows. In such an installation, the extract fan should be situated separate from the LEV captor unit and close to the discharge stack to maintain the duct within the building under negative pressure.

9.249 The discharge point on a flat roof should be through a terminal at least 3 m above roof level but as high as necessary to limit re-entry into supply air inlets or other plant openings. This will protect those who may need to access the roof. Terminals at other roof types need to be high enough to prevent the wind blowing across the roof from causing downdrafts.

9.250 Where there are adjacent buildings with opening windows, or where downdraughts are likely to occur, it may be necessary to increase the height of the discharge stack in order to achieve adequate dispersal. In complex locations, airflow modelling or wind tunnel tests may be required to determine the optimum height.

9.251 The discharge stack should have an open end. It may be fitted with a collar to reduce its area and so increase the air efflux velocity at the point of discharge (known as the venturi effect). To ensure that air leaving the terminal is not deflected down but allowed to disperse freely, the terminal cannot be fitted with any sort of cover or hat. A drain may be required at the base of the discharge stack to remove any rain that enters (see photograph).

Figure 9 Typical LEV discharge stacks

LEV system information and identification

9.252 Once installed, all elements of each LEV system should be uniquely identified with a permanent label as described in Chapter 13. There is a statutory requirement to have information on the design and required operational performance of an LEV system available to those who are responsible for its operation and

9.256 maintenance. The designer should ensure that this information is available at handover.

10. Installation Standards

General

10.1 AHUs, ductwork sections and associated elements of the ventilation system will be delivered to site suitably packaged to protect them from damage and casual contamination. They should remain protected when stored on site awaiting installation.

10.2 Ductwork should be installed to the “Advanced Level” as defined in BESA’s (2019) ‘TR/19: Guide to good practice – internal cleanliness of ventilation systems’. Should any doubt exist as to whether the guidance has been observed, the ducts should be cleaned internally to restore them to this standard and be visibly clean before being taken into use.

10.3 When the ventilation elements are installed, all open ends have to be sealed to prevent the ingress of construction dust as installation progresses. The access doors and panels of AHUs should be kept closed. All AHU dampers and fire dampers should be covered to prevent casual contamination during the construction phase. This is particularly important for fire dampers mounted in the plantroom floor. The damper blades should be wiped clean before final connection to the distribution ductwork.

10.4 The area around the supply air intake should be kept free of vegetation, waste, rubbish, builders’ debris or any other possible source of contamination.

10.5 “Builders’ work” ducts of brick or concrete should have a smooth internal finish and be surface sealed to prevent the release of dust before being taken into use. They should be fitted with a drainage system if not self-draining.

10.6 Every effort should be made to prevent the internal contamination of the ventilation system during the construction phase as once contaminated, it is extremely difficult to completely remove dust and debris. In particular, extract and recirculation fans should not be run up until the area is at least “builders clean” – that is, the floors swept and wet-mopped – otherwise the energy-recovery device in the AHU could become contaminated and its efficiency significantly reduced.

AHUs

10.7 Units should have a working life of up to 20 years; it can be anticipated that over this period there will be a need to access every element within the unit for deep cleaning. It is also quite possible that during the life of the unit, the main fan and all control valves will need replacement. Heater and cooling coils may also need to be repaired or replaced. Suitably positioned service connection joints and adequate spacing should permit these items to be isolated and withdrawn without the need to drain down entire systems or dismantle other installed plant.

10.8 Care should be taken during installation to ensure that electrical and mechanical services are not installed in positions that will reduce or impede access. Mounting all control valves and fan controllers on a frame positioned adjacent to the unit is the

preferred option. This approach has the advantage that the frame and its components can be built and tested “off-site”.

10.9 In order to reduce the effects of galvanic corrosion, black iron fittings should not be used in the pipework installation. Rolled jointed stainless-steel pipework is preferred.

10.10 Vibration from a remote plantroom can be transmitted by the structure of the building, and may be regenerated and sometimes magnified many times. Pipe and ductwork should incorporate anti-vibration couplings, pipe hangers and supports, preferably in two planes at right angles, as close to the vibration source as possible.

10.11 The service connection points for pipework and electrical conduits will have been made during construction of the unit. The unit will then have been leak-tested in the factory prior to delivery to site. If there is a need to drill through the AHU casing or panels (for example, to mount a sensor), the hole should be as small as practicable and sealed to prevent air leakage.

10.12 It is essential that the AHU/ductwork is mounted far enough from the floor to permit the correct installation of drainage systems for cooling coils, humidifiers and heat recovery systems. If the AHU is located on a roof, it will require a clearance of 600 mm to provide access to maintain the building structure below. Sufficient height for the installation of drainage pipework and traps should always be allowed. Easy access for maintenance of drainage systems and their associated pipework should be provided. It should be possible to fully withdraw the drainage tray if it is of the removable type.

10.13 AHUs should be positioned so that all parts are easily and safely accessible for routine inspection and service. If a unit is located against a wall or backs onto another unit, access to all parts should be available from the front. Units greater than 1 m wide should preferably have access from both sides or access doors large enough to permit the full and safe entry of maintenance personnel.

10.14 Air filters, cooling-coil drainage trays and drift eliminators are all items that should be changed, inspected or withdrawn on a regular basis. The installation of the AHU should permit this without the need for tools or to dismantle other plant or systems.

10.15 Access to air intakes and discharges, AHUs and items in the distribution system such as filters or auxiliary trimmer batteries located in a plantroom or plant area should be via fixed ladders, hook ladders, pulpit style steps or other moveable access platforms. The installation of distribution ductwork and other electrical or mechanical services should provide sufficient clearance to allow access equipment to be moved into position.

Distribution systems

10.16 Where ductwork penetrates a roof, it should be protected by an upstand to prevent water penetration. Where it penetrates an outside wall, the method of installation should prevent water tracking along the ductwork into the building or its wall cavity.

10.17 The installation of all services in service ducts and above ceilings should be coordinated so that cable trays, medical gas and other pipework do not obstruct or

prevent access to the ductwork cleaning doors, dampers and any auxiliary plant elements. The use of BIM should highlight clashes at the design stage.

10.18 Plant elements such as VAV boxes, trimmer heaters or cooling coils, humidifier lances or branch filters that are located outside of plant spaces should be accessible for routine inspection and have a cleaning access door on both sides. They cannot be installed above any of the following areas:

- operating theatres;
- preparation rooms or sterile pack stores;
- anaesthetic rooms or recovery areas;
- rooms containing imaging equipment;
- pharmacy cleanrooms;
- containment laboratories;
- patient bedrooms and isolation rooms.

10.19 Rectangular ductwork sections should be joined by bolted or clipped gasketed flanges. Circular and flat-oval slip-joints should be mastic-sealed and held with blind rivets, not screws. The mastic used should not support biological growth. The ductwork installation will be leak-tested prior to acceptance.

10.20 Volume control dampers (VCD) should be oriented so that their adjusting handles or knobs are located at the lower vertical edge or bottom of the damper when mounted above ceilings. The means of adjusting the damper will be within sight and reach from a designated ceiling void access hatch once the ceiling is complete. Volume control dampers mounted in any location should have the control adjuster mounted to allow easy access for the commissioning team and for future access when a post-cleaning rebalance is undertaken.

10.21 Access to VCDs or local auxiliary fans mounted above ceilings should be via low-leakage access hatches mounted in the ceiling or hatches integral to a light fitting.

Note: Obtaining access by removing a light fitting is not acceptable.

10.22 Where ducts are drilled to provide test holes or to mount sensors, the swarf should be removed, and the hole deburred before the fan is started.

Note: Care should be taken to prevent the inadvertent drilling of attenuators.

10.23 Flexible ductwork may only be used if there is no other way of connecting an air terminal to a duct. The flexible duct should be not more than 0.5 m in length, be as fully extended as possible and never used in lieu of a bend. The fire rating of the flexible duct should be no less than that of the fixed duct that it is connected to (see also paragraphs 9.131 and 9.160).

10.24 Fire and smoke dampers must be installed strictly in accordance with their manufacturer's instructions. There will be a rectangular access hatch (saddle mounted for circular ducts) and test switch adjacent to the damper so that a single person can trigger the damper and directly observe its operation during the annual

test (see photograph). When pressure stabilisers incorporate a fire damper, the test switch is to be located in an easily accessible position on the less clean side of the pressure stabiliser.

Figure 10 Fire damper with test switch and inspection hatch

Point of use

10.25 Items of equipment that require access for inspection and cleaning should not be accepted if they are installed in locations that prevent easy access.

10.26 Items of equipment that require access for inspection and cleaning such as fan coil units will not be accepted if they are installed directly above medical or diagnostic equipment.

Note: A common problem occurs because installation layout drawings show fan coil or similar units on the room plan. These are often only “indicative” of the fact that there will be a unit in the room but are taken as the desired position by those carrying out the installation. As an example, the installation drawing for an interventional imaging room shows a fan coil unit in the centre of the ceiling. If it is installed in this position it will be directly above the scanner once that is installed. The fan coil unit will then not be accessible for routine inspection and maintenance, and should it leak water, it will put the scanner out of action.

10.27 The installed position of ceiling terminals in storerooms (for example, a theatre's bulk sterile pack store) should coordinate with the siting of the storage racking. The airflow at the terminals should be routinely measured, so the racking and its contents should not obstruct access to the terminal when using a calibrated hood. The same problem can occur in recovery rooms and ward areas where bed curtain rails and bed hoist tracks can prevent the measurement of airflow from ceiling terminals.

10.28 Low-level extract grilles should be of the pull off face type for ease of cleaning.

10.29 See pictures of low level extract installations in Appendix 9.

Service penetrations

10.30 Where services penetrate the fabric of the building, they should be sealed to prevent any uncontrolled air leakage between rooms and service spaces or voids. Situations where this occurs will be:

- service spaces behind IPS panels at wash basins and scrub troughs;
- cased in wall-mounted medical gas pipeline units and ceiling-mounted pendants;
- electrical trunking and bedhead rail systems;
- boxed-in main and local drainage pipework;
- ceiling-mounted operating lights, examination lights and other pendant-supported items.

10.31 The sealing should be at the point that the service penetrates the wall, ceiling or floor and not at the access panels or covering shrouds as these will need to be removed from time to time. Sealing of the penetrations should be done at first-fix stage as access will become progressively more difficult once final covers and finishes are applied. In certain applications, permeability testing will be carried out at first-fix stage to ensure that this has been done.

Note: The "clean zone" is not the same as the overall size of the canopy, and it is vital to consult the UCV canopy supplier in order to get the position and size of the zone correct, as mistakes are expensive to rectify.

11. Commissioning Systems

General

11.1 Commissioning is the process of advancing a system from physical completion to an operating condition. It will normally be carried out by specialist commissioning contractors working in conjunction with equipment installers. Commissioning of the ventilation system will normally be the responsibility of the main or mechanical contractor who should coordinate the process.

11.2 Commissioning is often subdivided into sections (for example, air handling unit, automatic controls, air side balance, building fabric and fittings). Each section may be commissioned by its specialist installer, and they are often accepted in isolation.

11.3 Commissioning is an essential process for ventilation systems. It is therefore important that adequate provision for the process be made at the design stage of the project. Procedures for commissioning air-handling systems are given in CIBSE Commissioning Codes and BSRIA BG 49 – Commissioning Air Systems.

11.4 The duct design process should take into account the requirements of system balancing. The position and number of regulating dampers included in the design should be sufficient for this purpose.

Location of dampers and test holes

11.5 Balancing/commissioning dampers will be required in each branch of the distribution ductwork. In a critical system such as an operating suite, the branch to each room and each location where it is required to carry out a proportional balance should have a balancing damper.

11.6 Test holes for the measurement of airflow will be required at carefully selected points in main and all branch ducts. The number and spacing of holes are given in the BSRIA BG 49/2015 Commissioning Air Systems. Their positions should be identified at the design stage.

11.7 The test positions need to be accessible for commissioning to take place. They may also be required for subsequent annual verification of the system performance, so they should not be covered by permanent lagging.

11.8 The measurement point should be in a straight length of duct as far away as possible from any upstream bends, dampers or other elements that could cause disturbance to the airflow. The actual location should be:

- at least 1.5 duct diameters upstream of sources of turbulence such as dampers and bends;
- if this is not possible, ten diameters downstream of dampers, bends or tees, and five diameters downstream of eccentric reducers;
- where there is enough space round the duct to insert the pitot tube and take readings;
- where the duct has a constant cross- sectional area.

Test holes for measuring total airflow from a fan should be located either four diameters upstream or ten diameters downstream of the fan. Provision should also be made for measuring the fan's speed of rotation.

Note: Plug and EC fans are supplied with a measuring ring so their output can be read directly. This needs to be connected to an external pressure tapping or electronic fan control unit.

Information to be provided

11.9 It is essential that the designer should pass on the system-design intent fully to the commissioning engineer by providing:

- relevant parts of the specification;
- schematic drawings indicating data listed in Table 11;
- equipment schedules;
- controller and regulator schedule;
- fan performance curves;
- wiring diagrams for electrical equipment, including interlock details

Table 11: Information to be provided on schematic drawings

Items in system	Information to be provided
Fans	Fan total pressure Volume flow rate at normal and set back speed Maximum motor current
Plant items	Type and identification numbers from equipment schedules Fluid and air volume flow rates Fluid and air side pressure losses Dry bulb temperatures Wet bulb temperatures Humidity
Dampers, including motorised and fire dampers	Identification numbers from equipment schedules Location Identification number Volume flow rate
Main and branch ducts	Dimensions Volume flow rates and velocities Identification numbers from equipment schedules
Test holes and access panels	Location and size of duct Identification number Design airflow rate
Room supply and extract terminals	Location Identification number Grille or diffuser factor Volume flow rate and neck velocity Operating static pressure
Pressure cascade	Room differential pressures Airflow direction between rooms Pressure stabiliser and transfer grille locations
Internal environment conditions	Design room conditions and adjustable range Specific room air velocity if specified Noise level
Controllers	Set points

Notes: Fan total pressure is the difference between the total pressure (static pressure + velocity pressure) at the fan outlet and the total pressure at the fan inlet. Where volume flow rates are variable, maximum and minimum values should be provided.

Commissioning personnel

11.10 It is unlikely that all the required commissioning skills will be possessed by one individual; a commissioning team is therefore usually needed. The objective of commissioning is to ensure that the necessary performance and safety requirements are met.

11.11 During the commissioning process a great deal of information will be generated which will form an invaluable future source of reference about the plant. It is essential to ensure that it is collected together in the form of a commissioning manual and handed over to the client on completion of the contract together with the “as fitted” drawings.

11.12 In order to be successful the commissioning process will need to start before practical completion, as many parts of the system will become progressively less accessible. The correct installation of those parts should be witnessed and leak rate tests carried out as construction proceeds. Failure to establish responsibility for commissioning early enough will delay the completion of the project or lead to unsatisfactory plant performance (see CIBSE Commissioning Code M).

Commissioning brief

11.13 The commissioning team will require a detailed brief from the system designer. This should include:

- a “user” brief comprising a description of the installation and its intended mode of operation;
- the precise design requirements with regard to the scheme of air movement, room static pressures, supply and extract airflow rates and acceptable tolerances;
- full details of the design conditions both inside and out, for winter and summer, together with the control strategy;
- equipment manufacturers’ type test data, commissioning, operation and maintenance recommendations;
- drawings showing the layout of the system, positions of airflow measurement test points, dampers, regulating devices and filters within the duct runs, together with sizes of ducts and terminal fittings. It will save time if these drawings are annotated with the design volumes and static pressures required at each branch and outlet point;
- wiring diagrams for all electrical equipment associated with the air- handling systems, including motor control circuit details and any interlocking and safety devices.

11.14 CIBSE Commissioning Code A – ‘Air distribution’ or BSRIA BG 49 – ‘Commissioning air systems’ provide full guidance on the information that will be required by the commissioning team.

11.15 Designers should specify the type of measuring instruments and test procedures. They should include in the contract documents instructions on verifying the accuracy of test instruments, which should be supported by reference to relevant calibration certificates.

11.16 The system, on completion, should be operated by the contractor as a whole and subject to performance tests in accordance with the contract requirements. These will include independent validation of the system performance on behalf of the client.

11.17 The commissioning process should be carried out in the order in which it appears in this guidance document. That is to say, the static checks and visual inspections itemised in paragraphs 11.20–11.26 should be followed by the dynamic tests described in paragraphs 11.27–11.46, the performance tests listed in paragraphs 11.47–11.64 and finally the handover procedures set out in paragraphs 11.63–11.65.

11.18 Once the system is shown to meet the design intent, the handover documentation should be completed. In the event of performance not being acceptable, the matter should be dealt with in accordance with the contract arrangements.

Pre-commissioning checks

11.19 The pre-commissioning checks consist of visual inspection, manual operation of equipment, static measurements and functional tests of individual components. They should be carried out prior to setting the system to work and undertaking the dynamic commissioning process set out in paragraph 11.27 onwards.

Note: Before commencing commissioning, it is essential that builders' work in the area served by the system is complete. The doors and windows should be fitted, floor finishes applied, walls and ceilings completed and their final finish applied. Fans should not be run until the area is clean (see paragraph 10.6).

Standard of installation

11.20 During the installation of the system the following will be witnessed:

- that the plant and installations have been provided and installed in accordance with the design specification and drawings;
- that only approved sealants have been used in the installation;
- that all components function correctly;
- that the satisfactory sealing of access doors and viewing ports has been carried out;
- that the AHU airtightness test as per BS EN 1886 has been carried out;
- that air-pressure tests and air-leakage tests on ventilation ducting have been carried out in accordance with the methods set out in the BESA DW143 – 'Ductwork leakage testing' but the leakage rate to be not greater than 3% (it is usual to carry out these tests a section at a time as the ductwork is installed and before its insulation is applied. The results will be recorded in the commissioning manual);
- that gaps around doors and hatches are as specified in the design;

- that the permeability tests are carried out as per paragraph 12.17;
- that the correct operation of pressure stabilisers, control dampers, isolating and non-return dampers have been checked;
- that test holes have been provided in their specified locations and are sealed with suitable grommets;
- that control dampers are secured and their quadrants fitted correctly;
- that any interlocks are operative and in accordance with specification;
- that the electric circuits are completed, tested and energised;
- that electric motors have been checked for correct direction of rotation both at full speed and set back;
- that cooling and heating media are available at correct temperatures and pressures and in specified quantities
- that the air-conditioning plant components and controls function correctly;
- that the air-conditioning plant interlocks and safety controls function correctly;
- that the plant is physically complete, insulation is applied and all ducts and pipework are identified as specified;
- that all service penetrations of the fabric of the area are sealed at the point of penetration (see also paragraph 10.30);
- that the building housing the ventilation plant is generally in a fit condition for commissioning and performance tests to commence, that is, windows, doors, partitions, ceilings, etc. are completed, surfaces sealed and their final finish applied;
- that the areas containing the ventilation plant and those being served by it are clean;
- that access to all parts of the system is safe and satisfactory.

Certification of equipment

11.21 The following test certificates should be assembled by the commissioning team and be available for inspection at any time during the contract period. They will form part of the handover information and should be placed in the commissioning manual:

- type test performance certificates for fans;
- pressure test certificates for:
  - heater-batteries;
  - cooling coils;
  - humidifier (if appropriate);
- type-test certificates for attenuators;
- type-test certificates for primary and secondary filters;
- individual test certificates for EPA or HEPA air filters.

Equipment tests

11.22 Prior to setting the system to work the following will be witnessed and proving tests should be carried out as detailed:

Filters

11.23 The quality of filter housing and in particular, the seals, is a critical factor in maintaining the efficacy of the filtration system by ensuring that air does not bypass the filter elements. Therefore, the following checks should be made:

- filter seals should be fitted and in good condition;
- filters should be installed correctly with respect to airflow;
- bag filters should be installed so that the bags are vertical and their pockets free;
- all filters should be checked to ensure they are free of visible damage;
- EPA or HEPA filters should be scanned with an LSAPC to prove that they and their housings achieve the specified filter efficiency;
- the differential pressure indicators should be checked for accuracy and that they are marked with the initial and final filter resistance.

Drainage arrangements

11.24 The drain should conform in all respects to the standard set out in paragraph 9.105 onwards. In addition, the following should be proved:

- that the drain tray is easily removable or completely accessible;
- that the drift eliminator (if fitted) is removable without the use of tools;
- that a borosilicate glass trap is fitted and is easily removable;
- that the trap discharge point to drain has a clear air-gap of at least 15 mm;
- that the pipework is supported so that the air-break cannot be reduced;
- that the drain system from each drain tray is independent up to the air- break.

11.25 The operation of the drainage system is then proved by introducing water into the duct at the drain tray and observing that it completely drains out. This check is to be repeated both at normal speed and set back once the fans have been commissioned. At this time the clear trap can be marked to indicate the normal water level with the fan running.

Fire dampers

11.26 The following will be witnessed and proving tests should be carried out as detailed:

- the operation of all fire and smoke dampers (fire dampers fitted with a thermally actuated “memory metal” mechanism should be proved using a hot air heat source);
- the access provided to enable the dampers to be visually inspected and/ or reset should be sufficient for the purpose;
- indication should be provided of the dampers’ position (open/tripped);

- indication of the fire dampers' location should be provided both on the ductwork and at a visible point on the building fabric if the ductwork is concealed.

Dynamic commissioning

Air-handling and distribution system

11.27 Before commencing the dynamic commissioning all rubbish should have been removed and the floors swept and wet- mopped (see paragraph 10.6). Any IPS panels should be in position, access hatches closed, light fittings in place and ceiling tiles clipped down as necessary.

11.28 The fan drive, direction of rotation, speed and current drawn should be set in accordance with their manufacturer's instructions. In the vast majority of healthcare applications, the fan output should be set to give a constant volume of air. This to be controlled by measuring the pressure drop across the fan using a sensing ring and associated volume controller that will automatically integrate the fan 'K' factor to determine and control the pre-set output air volume. The fan output will then in air volume terms remain constant regardless of changes of system resistance. The actual volume delivered will be related to the air-change rate for the application.

11.29 After the installation has been checked to ensure that it is in a satisfactory and safe condition for start-up, it should be set to work and regulated to enable the plant to meet its design specification. The proportional balancing method described in the CIBSE Commissioning Code A should be followed. The airflow rates will be set within the tolerances laid down in the design brief. This will normally be the design airflow rate +10%; –0%.

Note: Plug fans are fitted with a measuring ring so that the design volume flow can be set when first started. It can then be reset as the airflow balance progresses. This method will result in the correct airflow with the least total system resistance once balancing is completed.

Air commissioning measuring equipment standards

11.30 All test and measuring equipment used will have a certificate to prove that its calibration has been checked within the previous 12 months at a facility using traceable national standards.

11.31 System performance should be measured at the main and branch duct supply and extract test points using a pitot and manometer or a thermal anemometer.

11.32 Supply and extract air volumes at the room terminals should be measured using a calibrated hood with back pressure compensation. If a hood correction factor is applied, it should be determined by a direct comparison with a duct measurement immediately adjacent to a terminal and not a general comparison between air at the main supply duct and the total as measured at the terminals. For multi-directional terminals a correction cross will be fitted in the measuring hood.

Note: Measurements taken with a "home- made" hood or cone will not be accepted.

11.33 Measurements at extract grille faces should, where possible, be taken using a calibrated hood. Alternatively, they may be measured with a rotating vane anemometer fitted with a hood, or as a last resort, scanned using a rotating vane anemometer and a free area factor applied. The grille face free area and factor used should be stated in the commissioning report.

Order of commissioning

11.34 When combined supply and extract systems are to be balanced and the area that they serve is to be at or above atmospheric pressure, the supply should be balanced first with the extract fan switched off, and then the extract balanced with the supply fan(s) on. The supply balance should then be rechecked.

11.35 For combined systems where the area that they serve is to be below atmospheric pressure, the extract should be balanced first with the supply fan switched off and then the supply balanced with the extract fan on. The extract should then be rechecked.

11.36 On completion of the balance, all volume airflows in supply and extract ducts and from grilles and diffusers will be measured and recorded. The true air- change rate can then be calculated from the data obtained.

Note: For accuracy the room dimensions should be actually measured on site rather than deriving them from design drawings.

11.37 All supply and extract duct volume control dampers should be locked and their position marked and the fan motor settings noted and recorded.

11.38 All grille and diffuser volume control registers should be locked to prevent alteration and their final position marked.

Room air distribution

11.39 The pressure relief dampers and pressure stabilisers will be set to achieve the specified room differential pressures and locked. The grille direction control vanes and diffuser cones will be set to give the specified air movement pattern. Visualisation techniques may need to be employed to prove the required airflow pattern is being achieved and detect any adverse coanda effects (see paragraph 9.162).

Note: When balancing combined supply/ extract cascade ventilation systems (for example, operating suites, cleanroom suites), the airflow through the extract terminals in the adjacent corridors may need to be adjusted outside of their original design values in order to achieve the desired room pressure differentials.

Air-conditioning plant

11.40 The specified flow rate and/or pressure drops will be set for all heater- batteries, cooling coils and humidifiers. The methods described in the CIBSE Commissioning Codes W and R should be followed. On completion their regulating devices will be locked to prevent alteration.

Control system

11.41 The control system should not be commissioned until both the air distribution system and air-conditioning equipment have been commissioned.

11.42 Because of the specialised nature of control systems and the fact that each manufacturer's system will contain its own algorithms and settings, commissioning should be completed by the supplier, and witnessed and documented by a representative of the client (for example, the healthcare organisation's appointed validator).

11.43 In the vast majority of healthcare applications, the fan output should be set to give a constant volume of air. This to be controlled by measuring the pressure drop across the fan using a sensing ring and associated volume controller that will automatically integrate the fan factor to determine and control the pre-set output air volume. The fan output will then in air volume terms remain constant regardless of changes of system resistance. The actual volume delivered will be related to the air-change rate for the application.

Note: Measuring the air pressure in the main supply duct and using that to set the supply fan speed as a percentage of its rated output and using that to set the extract fan speed as a percentage of the supply fan speed is not a satisfactory, accurate or acceptable way of controlling the desired supply and extract air volumes.

11.44 The location of all control and monitoring sensors should be checked and their accuracy proved.

11.45 The control system's ability to carry out its specified functions will need to be proved. The correct operation of any alarm systems should also be proved.

11.46 If the plant is provided with a "users" control panel in addition to the one located in the plantroom, the operation of both should be proved. This will typically apply to operating departments and laboratory systems.

Specific performance standards

11.47 The performance of the system should be measured and compared with information provided by the designer.

Plant capacity and control

11.48 When setting to work and proving the design, both the manufacturer of the air handling plant and the control specialist should attend site together and jointly commission the system.

11.49 If any doubt exists as to the capacity of the installed system, its ability to achieve the specified inside design conditions with the plant operating at winter and summer outside design conditions should be proved. Artificial loads will be required in order to simulate the internal gains/losses and the outside design conditions.

11.50 On completion of the plant performance test, recording thermo- hygrographs should be placed in each room/ area served by the plant and also the supply air duct upstream of the fog coil. The plant should be run for 24 hours with all doors closed.

During this period the inside conditions should stay within the tolerances specified. Alternatively, the BMS may be used to obtain the information required.

Noise levels (general)

11.51 The commissioning noise level is that measured with a sound level meter in the unoccupied room, taking account of the external noise together with the noise generated by the ventilation system. Chapter 8 and Table 1 in Chapter 4 give information for many applications.

11.52 The noise levels apply at the maximum velocity for which the system is designed to operate. Acoustic commissioning tests should be carried out with all plant and machinery running normally and achieving the design conditions of airflow, temperature and humidity.

11.53 An industrial-grade Type 2 sound level meter will normally be sufficient to check the noise level. Its accuracy should be checked using a calibrated sound source before use.

11.54 The noise level readings are to be taken at typical normal listening position 1.5 m above floor level and at least 1 m from any surface and not on any line of symmetry. In critical rooms the noise should be measured at the centre of the room and at the centre of each quarter. The mean of the five readings should then be calculated

11.55 In the event of a contractual deficiency a Type 1 precision-grade sound level meter should be used and the noise level determined by the procedure given in Scottish Health Technical Memorandum 08-01.

Filter challenge

General ventilation filters

11.56 In-situ performance tests will not normally be required for primary and secondary filters and their housings. However, the filters should be visually inspected for grade, tears, orientation and fit within their housing. Filters should be clean and a replacement set available. Bag filters should be installed so that their bags are vertical and spaced so that air can move through them freely.

11.57 Air leakage around a filter housing significantly reduces the filter efficiency. The as-fitted filter housing and access door arrangement should not permit air to bypass.

EPA or HEPA filters (for exhaust protective enclosures and laboratories)

11.58 Pathogenic material may be discharged through damaged or badly installed EPA or HEPA terminal filters. The complete installation should be tested using the method set out in BS EN ISO 14644 and ISO 17141.

The challenge tests may be carried out using either of the following techniques:

- a light scanning airborne particle counter (LSAPC) and a natural challenge to detect leaks;
- dispersed oil particle (DOP) to provide the challenge and a photometer to detect leaks.

11.59 In both cases the upstream challenge should be measured. A measurement of particle penetration through a representative section of the EPA filter media is then taken and used as the reference background level. These two readings enable the range of the detecting instrument to be set.

11.60 With an LSAPC the filter face is sampled at several points to establish the smallest non-penetrating particle size. This will directly relate to the grade of filter under test. The filter face, its seal and housing are then scanned, and if a significant number of particles at or above this size are detected, there is deemed to be a leak at or near the test position.

11.61 With DOP a challenge aerosol of inert particles of the type produced by a dispersed oil particle generator is introduced into the air, upstream of the EPA or HEPA filter. The downstream face of the filter, its mounting seal and housing are then scanned for leakage using a photometer. A leak should be deemed to have occurred if a steady and repeatable reading on the photometer at any point exceeds 0.01% of the upstream reading.

11.62 Should the EPA or HEPA filter fail this test, it will be replaced. Should the filter mounting seal or housing fail this test, it may be repaired and the test repeated.

Ventilation system commissioning records

11.63 Following commissioning, the main contractor will collate the individual commissioning reports together with the plant user manuals ready for handover.

11.64 The fire dampers will have been tested by a specialist, and a written statement detailing which fire dampers were tested, when and by whom should be provided. If any fire dampers in the system were not tested, they should be listed and appended to the statement.

11.65 The airflow balancing report compiled by the commissioning engineers should be available to the validator. The report should include copies of the equipment calibration certificates.

12. Acceptance Testing: Validation

12.1 All new and refurbished ventilation systems should be independently validated prior to acceptance by the client.

12.2 Validation differs from commissioning in that its purpose is to look at the complete installation from air intake to extract discharge and assess its "fitness for purpose as a whole". This involves examining the fabric of the building being served by the system and inspecting the ventilation equipment fitted as well as measuring the actual ventilation performance. Validation is not a snagging exercise; see the Note after paragraph 12.30.

12.3 Validation is a process of proving that the system in its entirety is fit for purpose and achieves the operating performance originally specified. It will normally be a condition of contract that "*The system will be acceptable to the client if at the time of validation, it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life*."

Appointment of validator

12.4 In order to ensure that the complete system operates correctly it will be necessary to validate it as a whole from the air intake through to the extract discharge. It is unlikely that the client's in-house staff will possess the knowledge or equipment necessary to undertake this process. Validation should therefore be carried out by a suitably qualified competent engineer appointed by the client. The validator would be the client's AE(V) (see Chapter 2 in Part B of Scottish Health Technical Memorandum 03-01) or someone of similar standing who is familiar with the ventilation requirements for healthcare facilities. They will be completely independent of the system designers, contractors, suppliers, installers, commissioners and those who will subsequently operate and maintain the system.

12.5 To retain independence, the validator should be appointed and paid directly by the client. The validator will act as the client's representative to inspect the system, check its performance and recommend acceptance, or not, to the client.

Note: "Client" means the healthcare provider, not a contractor or service provider.

Design proposal review

12.6 It is essential that whoever has been appointed to carry out the final validation acceptance of the system should be involved in the initial client's brief and design specification, preferably prior to the project being put out to tender. They will then be fully aware of the client's requirements and any limiting factors.

Note: While it is beneficial to involve the client's validator in the design process, it should be remembered that the appointed designer carries the "design risk" and advice from the validator will not obviate this.

12.7 It is important that the validator understands the complete project and not just the obvious ventilation aspects. Decisions about the type of ceilings, doors, access

hatches, fire compartmentation, floor markings, room functions, their adjacency and the proposed workflow patterns all have a direct effect on the likelihood of being able to achieve the desired ventilation performance. It is not sufficient to consider the ventilation in isolation.

12.8 During this process any derogations proposed by the contractor/supplier should be clearly defined, agreed and documented with the client (for example, through the VSG). All parties will then be clear as to what will be the acceptable standard of installation and performance when finally validated.

12.9 The ventilation designer(s) should provide the validator with system information listed in Table 11. The information should be in the form of an annotated drawing for each ventilation system to be validated. They should also provide any other design or specification information that will assist the validation process.

12.10 The contract arrangement should give the validator the right to visit the site as often as they deem necessary during the contract period.

First fix inspection

12.11 The validator should carry out a physical walk-around inspection of the installation at a point in the project when the AHU is “on site” and the main and branch ductwork is for the main part installed, but prior to the ductwork being concealed behind wall panelling or ceilings.

12.12 If possible, the following airtightness tests should be witnessed during the inspection:

- AHU installation leakage (BS EN 1886);
- supply and extract duct leakage (BESA DW/143);
- initial permeability test (see paragraph 12.17).

12.13 The quality of the installation, compliance of the AHU, suitability of the basic installation, location and future accessibility of commissioning dampers, location and compliance for testing of fire dampers, etc., can all be assessed during the visit.

12.14 When validating large projects that have many AHUs, it is worthwhile to visit the AHU manufacturer to inspect a specimen unit and agree its compliance before all remaining units are built and transported to site. At that time the leakage and deflection tests can be demonstrated by the AHU supplier in their factory.

12.15 Once units are delivered to site, it is useful to get all mechanical and electrical services connected to a specimen AHU. The location of pipework joints, drain points, anti-vibration couplings, isolating and control valves can all be agreed, as can the route of cable ways and control wiring. The object will be to create an agreed “exemplar unit”. If all other AHUs are installed in an identical fashion, they will normally be considered compliant at the time of final validation.

12.16 On completion of the first fix visit the validator should provide the client with a short report identifying items that are not compliant with the specification.

Permeability testing

12.17 The following areas will require permeability testing:

- isolation suites of any type;
- operating suites of any type;
- pharmacy aseptic preparation facilities;
- IAP cleanrooms in central decontamination units (containment leak test in accordance with BS EN ISO 14644-3:2019);
- category 3 and 4 containment facilities;
- any other area specified within the contract.

The methodology for permeability testing is set out in BSRIA document BTS 3 – 'Air permeability testing of isolation facilities'.

12.18 An initial permeability test should be witnessed at first-fix stage when the envelope of the suite is physically complete but before wall, ceiling and floor finishes are applied. The objective will be to find and eliminate any construction leaks (for example, between a floor slab and curtain wall) before they become covered up during the fit-out stage (see paragraph 10.30).

12.19 A full permeability test in accordance with the methodology given in BSRIA BTS 3 will be carried out at practical completion to ensure that all service penetrations have been adequately sealed.

Note: Any leaks discovered during the test are to be sealed at the point of penetration of the building fabric envelope and NOT at the gaps around IPS panels, ceiling hatches or bedhead trunking covers, etc. (see also paragraph 10.30).

Follow-on inspections

12.20 Dependent on the size and complexity of the installation, a second and further inspection visits may be required. The validator should attend site as frequently as necessary in order to try to eliminate any installation issues as the project develops and while trades are still in attendance, rather than having to resolve them at the time of final acceptance.

Final acceptance inspection: validation

12.21 The commissioning of a ventilation system will normally be carried out by the suppliers of the various elements. The final acceptance validation will check that all of the elements work as a whole to achieve the project aim.

12.22 The following regime of inspection and testing should be applied to the validation of all new and refurbished ventilation systems. It may also be applied to systems that have undergone significant changes such as the replacement of a fan or other major component.

Basic requirements

12.23 The area served by the ventilation system to be validated should be physically complete with final finishes applied. The doors should fully close against the design pressure differential with IPS panels fitted and any access hatches closed. All ventilation plant serving it should be operating correctly and have been commissioned in accordance with the project contract.

> **Note**: In projects on existing sites, the area of the building being built/refurbished is often sealed off from the “in use” part to prevent dust penetration. At final validation the seals need to be at least temporarily breached in order to be able to determine the ventilation performance in “normal” conditions.
>
> If this is not possible, validation will be conditional on a final “actual” performance check when the seal is removed at the time of handover.

12.24 The area served should be free of any rubbish, debris, obvious dust and have been wet-mopped before the validation is undertaken.

> **Note**: There is no need to clean the area to the point that the validator needs to gown up in order to enter it. A certain amount of disturbance to hatch seals, ceilings, panels, etc. will be inevitable during
>
> the validation process, so the area will require a final “clinical” clean prior to being taken into use.

12.25 The validation process should be a continuation of the earlier site inspections and will in many cases be carried out in parallel with the commissioning process.

12.26 Unless stated elsewhere in the design specification, the conditions in the principal space served by the ventilation system being validated should be stable and within the given ranges.

Temperature: 18–22ºC dry bulb.

Humidity: 30–70% Relative humidity.

12.27 Any test or measuring equipment used should have a certificate to prove that it has been calibrated within the previous 12 months at a facility using traceable national standards.

12.28 In the case of a noise meter, its “matched sound source” should have a certificate to prove that it has been calibrated within the previous 12 months at a facility using traceable national standards. The noise meter should be calibrated to the sound source on each occasion that it is used.

12.29 The validator has the right to either witness readings taken by the commissioning team or to independently take such readings and measurements as they deem fit in order to satisfy themselves as to the actual performance of the system.

Validation process

12.30 The validation process should follow the sequence given below. Any failures discovered during the process should be rectified before continuing. The validator should check the following:

- the location of the air intake and discharge and their position relative to each other and other intakes and discharges;
- inspection and cleaning access to the vermin mesh and as necessary throughout the installation;
- the security, suitability of and access to the AHU location;
- sufficient space and access arrangements for service and maintenance;
- that the AHU is uniquely identified (see paragraph 13.17) and complies with the minimum standards set out in Chapter 9;
- that the AHU and distribution system have been leak-tested and comply with the design;
- that the AHU and supply ductwork system are clean and free of visible dust;
- that all fire and smoke dampers have been inspected and tested for correct installation and operation. A certificate to that effect, signed and dated by the inspector and tester, will be available for inspection;
- that the area served by the ventilation system is complete and free from significant defects that could invalidate the validation process;
- that the supply and extract airflow rates are in accordance with the design +10%; –0% and the system terminals are in balance. Note that the total supply and extract air volumes measured at the AHU should equate to those measured at the terminals. A discrepancy in the totals would indicate a leak in the system which should be resolved before proceeding further;
- that the air-change rate calculated from the measured airflow and room dimensions accords with the design specification;
- that the room differential pressure regime is in accordance with the design and that if pressure stabilisers are fitted, they operate correctly and silently;
- the air velocity at a specific location(s) if required in the application specification;
- that the noise level does not exceed the design value;
- that the system indicators correctly and clearly show whether or not the ventilation system is in an operational state;
- that any user controls fitted operate correctly (for examples of “cause and effect testing”, see Appendix 10);
- that the temperature and humidity in the space being ventilated are accurately indicated on the user panel and that they can be adjusted within the specified limits, if applicable;
- that the estates control functions operate correctly and the plant condition is clearly shown both on the plant control panel and at the BMS/ BEMS interface;
- that the fire cause and effect strategy has been demonstrated and operates correctly. This may be carried out by others, in which case a statement signed

and dated by the person carrying out the test will form part of the handover information;

- that any additional tests called for in the project specification have been carried out and witnessed by the validator or the client's appointed expert.

Note: Validation is not a "snagging" inspection. The main contractor has presented the installation as being complete, fully commissioned, achieving the specified level of performance and ready for handover. The validator's role is to check on behalf of the client that the contractor is correct in that assertion.

If the validator discovers that there are a significant number of snags and non-compliances, the validation should be terminated. It is the contractor's responsibility to snag the project, carry out remedial works and re-present the installation for acceptance. The validator will then need to repeat the validation process. The client is entitled to deduct any resulting additional validation fees incurred from the contractor.

12.31 It is vitally important to complete the validation process before the system is accepted by the client. Due to the nature of the ventilation installation and the intensity of use in the healthcare setting, it will not be possible to correct any faults or non- compliances once the system has been accepted and taken into use. There are also medico-legal aspects around taking a non- compliant system into use. Pre-announced handover or occupancy dates are not a reason for the validator or client to accept a non-compliant installation.

Validation report

12.32 Following validation, a full report detailing the findings will be produced and sent to the client's lead project manager. The report should conclude with a clear statement on whether the system achieved or did not achieve the standard set out in the agreed design specification.

12.33 The client's lead project manager should lodge a copy of the validation report with:

- head of the user department;
- infection prevention and control;
- estates and facilities.

Additional specialist tests

12.34 Certain critical areas will require additional testing and validation in addition to the process given above.

UCV theatres

12.35 The following regime of inspection and testing should be applied to the validation of new installations designed to provide ultra-clean conditions in an operating suite. The test regime has been devised to ensure that the system as installed fully achieves the operational requirement for these systems as set out in Chapter 8.

UCV canopy validation procedure

12.36 The validation procedure set out in paragraph 12.30 onwards should have been satisfactorily completed prior to attempting to validate the UCV canopy. The

operating suite to be validated should be physically complete with final finishes applied. All ventilation systems serving it should be operating correctly and delivering their design airflow rates.

12.37 Tests to validate the suitability and performance of a UCV canopy should be undertaken in the order that they appear below. If an item fails to meet the required standard it should be rectified and successfully retested before passing on to the next test.

Summary of test regime

12.38 Leakage tests should ensure that:

- the UCV canopy is correctly assembled and sealed so that no air will bypass the filters;
- the canopy terminal filters are correctly sealed in their housings;
- the canopy terminal filters are of a uniform quality and undamaged.

12.39 Air velocity measurements should ensure that:

- a sufficient quantity of air is being delivered by the canopy;
- the airflow has sufficient velocity to reach the operating site plane.

12.40 An entrainment test should ensure that contaminants arising outside of the UCV canopy footprint are not drawn into it.

12.41 Visualisation techniques should gain an understanding of the overall system performance.

12.42 Noise measurement should ensure that working conditions are satisfactory.

12.43 Control system “cause and effect” checks should ensure that the system operates and indicates as specified (for example, see Appendix 10).

12.44 The successful completion of the test regime will ensure that the system will be effective if used correctly.

Test and measuring background conditions

12.45 The entire theatre suite should be clean and free from debris and visible dust. It should be in a condition that if the validation is successful the suite will only require a final clinical clean before being taken into use (see paragraph 12.24).

12.46 All doors should remain closed when readings and scans are being taken.

12.47 The conditions in the operating theatre should be stable and within the given ranges.

Temperature: 18–22ºC dry bulb.

Humidity: 30–70% Relative humidity.

Test and measuring equipment

12.48 Any test or measuring equipment used should have a certificate to prove that it has been calibrated within the previous 12 months at a facility using traceable national standards.

12.49 In the case of a noise meter, its “matched sound source” should have a certificate to prove that it has been calibrated within the previous 12 months at a facility using traceable national standards. The noise meter should be calibrated to the sound source on each occasion that it is used.

Test grid – vertical flow canopies

12.50 A test grid should be constructed on the floor within the UCV canopy footprint as projected by the inside dimensions of the side walls or boundary air curtain. A suitably marked test sheet will provide a consistent standard of test grid.

Note: The entire clean zone footprint of the UCV canopy will be designated by a contrasting coloured inlay in the floor covering. A line marked on or cut into the floor covering is not sufficient and will not be accepted.

12.51 The test grid should comprise test squares of 280 mm × 280 mm dimension.

12.52 The test grid should be aligned along the centre lines of the canopy footprint with its centre under the centre point of the canopy.

12.53 Any test square with 80% of its area within the UCV footprint should be used as a test position.

12.54 An inner zone will be designated that is not less than 36% of the total footprint. It will be made up of a number of test squares distributed symmetrically about the canopy footprint centre line. Regardless of the size or shape of the canopy footprint, the inner zone will comprise a minimum grid of 6 × 6 test squares.

12.55 Unless specified otherwise, a test position should be in the geometric centre of a test square.

12.56 Test position 1 will be the left-most test square in the row nearest to the operating theatre wall that houses the theatre control panel. (For an example of a grid for a 2.8 m × 2.8 m canopy, see Figure 11.)

UCV canopy leakage tests

12.57 The diffuser screen fitted below the face of the canopy terminal filters should be lowered or removed while the leakage tests are being carried out.

12.58 The installed terminal EPA filters are to be checked to ensure that their grade accords with the design specification and that their performance has been certified by their manufacturer.

Test equipment

12.59 An LSAPC connected to an isokinetic fishtail scanning probe will be used to detect the size and number of particles present.

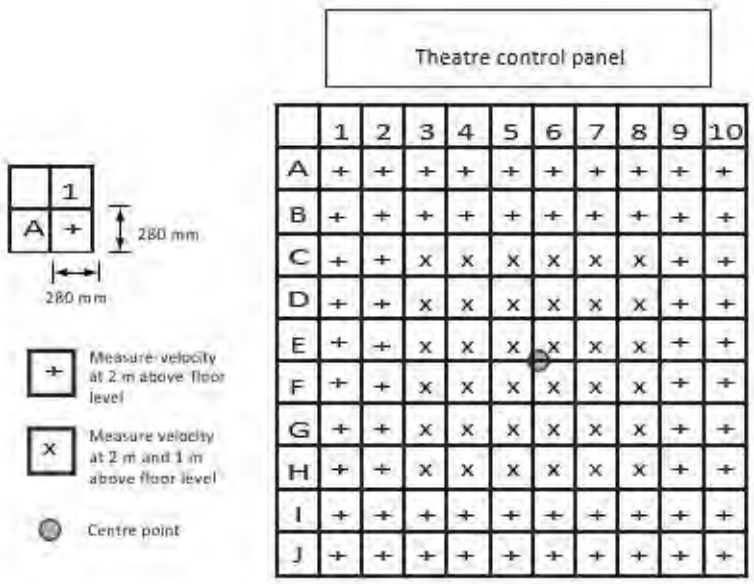
12.60 Spot readings are taken at several filter faces to establish the smallest non-penetrating particle size. If particles at or above this size are detected when subsequent scans are made, there is deemed to be a significant leak at, or near, the test position.

UCV canopy clean zone leak test

12.61 The test will confirm that there is no unfiltered air leakage in the canopy.

12.62 The construction joints and service penetration points under the UCV canopy within its side walls or boundary air curtain should be scanned to prove that there are no leaks.

Figure 11: Example of a test grid for a 2.8 m × 2.8 m UCV terminal



Note: For larger UCV terminals, add extra (280 mm x 280 mm) test squares symmetrically around the periphery of the grid and increase the inner zone in accordance with the guidance in paragraphs 12.50–12.56 of Scottish Health Technical Memorandum 03-01 Part A.

12.63 A leak is defined as a significant and repeatable rise above the background level.

Terminal EPA filter seal leak test

12.64 The test will confirm that there is no unfiltered air bypassing the EPA filter seal.

12.65 Each EPA filter seal should be scanned to prove that there are no leaks.

12.66 A leak is defined as a significant and repeatable rise above the background level.

EPA filter media leak test

12.67 The test will confirm that the EPA filters have not sustained damage while being installed.

12.68 The face of each EPA filter should be scanned to prove that there are no leaks.

12.69 A leak is defined as a significant and repeatable rise above the background level.

Vertical flow UCV canopy air velocity tests

Test setup

12.70 The canopy face diffuser screen should be in place for these tests.

12,71 Take spot readings to establish that the room is within the specified temperature and humidity test conditions.

12.72 Set out the test grid as described previously.

12.73 Swing the operating lamp arms and any other stem arms so that they align to present the least resistance to airflow, are perpendicular to the front edge of the test sheet and face the back edge. Any lamp and equipment heads should as far as practicable be outside of the UCV canopy footprint (see photographs).

Test instrument

12.74 The measuring instrument should be a thermal anemometer with a digital readout. The instrument resolution should be at least 0.01 m/s, have a tolerance of ±0.015 m/s or 3% and be calibrated down to 0.15 m/s or lower. An alternative instrument may be used providing it is of no lesser specification.

Test method

12.75 The instrument should be mounted on a test stand and set to take a mean reading over a 10-second sample interval.

12.76 The test instrument should record readings automatically for later download or be connected to a printer.

12.77 The test stand should be positioned on each test point in turn and the reading taken when the instrument has stabilised.

12.78 When taking a reading, the test person should not stand within the same quadrant as the test instrument.

12.79 Readings are to be taken at the test positions with the instrument probe facing the wall housing the theatre control panel commencing at the first test position. Readings are taken either working along the rows from left to right or for all test positions in one quadrant at a time.

12.80 When all test positions under one half of the canopy have been covered, readings of temperature and humidity are taken at the specified height in the centre of the canopy. The readouts from the theatre control panel should be recorded at this time.

12.81 Having completed one half of the test grid, the operating lamp arms and any other stem arms should be swung round through 180º and the test stand reversed so that the wall housing the theatre control panel is behind the test person. Readings are recommenced starting at the right of the test row and working from right to left or a quadrant at a time, as above.

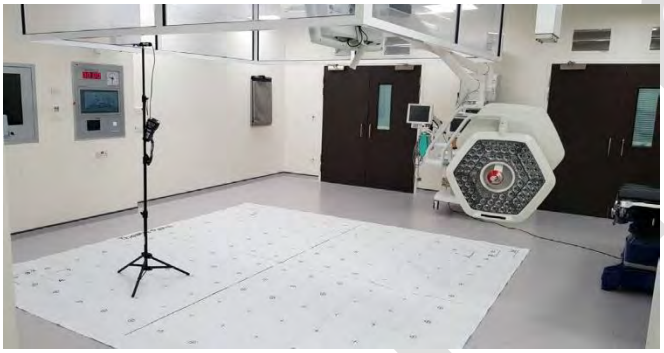
UCV canopy high level discharge velocity test

12.82 Measurements of air velocity are to be taken at every test position 2 m above floor level and the results averaged. The average of the total readings taken is to be not less than:

- 0.38 m/s for a canopy with no side walls or side walls that terminate at 2 m above floor level.
- 0.30 m/s for a canopy with side walls that terminate 1 m above floor level.

12.83 For UCV canopies that are an assembly of two or four units, each fed by a recirculation fan, the average air velocity for each unit should not exceed ±6% of the measured average velocity for the canopy.

Figure 12: UCV 2m air velocity test set-up



UCV canopy low level air velocity test

12.84 Measurements of air velocity are to be taken at each of the inner zone test positions 1 m above floor level.

12.85 The measured velocity at every test position in the inner clean zone should be not less than 0.20 m/s.

Figure 13: UCV 1m air velocity test set-up

UCV canopy entrainment test

Rationale for the entrainment test

12.86 The performance of a UCV canopy may be compromised by room air being drawn into the ultra clean airflow, a phenomenon known as entrainment. Significant levels of entrainment could lead to microbial contamination of items left exposed on instrument trolleys laid out beneath the canopy.

12.87 UCV canopies having permanently fitted side walls that terminate 1 m above floor level do not need to be tested, as the walls physically prevent entrainment.

Principle of the test

12.88 A source of particles is produced outside of the UCV canopy footprint and is used to challenge the system. A sample probe and detector are placed within the ultra clean airflow and used to determine the percentage penetration of the test particles at predefined locations under the UCV canopy footprint. The source and sample probe are moved in tandem around the UCV canopy and pairs of readings taken at the detector, from which the percentage penetration at specified locations is calculated. The degree of penetration should be below specified maximum limits if entrainment is to be declared not significant.

Test setup

12.89 The challenge will be provided by using non-EPA-filtered air emerging from the preparation room via the pressure stabiliser or transfer grille and ducted to the specified release position.

12.90 The canopy face diffuser screen should be in place for these tests.

12.91 The test is performed without any theatre equipment in place beneath or closely adjacent to the UCV canopy. All doors in the theatre suite should be closed and remain so for the duration of the test.

12.92 The operating lights and support booms should be moved to a central position beneath the canopy and raised to 2 m above floor level, so as not to interfere with the peripheral airflows (see photograph).

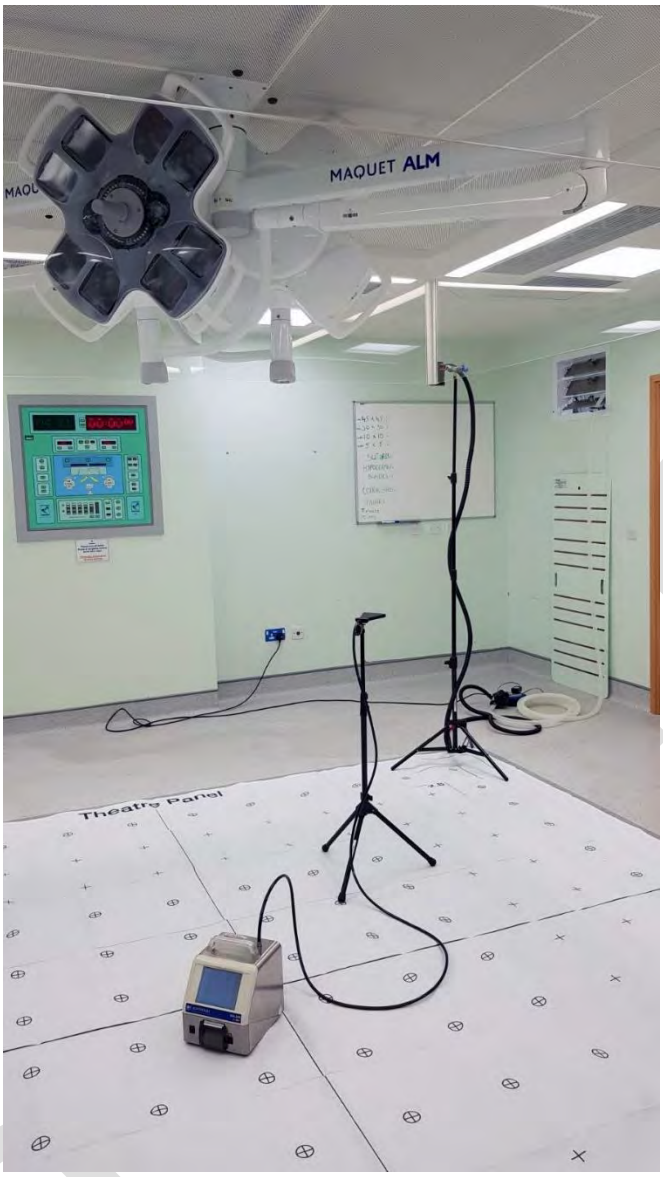
12.93 Spot readings are taken at the centre of the canopy, 1 m from floor level, to establish that the room is within the specified temperature and humidity limits (see paragraph 12.47).

12.94 The test grid is set out as described previously (see paragraph 12.50).

Test equipment

12.95 The source unit will be a fan/blower or other method that ducts non-EPA- filtered air (see paragraph 12.89) and expels it via a delivery head mounted on a test stand or clamped to the UCV canopy sidewall at the specified release position to provide the particle challenge. The challenge air will be delivered vertically downwards from a position 2 m above floor level alongside the outside edge of the side wall or in line with the downward air curtain if the canopy does not have side walls. The challenge airflow velocity should be the same as the measured average velocity at the 2 m level for the canopy under test.

Figure 14 UCV entrainment test setup



12.96 The detector will be an LSAPC capable of sampling a minimum of 28.3 L of air (1 ft3) per minute and providing readings for particle sizes from to 5 µm to 0.3 µm. Measuring instruments should be compliant with the requirements of BS EN ISO 14644 or ISO 17141 to reflect the type of test. An alternative instrument may be used providing it is of no lesser specification

12.97 The sampling head will be an isokinetic fishtail scanning probe mounted horizontally on a test stand 1 m above floor level and connected to the LSAPC by a hose no longer than 2 m

Test positions and orientation of source and detector sampling probe

12.98 The test positions will be at the centre of each test square, as defined for the velocity test (see paragraph 12.50).

12.99 For rectangular UCV canopies, measurements of penetration are to be taken at the four corner test squares of the test grid and at intermediate positions along the line of test squares between the corners. The number of intermediate test positions will be

as equally spaced as possible around the periphery, with not fewer than three and not more than five complete test squares between test positions.

12.100 A further series of measurements are to be obtained around the periphery of the inner zone (defined in paragraph 12.54). Measurements of penetration are to be taken at the four corner test squares of the inner zone of the test grid and if necessary at intermediate positions along the line of test squares between the corners as equally spaced as possible, with not fewer than three and not more than five complete test squares between test positions.

12.101 The centre of the challenge particle source delivery head is aligned with the centre of the designated test square, with its longer edge against the outer edge of the side wall or air curtain and delivering the challenge 2 m above floor level. The air containing challenge particles is directed vertically downward. Where there is physical interference due to obstructions such as gas pendants, the source will be moved to the next available non-obstructed test square location nearest to the stipulated test position. The sampling probe will then also be moved to remain opposite the source.

12.102 In the case of non-rectangular canopies, an interpretation of the above strategy should be adopted that will yield a no less searching examination of the unit's ability to control entrainment.

Test method

12.103 A measurement of particle penetration through a representative section of the EPA filter media is to be taken. The smallest non-penetrating particle size will be used as the reference background level and set in the detector instrument. The detector instrument should be set to take a reading over a 15-second sample interval and record the number of particles at the non-penetrating particle size determined above.

12.104 An initial sample of air at the source delivery head should be taken to check that there are sufficient particles of the considered size present. The challenge will be considered suitable if:

- the particles are within the size range 5 to 0.3 µm and thus capable of remaining airborne for a substantial time;
- the particles should not be able to penetrate the canopy EPA filters in sufficient numbers to cause a background count that is more than 0.1% of the challenge count;
- the number of particles present will enable a minimum of three logarithm (1000-fold) range of counts to be recorded between the source and background readings. A concentration of approximately 105 particles per cubic metre of source air has been shown to be adequate.

Note: The same equipment should be used to measure both the challenge source and penetration so as not to bias results through particle losses within the test equipment.

12.105 The sampling probe of the detector instrument is mounted on a test stand with its orifice facing outwards horizontally from the centre of the UCV canopy, 1 m above floor level. The sampling probe will be orientated at right angles to the partial wall

when sampling along the sides of the test grid but will be set to bisect the angle when measuring at the corner test positions. (See Figure 15 for test locations and see photograph of entrainment test equipment in Figure 13.)

12.106 The test will commence at the first test position; this being designated the left-most corner of the test grid when facing the wall housing the theatre control panel. The penetration will also be measured at the corresponding test point on the inner zone commencing at the corner nearest to the first test position.

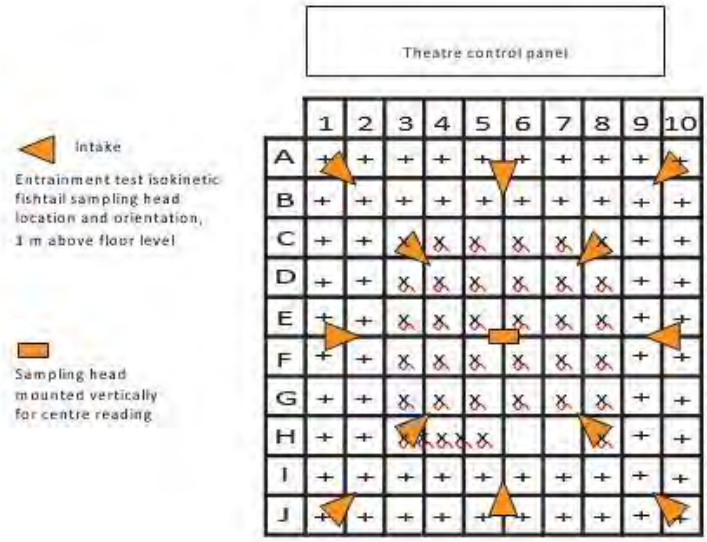
When these tests have been completed, the source distribution head and sampling probe will be moved to the next test positions, working around the test grid in a clockwise direction.

12.107 The test stands will be positioned on each test point in turn and a pair of readings (challenge, then penetration) taken when the instrument has stabilised.

12.108 When taking a reading, the test person should stay within the UCV canopy footprint but on the side opposite the sampling probe.

12.109 A single measurement will be taken at the geometrical centre of the UCV canopy footprint. The centre measurement will be taken with the sampling probe mounted vertically 1 m above floor level

Figure 15: Entrainment test locations for a 2.8 m ×2.8 m UCV terminal



Note: Test grid layout is as for Figure 11. Entrainment test set-up and guidance is given in paragraphs12.86 onwards.

For this test the challenge source distribution head will be placed at the test position that yielded the greatest penetration at the periphery of the canopy footprint.

Analysis and interpretation

12.110 The following standard is to be achieved:

- penetration to be no greater than 10% of the challenge at each test position in the outer zone;

- penetration to be no greater than 1% of the challenge at each test position in the inner zone;
- penetration to be no greater than 0.1% of the challenge at the centre of the test grid.

12.111 If a result is close to or above the given limits, a further reading should be obtained using a longer time base (1 minute) and the penetration should not exceed the given limit.

UCV canopy flow visualisation

12.112 The use of smoke to gain an understanding of the overall performance of the canopy may prove useful at this stage in the validation process but cannot be relied on to produce a contractually definitive measure of performance.

UCV canopy noise level

12.113 An industrial-grade sound level meter to BS EN 61672 Type 2 fitted with a muff will be used to check the noise level. The instrument should be calibrated using a matched sound source prior to each set of readings.

12.114 The noise level readings are to be taken at a typical normal listening position 1.5 m above floor level and at least 1 m from any surface and not on any line of symmetry. Measurements should be taken under the centre of each quadrant and in the centre of the canopy, and the five readings averaged.

12.115 The readings should be taken with the UCV canopy at operational speed and repeated with it at set back.

12.116 For UCV operating suites, the noise level should not exceed:

- operating theatre and spaces without doors that are open to it (for example, the scrub): 53 dB(A);
- all other peripheral rooms of the suite: 48 dB(A).

UCV terminal control system checks

Temperature

12.117 The readings of temperature taken under the UCV canopy should be within ±1ºC of the readout on the theatre control panel.

Humidity

12.118 The readings of humidity taken under the UCV canopy should be within±5%RH of the readout on the theatre control panel.

Direct reading differential pressure gauges

12.119 The differential pressure across the terminal filter should be measured to confirm the accuracy of the indicated reading of any gauge.

Control functions

12.120 The operation of all control functions provided on the theatre control panel should be checked for conformity with the design specification (see Appendix 10).

12.121 If an auxiliary panel has been fitted, its interlocking with the main theatre control panel control functions will be checked for conformity with the design specification.

Panel indicator lights

12.122 The panel indicators should illuminate as appropriate when the control functions are selected, or warning levels are reached (see Appendix 10 for an example “cause and effect” test regime).

BMS interface

12.123 The operation, monitoring and alarm functions should be checked for conformity with those set out in the design specification.

UCV theatre microbiological tests

12.124 There is little value in performing microbiological sampling in an empty operating theatre supplied with ultra clean ventilation. The foregoing filter challenge tests, air velocity measurements and entrainment test will have proved that the system operates satisfactorily and achieves the contracted level of performance. The EPA filters will remove bacteria-sized particles from the air supplied through the UCV canopy. Therefore, there will be an insignificant number of bacterial and/or fungal cfus present until the theatre is actually used.

12.125 Following full validation, in-use microbiological sampling during a surgical procedure will not be required unless specified by the client’s VSG.

UCV operating suite validation report

12.126 Following validation, a full report detailing the findings will be produced and sent to the client’s lead project manager. The report should conclude with a clear statement on whether the UCV operating suite as a whole achieved or did not achieve the standard set out in the agreed design specification.

12.127 The client’s lead project manager should lodge a copy of the report with:

- theatre manager;
- infection prevention and control;
- estates and facilities.

Pharmacy aseptic preparation facilities

12.128 The following regime of inspection and testing should be applied to the validation of new installations. The test regime has been devised to ensure that the system as installed fully achieves the operational requirement for these systems as set out in EUGGMP and the design specification.

Basic requirement

12.129 The validation procedure set out in paragraphs 12.1–12.33 should have been satisfactorily completed prior to attempting to validate the aseptic preparation facility. The suite to be validated should be physically complete with final finishes applied and have been completely cleaned. All ventilation systems serving it should be operating correctly and delivering their design airflow rates.

Aseptic preparation facility validation procedure

12.130 Tests to validate the suitability and performance of the aseptic preparation facility should be undertaken in the order that they appear below. Should an item fail to meet the required standard it should be rectified and successfully retested before passing on to the next test.

Summary of test regime

12.131 Challenge tests should ensure that:

- the supply terminal HEPA filters are sealed in their housings so that no air will bypass them;
- the terminal filters are of a uniform quality and undamaged.

12.132 Differential pressure measurements should ensure the correct pressure cascade.

12.133 Particle counting should be carried out at a specified number of test positions in order to determine the individual cleanroom classification in accordance with ISO EN 14644 and ISO 17141.

12.134 Control system checks should ensure that the system operates as specified.

12.135 Microbiological sampling should check the air quality.

Test and measuring conditions

12.136 While validating the aseptic preparation facility, the conditions in the cleanrooms should be stable and within the given ranges.

Temperature: 19–23ºC dry bulb.

Humidity: 30–70% relative humidity.

Test and measuring equipment

12.137 Any test or measuring equipment used should have a certificate to prove that its calibration has been checked within the previous 12 months at a facility using traceable national standards.

Supply terminal EPA or HEPA filter seal leak test

12.138 The test will confirm that there is no unfiltered air bypassing the EPA or HEPA filter seal.

12.139 Each EPA or HEPA filter seal should be scanned using a light scattering airborne particle counter (LSAPC) to prove that there are no leaks.

12.140 A spot reading will be taken at the face of the filter to determine the background particle level. A leak is defined as a significant and repeatable rise above the background level.

Terminal (EPA or HEPA) filter media leak test

12.141 The test will confirm that the terminal filters have not sustained damage while being installed.

12.142 The face of each terminal filter should be scanned using an LSAPC to prove that there are no leaks.

12.143 A leak is defined as a significant and repeatable rise above the background level.

Cleanroom particle count

12.144 The test will confirm the number and size of particles present and therefore the classification of the cleanroom in terms of ISO 14644 or EUGGMP as specified in the project brief.

12.145 The number of test positions is determined by reference to Table A.1 in ISO 14644-1.

12.146 The complete test methodology will be as set out in ISO 14644.

Cleanroom biocontamination control

12.147 BS EN 17141 gives details on cleanroom biocontamination control.

Radiopharmacy aseptic preparation facilities

12.148 Validation will be as for a pharmacy aseptic preparation facility.

12.149 Additional radiological tests as specified in the project brief will be required. These will be carried out and/or witnessed by the client's appointed specialist.

Inspection, assembly and packing (IAP) rooms in central decontamination units

12.150 Validation will be as for the standard practice described in paragraphs 12.1–12.33.

12.151 The pressure cascade and associated automatic monitoring sensors and alarms should be tested for correct operation in accordance with the design specification.

Note: The detail of the sealing between the instrument washers, transfer hatches and sterilizers that penetrate the walls of the IAP room will be critical in attaining the specified room pressure.

12.152 Following the satisfactory validation, the IAP room should be physically cleaned using specialist contractors. Particle counts at locations related to the floor area as set out in table A.1 of ISO 14644 Part 1, along with instructions from ISO 17141 will then be used to establish whether the room achieves a Class 8 cleanroom standard.

Containment level 3 laboratories

12.153 Validation will be as for the standard practice described in paragraphs 12.1–12.33.

12.154 The room will be subject to a permeability test as set out in paragraph 12.17.

12.155 The pressure cascade and associated automatic monitoring sensors and alarms should be tested for correct operation in accordance with the design specification.

Isolation rooms

12.156 Validation will be as for the standard practice described in paragraphs 12.1–12.33.

12.157 See Scottish Health Planning Note 4 Supplement 1 for details of the test regime.

Microbiological sampling

12.158 It is essential that all parts of the validation test specified above have been successfully completed and the areas thoroughly cleaned prior to any microbiological sampling.

12.159 Microbiological sampling will not normally be required for either general or local exhaust ventilation (LEV) systems unless otherwise specified within the contract.

12.160 The procedure for carrying out microbiological sampling in cleanrooms is set out in ISO 17141.

Microbiological sampling conventional theatres

12.161 The level of airborne bacteria introduced by the supply air can be checked by closing all doors and leaving the operating room empty with the ventilation system running for 15 minutes. An active air sampler set to 1 cubic metre and mounted on the operating table should then be activated remotely. Aerobic cultures on non-selective media should not exceed 10 bacterial and/or fungal colony forming units per cubic metre (CFU/m3).

12.162 The results should be examined to establish the broad category of organisms present. A high preponderance of fungal organisms may be an indication of inadequate filtration for the particular installation. Precise guidance is inappropriate and will depend on local circumstances.

12.163 It may be appropriate to carry out a check of airborne bacteria during a surgical operation. If required, this should be carried out as soon as possible after handover. Unless there are unusually high numbers of personnel or extensive activity in the room, the number of airborne bacterial and/or fungal CFU averaged over any five-minute period, would be unlikely to exceed 180 per cubic metre.

12.164 Information on the microbiological testing of UCV Operating suites is given in clauses 12.124 and 12.125.

13. Information

Records required

13.1 There is a requirement under the Building Regulations to provide documentary evidence of the design, commissioning and subsequent performance of ventilation systems as well as recommended maintenance routines (Building Regulations. 2010, Part 8, Paragraph 39).

13.2 Electronic records should be in a format that is compatible with the client's archive and retrieval system.

Handover

13.3 The following general information is required at plant handover:

- "as fitted" drawings of the plant showing the location of all items and listing the size of ducts, grilles and diffusers together with their factors;
- "schematic" drawing of the air distribution system showing design and actual airflows from all outlets together with the design and actual airflows in each duct. The duct centre correction factors should be given and the grille factors;
- the location of all volume control dampers should be marked on the "as fitted" and "schematic" drawings;
- a floor plan of the area served by the plant showing all doorways, hatches, transfer grilles, pressure relief dampers, pressure stabilisers, supply and extract terminals. The total supply and extract volumes should be shown for each room served by the plant. The volume flow and direction of flow through transfer grilles, pressure relief dampers and pressure stabilisers should also be shown, together with the room pressures in pascals measured with regard to atmospheric pressure. For operating suites the "key" door should be identified;
- a fire plan of the area served showing the fire zone and location of all fire and smoke dampers and detectors. An explanation of the ventilation strategy in the event of an in-zone fire, adjacent zone fire or smoke being drawn into the airhandling unit from an outside source should be provided.
- wiring diagrams for all electrical equipment associated with the air handling systems including motor control circuit details and any interlocking and safety devices such as emergency stop buttons adjacent to the item of plant;
- manufacturer's operating instructions and "setting to work" guidance for all specialist components incorporated in the systems;
  - a schematic of the control system showing the location of all plant sensors;
  - control algorithm(s) of the actual plant operation and the set points entered during commissioning together with the control panel access codes and keys.

Plant design information

13.4 The following plant design information is required at plant handover:

- a simple statement of the design intent;
- a description of the plant's intended mode of operation;
- winter outside design temperature in ºCdb;
- winter outside design humidity in % saturation;
- winter room supply air design temperature in ºCdb;
- winter room supply air design humidity in % saturation;
- winter inside design temperature for each room in ºC;
- winter inside design humidity for each room in % saturation;
- summer outside design temperature in ºCdb;
- summer outside design humidity in% saturation;
- summer room supply air design temperature in ºCdb;
- summer room supply air design humidity in % saturation;
- summer inside design temperature for each room in ºC;
- summer inside design humidity for each room in % saturation;
- winter psychrometric chart showing the condition of the air between all items of plant and the design outside, supply and room air conditions;
- summer psychrometric chart showing the condition of the air between all items of plant and the design outside, supply and room air conditions;
- the design mass airflow rate used to size the plant in kg/s;
- the design volumetric flow rate in m 3/s.

Individual equipment information

Heater-batteries including energy recovery

13.5 The following information concerning heater-batteries is required at plant handover:

- the size of the battery, number of passes and fin spacing;
- the design flow and return temperatures and flow rate in L/s;
- the pressure drop across the water side of the battery in Pa;
- the number of phases, supply voltage, current drawn and number of steps if electric;
- the maximum rated capacity of the battery and actual design rating in kW;
- the design and actual face velocity in m/s;
- the pressure drop across the air side of the battery in Pa;
- the design on and off coil air temperature and humidity at winter and summer design conditions

Cooling coils

13.6 The following information concerning cooling coils is required at plant handover:

- the size of coil, number of passes and fin spacing;
- the design flow and return temperatures and flow rate in L/s if chilled water;
- the pressure drop across the water side of the coil in Pa;
- the supply pressure and mass flow rate if direct expansion;
- the maximum rated capacity of the coil and actual design rating in kW;
- the contact factor;
- the design sensible and latent cooling loads in kW;
- the design and actual face velocity in m/s;
- the pressure drop across the air side of the coil in Pa;
- the design on and off coil air temperature and humidity at summer design conditions.

Humidifiers

13.7 The following information concerning humidifiers is required at plant handover:

- the size of the humidifier and number of lances;
- the supply pressure and mass flow rate of the steam;
- the number of phases, supply voltage, current drawn and number of steps if electric;
- the maximum rated capacity of the humidifier and actual design rating in L/hour;
- the design and actual face velocity in m/s;
- the design upstream and downstream air temperature and humidity at winter design conditions

Filters

13.8 The following information concerning filters is required at plant handover:

- the size of the filter and number in bank;
- its grade;
- the design and actual face velocity in m/s;
- the initial pressure drop across the filter when clean in Pa;
- the final pressure drop across the filter when dirty in Pa;
- the manufacturer's name and filter identification code.

Fans

13.9 The following Information concerning fans is required at plant handover:

- the size of the fan and its type;
- the fan curve;
- speed and direction of rotation;

- the drive motor frame size;
- the number of phases, voltage and maximum design and actual current drawn;
- the design and actual delivered air volume in m3/s;
- the fan suction pressure at high and low speed in Pa;
- the fan delivery pressure at high and low speed in Pa;

Attenuators

13.10 The following information concerning attenuators is required at plant handover:

- the size of the attenuator and number in bank;
- the design and actual face velocity in m/s;
- the initial pressure drop across the attenuator in Pa;
- the upstream sound level in dB(A); the downstream sound level in dB(A).

System information

13.11 The preservation of information and records of ventilation systems and their performance is a legal requirement. It is therefore essential that when new systems are completed, full information as to their purpose, design, layout and actual commissioned performance are handed on to the client. If any derogations were agreed from this standard, they should be noted and the reason for them explained. The system information if electronic (for example, BIM model) should be in a form that is compatible with the client's IT standard and can be accessed and searched by it.

13.12 In new "green field" developments an inventory of the installed ventilation systems should be compiled. In existing developments the client will normally have an inventory of their installed systems, and all new systems should be added to it.

13.13 The inventory will be subdivided into the following categories:

- local exhaust ventilation systems (LEV) – note these are statutory items;
- critical healthcare ventilation systems (CHV).

(These are systems the loss of which would seriously limit the delivery of healthcare – for example, operating suite, SCBU, critical care areas, interventional imaging suite, aseptic preparation facility.)

- general ventilation system [supply and extract] (GVS);
- general extract systems (GES);
- systems installed for smoke clearance in the event of a fire, classed as smoke and heat exhaust ventilation systems;
- – (SHEVS) (for example, smoke extract fans in stairwells, automatic smoke clearance dampers in atria).

Note: During the design and contract process, ventilation systems are often given "construction" codes for drawing reference and site identification purposes. It is

imperative that prior to handover the actual identification codes and labels affixed to the systems conform to the inventory in use at the site or desired by the client. Each system code should be unique and conform to the categorisation format for the client's inventory given above.

For ease of future reference, a list of design and construction references for drawings and plant, cross-referenced to the client's building designations and plant inventory codes, should be produced.

13.14 For each ventilation system the inventory should contain the following details:

- a unique system identification code (for example, LEV 001; CHV 001) as appropriate;
- the location of the ventilation fan unit or supply and extract AHU(s);
- the location of the fresh air inlet;
- the location of the extracted air discharge;
- the specific area(s) served by the system;
- the date the system was installed;
- the date the system was validated and accepted by the client.

13.15 Each ventilation system should have a logbook (physical or electronic) that contains the following information:

- the unique system identification reference;
- purpose of the system;
- date of installation;
- details of the installed equipment and ductwork layout;
- detail of the fire plan and location of fire and smoke dampers;
- design performance parameters (for example, airflow rates, air-change rates, pressures);
- commissioned date and performance;
- record of the system validation and acceptance;
- records of the annual inspection and verification;
- maintenance records and plant information (for example, fan specifications and filter sizes).

13.16 The records should be linked to the inventory and stored in such a way as to be readily available in the event of plant breakdown or other incident.

13.17 Every ventilation system should be clearly identified with a permanent label. The label should show in lettering 100 mm high the inventory reference code of the AHU and clearly identify the area that it serves. The label should be mounted with screws or rivets in an easily visible place near the fan of the unit adjacent to the local electrical isolator. The system control panel should have a duplicate label. Any subsystems and the principal branch ducts should be similarly labelled.

13.18 The nature of air and direction of flow should be clearly marked on all ducts using the symbols given in BS 1710.

13.19 All airflow test-points should be clearly identified with a permanent label and the design information given (for example, TPS 1 – Anaesthetic supply; 400 × 300; Design 185 L/s).

13.20 If two ventilation systems supply a common room or an outlier from another zone, the room identification label should state the relevant ventilation identification codes, for example: Theatres 5&6 Utility; [CHV 012 and CHV 015], as should the labels on their individual AHUs.

13.21 Any ventilation system that conveys a hazardous substance or is affected by a hazardous radiation must be clearly marked with the appropriate symbol.

Fire and smoke dampers

13.22 A complete schedule of dampers fitted, their location and unique identification code should be provided.

13.23 A statement of when they were tested and by whom should be included.

Spares

13.24 Unless otherwise agreed with the site maintenance department, spares should be stored on a rack in the entrance of the relevant plantroom and preserved from casual damage or contamination.

13.25 The scale of spare fans to be provided should relate to the number of AHUs using fans of the same size. The spare fans should be pre-wired with power and control connectors so that when used they are plug and play.

13.26 A complete set of new filters should be handed over.

13.27 A complete set of any other consumable item installed in the installation should be handed over.

BIM status

13.28 If the installation was modelled using BIM during construction, the BIM model should be brought up to date and all asset tags incorporated prior to handover.

13.29 Training for estates staff who will be tasked with keeping the BIM model in date should be given, ideally while the original BIM team is available.

Maintenance routines

13.30 Any product or installation-specific maintenance routines should form part of the handover documentation and, if necessary, training.

13.31 Information on routine inspection and maintenance is given in Part B of Scottish Health Technical Memorandum 03-01.

Expected service life

13.32 Air handling units (AHUs) have an expected service life of 20 years. Part B of this SHTM states that ventilation systems should be taken out of service, deep cleaned, their controls renewed and recommissioned after 10 years. The handover information will both assist this process and help inform the selection of replacement plant.

Additional end user information

13.33 The information itemised above is intended to fulfil the contract requirement and provide a record for the client and their appointed operational management and maintenance teams. There is also a need in some circumstances to provide the end-user with information as to the role that them and their patients from airborne contaminants.

13.34 In operating suites and interventional imaging suites of any type, a simplified plan of the suite showing the principal direction of air movement should be displayed at the entrance to the suite. The following bullet points should be appended to the plan:

- the air supplied to each room is intended to dilute any airborne contaminants;
- the airflow between rooms will ensure that contaminants do not enter;
- people are the main source of airborne contaminants; they disperse such contaminants as they move around: the more people, the more movements, the more airborne contaminants;
- optimum conditions exist when all doors are closed;
- in order to ensure that the system operates correctly and efficiently:
  - routine checks should be carried out of the system performance;
  - the system should be taken out of use periodically to carry out essential maintenance.

13.35 The VSG should advise if other applications require similar explanatory information.

Staff training

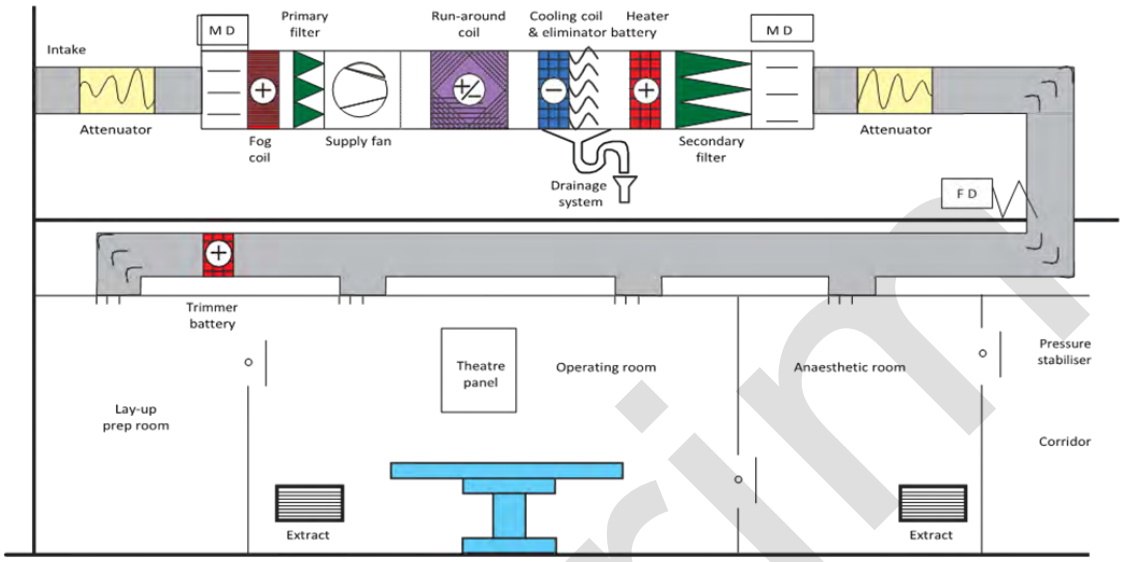
13.36 On completion of the project, training in the correct use, operation and routine maintenance of the installed systems should be given as appropriate to the following staff groups:

- the end-users;
- those who will operate and maintain the installed systems.

Appendix 1: Typical AHU Plant Layouts

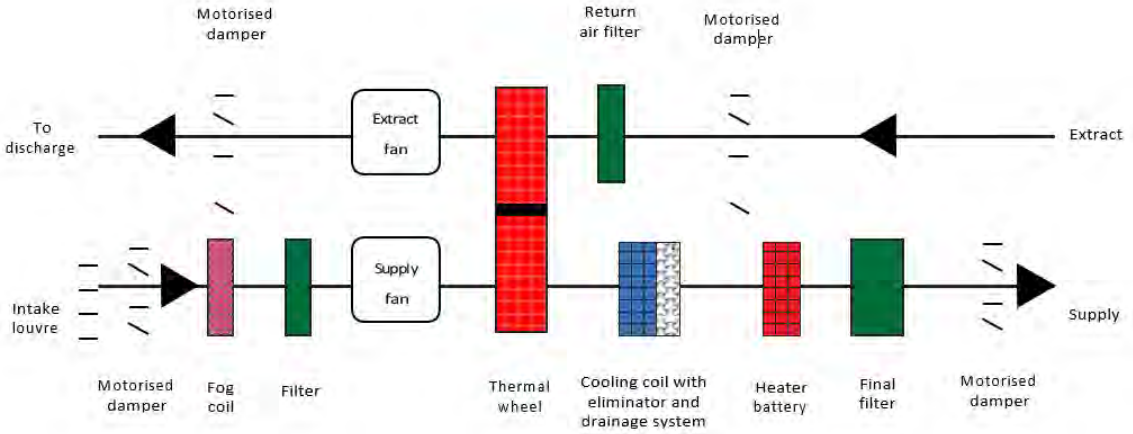
Supply AHU with remote extract unit

Figure A1: Schematic of typical operating suite AHU with energy recovery by run-around coil from a remote extract fan unit



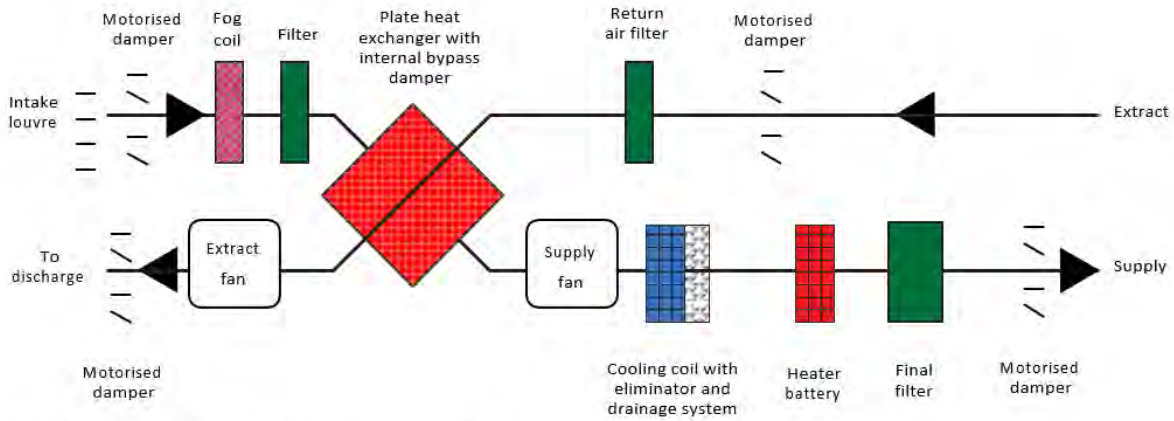
Double-stacked supply and extract AHU

Figure A2: Schematic of typical double-stacked AHU with energy recovery by thermal wheel



Note: Other configurations are possible

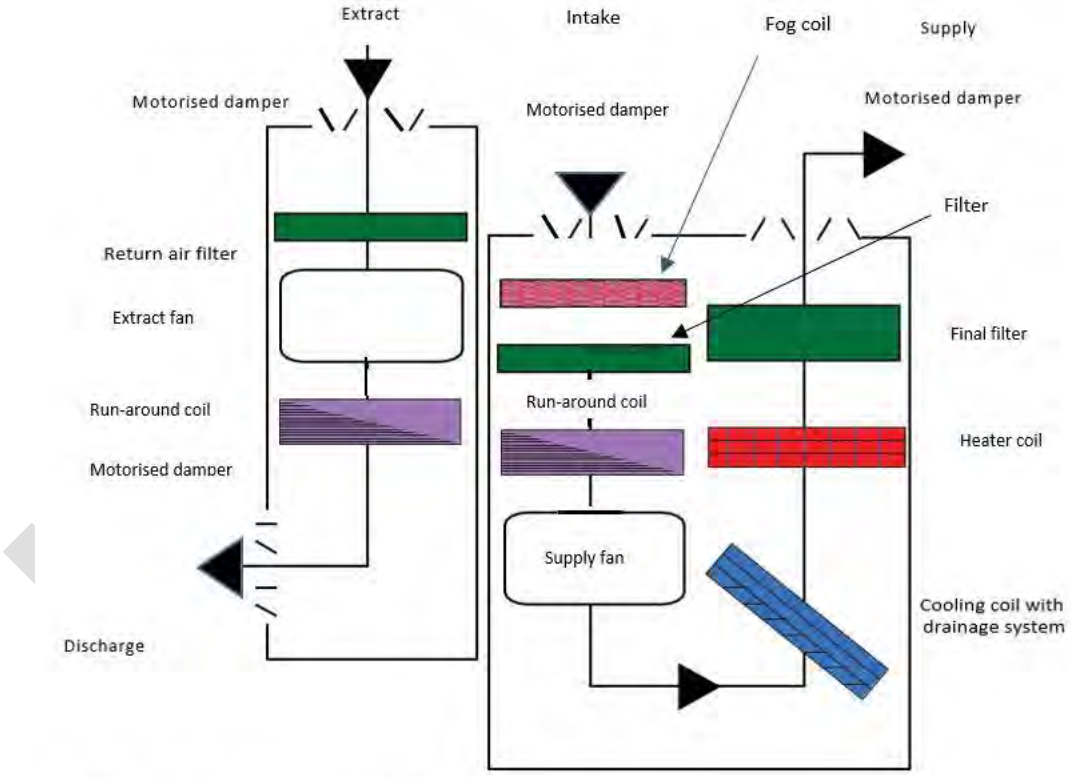
Figure A3: Schematic of typical double-stacked AHU with energy recovery by plate heat exchangerCabinet AHU



Note: Other configurations of the fan positions are possible

Cabinet AHU

Figure A4: Schematic of typical cabinet-style AHU with energy recovery by run-around coil



Note: Other types of compact vertical AHUs are possible

Appendix 2: Summary of design conditions

Table A1 Design conditions for miscellaneous rooms

Application	Ventilation	Air-change rate (ac/h)	Pressure (Pascal Pa)	Supply filter grade (BS EN 16798 or BS EN 1822-1)	Noise (dB(A))	Temp (°C)	Comments (for further information see Chapter 8)
General ward (level 0 and 1 care)	S/N	6	–	SUP2	35	18–28	
Communal ward toilet	E	6	–ve	–	45	–	
Single room	S/E/N	6	0 or –ve	SUP2	35	18–28	
Single room WC	E	>10	–ve	–	45	–	
Clean utility	S	6	+ve	SUP3	45	18–22	
Dirty utility	E	6	–ve	–	45	–	
Ward isolation room (PPVL)	S	10	Lobby +10 Room 0	SUP2	35	–	See Scottish Health Planning Note 4 (Supplement 1)
Infectious diseases isolation room	E	10	–5	SUP2	35	–	See Table 4
Neutropaenic patient ward	S	10	+10	E12	35	–	See Table 3
Critical care areas (Level 2 and 3 care)	S	10	+10	SUP1	35	–	Isolation room may be –ve pressure or PPVL. See Table 3
Birthing room	S & E	10	0	SUP2	45	20–25	See Table 5
NICU/SCBU	S & E	10	+ve	SUP1	35	20–28	Isolation room may be –ve pressure
Operating department recovery room	S & E	15	0	SUP2	45	18–25	Provide clean airflow path
Catheterisation room	S & E	10	+ve	SUP2	45	18–22	
Interventional or non-interventional Imaging room of any type	S & E	10	+ve	SUP2	48	–	Stable conditions as specified for the imaging equipment
Sedation recovery room as in paragraph 8.16	S & E	15	S/E	SUP2	45	18–28	
Endoscopic procedure room	S & E	15	-5	SUP2	40	20–25	See Table 2
Endoscope reprocessing wash room	E	10	–ve	–	45	–	
General treatment room	S & E	10	Neutral	SUP2	45	20–25	See Table 2
Emergency department waiting area	S & E	6	–	SUP2	–	18–25	See Table 2

Application	Ventilation	Air-change rate (ac/h)	Pressure (Pascal Pa)	Supply filter grade (BS EN 16798 or BS EN 1822-1)	Noise (dB(A))	Temp (°C)	Comments (for further information see Chapter 8)
Containment level 3 laboratory	#	>20	#	H14*	–	18–22	# See ACDP guide; *Filter in extract See Table 4
Post-mortem room	S & E	S = 10 E = 12	–ve	SUP2	45	18–22	Provide clean airflow path
Specimen store	E	–	–ve	–	–	–	Fan accessible from outside of store

Notes:

For general and UCV operating suites and associated rooms, see specific guidance in Chapter 8 and typical design solutions in Appendix 7

Waiting and circulation areas should be directly or indirectly ventilated to provide a comfortable environment and control airborne contamination and odours.

18–22°C indicates the range over which the temperature may float.

18-22°C indicates the range over which the temperature should be capable of being controlled at any point within that range.

S = Supply

E = Extract

N = Natural ventilation where possible where natural ventilation is used the design must reflect clauses 5.2 to 5.9

SUP refers to the supply air quality as defined in BS EN 16798

Appendix 3: Hierarchy of cleanliness

Table A2 Hierarchy of cleanliness

Class	Room	Nominal pressure (Pa)a	Airflow rate for bacterial contaminant dilution Flow in or supply (m3/s)	Flow out or extract(m3/s)
Sterile	Preparation room lay-up sterile pack store Operating theatre Scrub bay	 35 25 25 25	See standard schemes in Appendix 7 and detailed calculation process in Appendix 8 for recommended design values	
Clean	Sterile pack store Anaesthetic room Scrub room	+ve 15c 15	6 ac/h The greater of 15 ac/h or 0.15 –	– The greater of 15 ac/h or 0.15 0.10 mind
Transitional	Recovery room Clean corridor General access corridor Changing rooms	0 0 0 3	15 ac/he (See note f) (See note f) 7 ac/h	15 ac/he 7 ac/h 7 ac/h 7 ac/h
Dirty	Service corridor Utility room	0 –5 or 0	– –	(See note g) 0.40 or 0.10

Notes:

Nominal room pressures are given to facilitate setting up of pressure-relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not immutable provided the desired airflow rates and movement directions are achieved.

An open or semi-open bay is considered to be part of the operating theatre; a low-level extract under the scrub trough is required. (See Chapter 8 paragraph 8.45 onwards and “Note” for more information.)

For design purposes, anaesthetic should be assumed to be at 15 Pa. When commissioning, equal to or greater than 10 Pa is considered suitable.

May need to be increased if scrub is large to promote scouring.

15 ac/h is considered necessary for the control of anaesthetic gas (see Appendix 9).

Supply airflow rate necessary to make up 7 ac/h after taking into account secondary air from cleaner areas.

No dilution requirement. Temperature control requirements only.

Appendix 4: Leakage flows in m3/s through closed door gaps

Pressure difference (Pa)

Table A3 Leakage flows through closed door gaps

Type	5	10	15	20	25	30	35	40
Single door	0.03	0.05	0.06	0.06	0.07	0.08	0.09	0.10
Single door + half	0.04	0.06	0.07	0.08	0.09	0.10	0.11	0.12
Double door	0.05	0.08	0.10	0.11	0.12	0.13	0.14	0.15

Designers' notes:

The door gaps assumed are 4 mm along the bottom, 3 mm at the top and sides, and 2 mm between double leaves.

If doors are fitted with cold smoke seals, these will significantly reduce the door leakage rate when new and undamaged. It is therefore recommended that provision for the design leakage be factored into the size of the appropriate transfer grille or pressure stabiliser. Failure to do this will result in air-gap whistles and doors being held partially open by air pressure.

Factory-assembled door-sets with a steel frame and pre-hung leaves are becoming common. There is effectively no leakage across these doors when closed. Therefore, when this type of door assembly is fitted, the door leakage can be ignored and the design airflow into the room reduced accordingly. The design airflow would then become that required either (i) for open door protection (Appendix 5), or (ii) to achieve the specified air-change rate – whichever is the greater.

Appendix 5: Recommended airflow rates in m3/s through a doorway between rooms of different cleanliness to control cross-contamination

Table A4 Flows through dooorways

Room class		Dirty	Transitional	Clean	Sterile
Sterile	Hatch Single door Double door	0.3 0.47 0.95	0.24 0.39 0.75	0.18 0.28 0.57	 0 or 0.28a 0 or 0.57a
Clean	Single door Double door	0.39 0.75	0.28 0.57	0 or 0.28a 0 or 0.57a	
Transitional	Single door Double door	0.28 0.57	0 or 0.28a 0 or 0.57a		
Dirty	Single door Double door	0 0	Open single door = 0.80 m x 2.01 m high Open double door = 1.80 m x 2.01 m high	Open single door = 0.80 m x 2.01 m high Open double door = 1.80 m x 2.01 m high	Open single door = 0.80 m x 2.01 m high Open double door = 1.80 m x 2.01 m high

Designers' notes:

The degree of protection required at an open doorway between rooms is dependent on the degree of difference in cleanliness between them.

Flow-rate required between rooms within the same class tends to zero as class reduces.

If two rooms are of equal cleanliness, no flow is required (in practice there will be an interchange in either direction) and the design of the air movement will assume zero airflow. In certain cases, however, interchange is not permitted, and a protection airflow of 0.28 is assumed in the design – for example, in the case of a preparation room used as a "lay up".

Appendix 6: Typical approximate pressures in an operating suite when a given door is open

Typical approximate effect on other rooms

Table A5 Pressure in room with open door

Door open between	Typical approximate resultant	Room	Pressure (Pa) pressure in these rooms (Pa)
Operating theatre and corridor or Scrub bay and corridor	0	Anaesthetic Preparation – lay-up Utility Preparation – sterile pack store	0 12 –6 5
Operating theatre and anaesthetic room (or other series room with double doors)	17	Preparation – lay-up Utility Preparation – sterile pack store	26 –9 22
Operating theatre and Utility room or Operating theatre and preparation room	25	No change	
Anaesthetic room and corridor (or other series room with double doors)	0	Preparation – lay-up Utility Operating theatre Preparation – sterile pack store	30 –6 20 25
Preparation room and corridor or Utility room and corridor	0	No change	
Utility room and outer corridor	0	No change	

Notes:

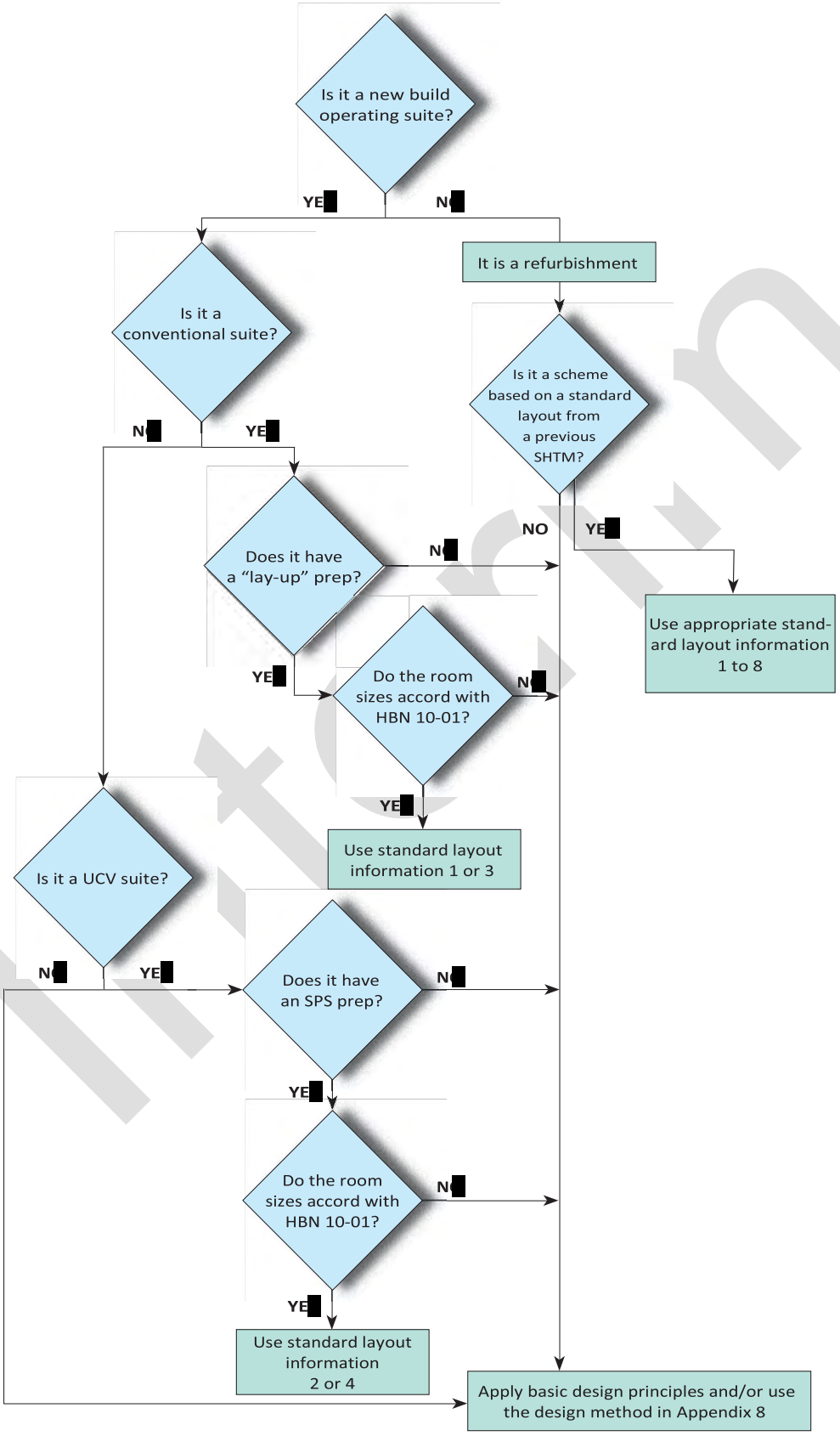
The room differential pressure protects against reverse flows when the door is closed.

The flow of air through a doorway protects against reverse airflow when the door is open.

Pressure stabilisers control flow and ensure a known airflow path between rooms when doors are closed and also reduce backflow between rooms when doors to other rooms are open.

Appendix 7: Operating suite design logic

Figure A5 Operating suite design logic



Standard layout 1 – Two-corridor conventional operating suite with “lay-up” prep

Table A6 Two corridor conventional operating suite with “lay up” prep design criteria

Room	Size (m3)‡	Air-change rate (ac/h)	Nominal pressure (Pa)	Flow rate (m3/s)
Theatre	165	≥22	25	Primary = 0.73 From Prep = 0.28 Total = 1.010
Anaesthetic	57	15	Design 15 Commissioned ≥10	0.24
Lay-up prep	36	≥22	35	0.28**
Scrub	*	–	25	–

Notes:

‡ Derived from Health Building Note 10-01 (2021). If room sizes differ from those given, recalculate the design air flows to achieve the air change rate or door protection.

*This is a separate scrub and is not considered as being part of the theatre volume.

**Interchange is not permitted between the theatre and lay-up prep; therefore, as in Appendix 5, an airflow protection of

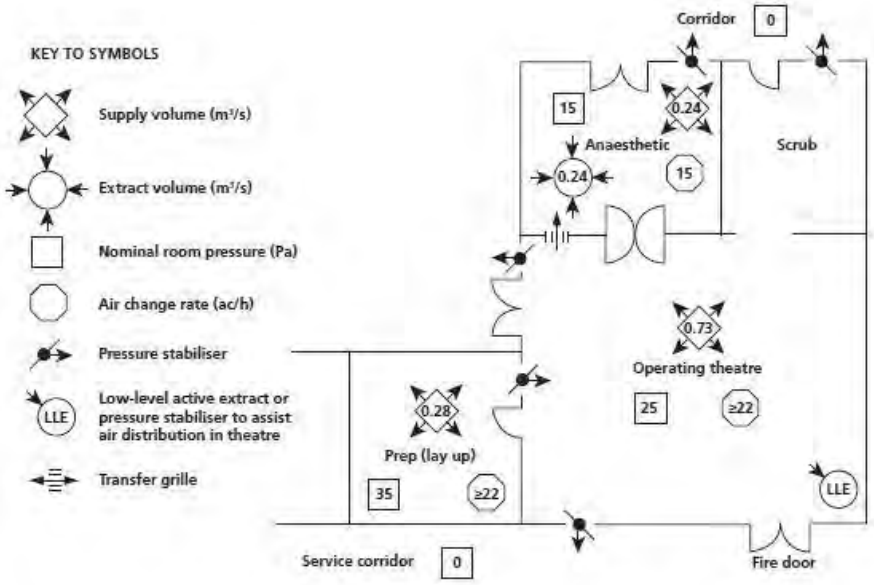
0.28 m3/s is required as a minimum (but see also the “designers’ notes” in Appendix 4).

N.B.If the lay-up prep also has a door or hatch to the corridor, its supply airflow volume would increase to 0.35 m3/s

The volume of air to be extracted from the theatre should be determined by subtracting the airflow required for door protection at the key door from the total air entering the space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre and scrub may be either passive and fitted with pressure stabilisers or active and connected to the extract system. They should where possible be located at low level and positioned to promote the active ventilation and scouring of all areas of the space (see paragraph 8.92). Air transfer from theatre to anaesthetic room may be by pressure stabiliser or transfer grilles (see paragraphs A8.51 and A8.52 in Appendix 8). The anaesthetic room extract will be at low level (see Appendix 9).

Figure A6 Two corridor conventional operating suite with "lay up" prep, schematic layout



Standard layout 2 – two-corridor UCV operating suite with SPS prep

Table A7 Two corridor UCV operating suite with SPS design criteria

Room	Size (m3)‡	Air-change rate (ac/h)	Nominal pressure (Pa)	Flow rate (m3/s)
Theatre	165	≥22	25	# 1.01
Anaesthetic	57	15	Design 15 Commissioned ≥10	0.24
Sterile pack store prep	36	10	25	0.10
Scrub	*	–	25	–

Notes:

‡ Derived from Health Building Note 10-01 (2021). If room sizes differ from those given, recalculate the design air flows to achieve the air change rate or door protection.

* This is a separate scrub and is not considered as being part of theatre volume.

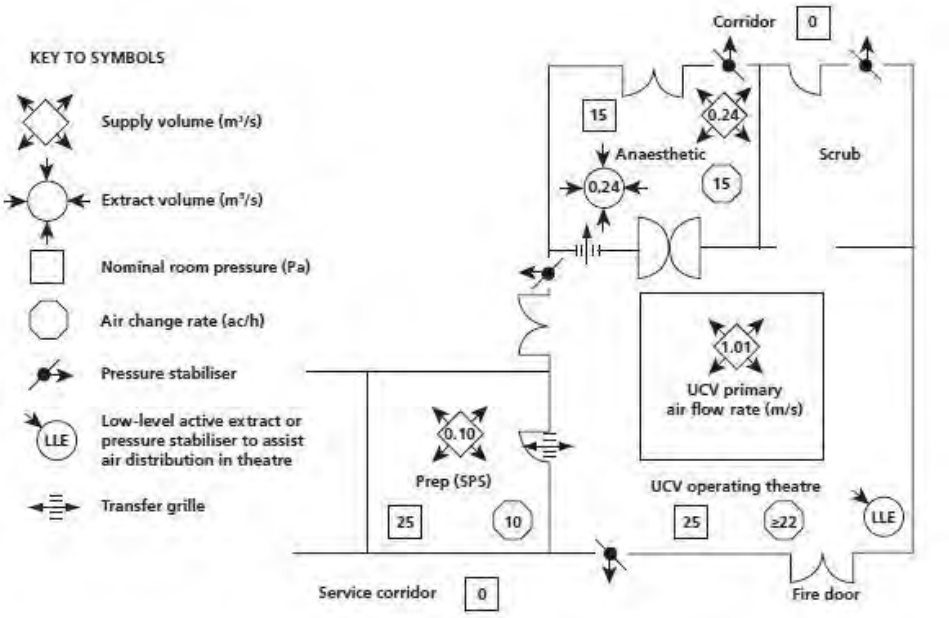
Primary fresh-air volume to UCV canopy only or ≥22 or door protection

The volume of air to be extracted from the theatre should be determined by subtracting the airflow required for door protection at the key door from the total air entering the space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre and scrub may be either passive and fitted with pressure stabilisers or active and connected to the extract system. They should where possible be located at low level and positioned to promote the active ventilation and scouring of all areas of the space (see paragraph 8.92). Air transfer from theatre to anaesthetic room may be by pressure stabiliser or transfer grilles (see

paragraphs A8.51 and A8.52 in Appendix 8). The anaesthetic room extract will be at low level (see Appendix 9).

Figure A7 Two corridor UCV operating suite with SPS schematic layout



Standard layout 3 – single-corridor conventional operating suite with “lay-up” prep

Table A8 Single corridor conventional operating suite with “lay up” prep design criteria

Room	Size (m3)‡	Air-change rate (ac/h)	Nominal pressure (Pa)	Flow rate (m3/s)
Theatre	165	≥22	25	Primary = 0.73 From Prep = 0.28 Total = 1.01
Anaesthetic	57	15	Design 15 Commissioned ≥10	0.24
Lay-up prep	36	≥22	35	0.35**
Scrub	*	–	25	–
Utility	36	–	–5	0.40

Notes:

‡ Derived from Health Building Note 10-01 (2021). If room sizes differ from those given, recalculate the design air flows to achieve the air change rate or door protection.

* This is a separate scrub and is not considered as being part of the theatre volume.

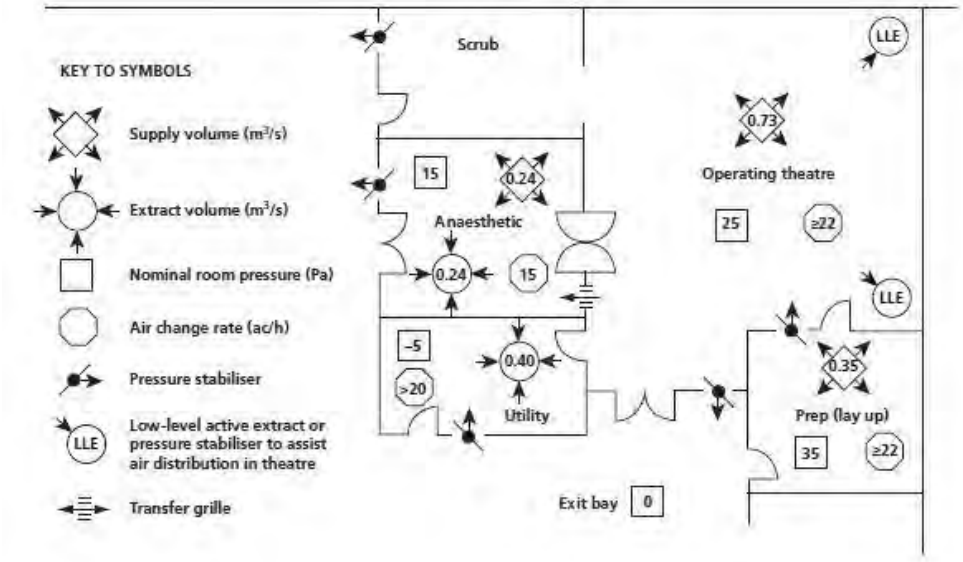
** Interchange is not permitted between the theatre and lay-up prep; therefore, as in Appendix 5, an airflow protection of 0.28

+ 0.07 closed-door airflow is required as a minimum (but see also the “designers’ notes” in Appendix 4).

The volume of air to be extracted from the theatre should be determined by subtracting the airflow required for protection at the key door from the total air entering the space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre and scrub may be either passive and fitted with pressure stabilisers or active and connected to the extract system. They should where possible be located at low level and positioned to promote the active ventilation and scouring of all areas of the space (see paragraph 8.92). Air transfer from theatre to anaesthetic room may be by pressure stabiliser or transfer grilles (see paragraphs A8.51 and A8.52 in Appendix 8). The anaesthetic room extract will be at low level (see Appendix 9).

Figure A8 Single corridor conventional operating suite with “lay up” prep schematic layout



Standard layout 4 – single-corridor UCV operating suite with Lay-up prep

Table A9 single-corridor UCV operating suite with Lay-up prep design criteria

Room	Size (m3)‡	Air-change rate (ac/h)	Nominal pressure (Pa)	Flow rate (m3/s)
Theatre	165	≥22	25	#1.01
Anaesthetic	57	15	Design 15 Commissioned ≥10	0.24
Sterile pack store prep	36	≥22	35	0.35**
Scrub	*	–	25	–
Utility	36	–	–5	0.4

Notes:

‡ Derived from Health Building Note 10-01 (2021). If room sizes differ from those given, recalculate the design air flows to achieve the air change rate or door protection.

* This is a separate scrub and is not considered as being part of the theatre volume.

** Interchange is not permitted between the theatre and lay-up prep; therefore, as in Appendix 5, an airflow protection of 0.28

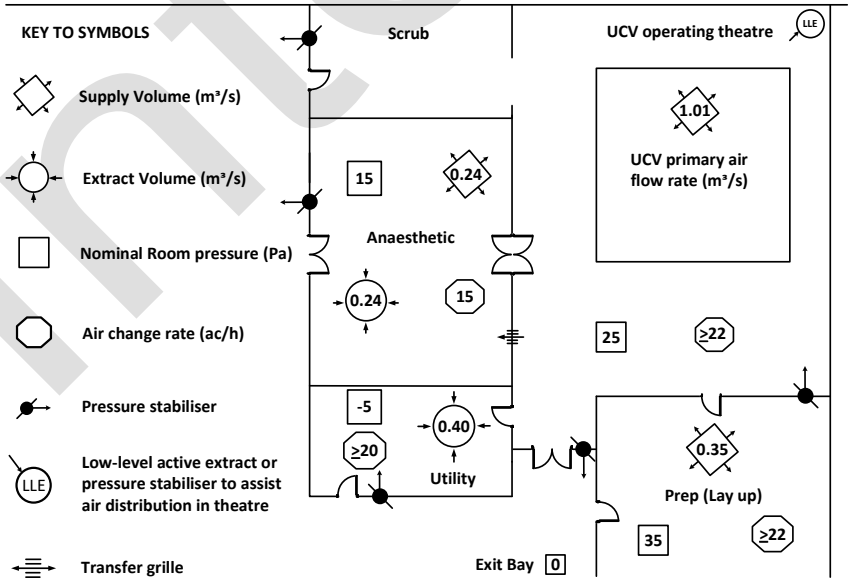
+ 0.07 closed-door airflow is required as a minimum (but see also the “designers’ notes” in Appendix 4).

Primary fresh-air volume for the UCV canopy or ≥22 ac/h or door protection

The volume of air to be extracted from the theatre should be determined by subtracting the airflow required for protection at the key door from the total air entering the theatre space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre and scrub may be either passive and fitted with pressure stabilisers or active and connected to the extract system. They should where possible be located at low level and positioned to promote the active ventilation and scouring of all areas of the space (see paragraph 8.92). Air transfer from theatre to anaesthetic room may be by pressure stabiliser or transfer grilles (see paragraphs A8.51 and A8.52 in Appendix 8). The anaesthetic room extract will be at low level (see Appendix 9).

Figure A9 single-corridor UCV operating suite with Lay-up prep schematic layout



Standard layout 5 – (ex SHTM 2025 Plan 1b): single-corridor conventional operating suite with “lay-up” prep

Note: This layout and data is for historical purposes only. The information is to be used for the evaluation of existing systems, the fitting out of existing shell schemes or rebalancing of such systems following cleaning.

Table A10 (ex SHTM 2025 Plan 1b): single-corridor conventional operating suite with “lay-up” prep design criteria

Room	Size	Air-change rate (ac/h)	Nominal pressure (Pa)	Flow rate (m3/s)
Theatre	* See Notes below	≥22	25	# See Notes below
Anaesthetic	* See Notes below	15	Design 15 Commissioned ≥10	~ Supply and extract to achieve the air change rate
Lay-up prep	* See Notes below	≥22	35	0.35**
Scrub	* See Notes below	–	25	–
Utility	* See Notes below	>20	–5	0.40

Notes:

* Existing theatre suite rooms to be measured on site

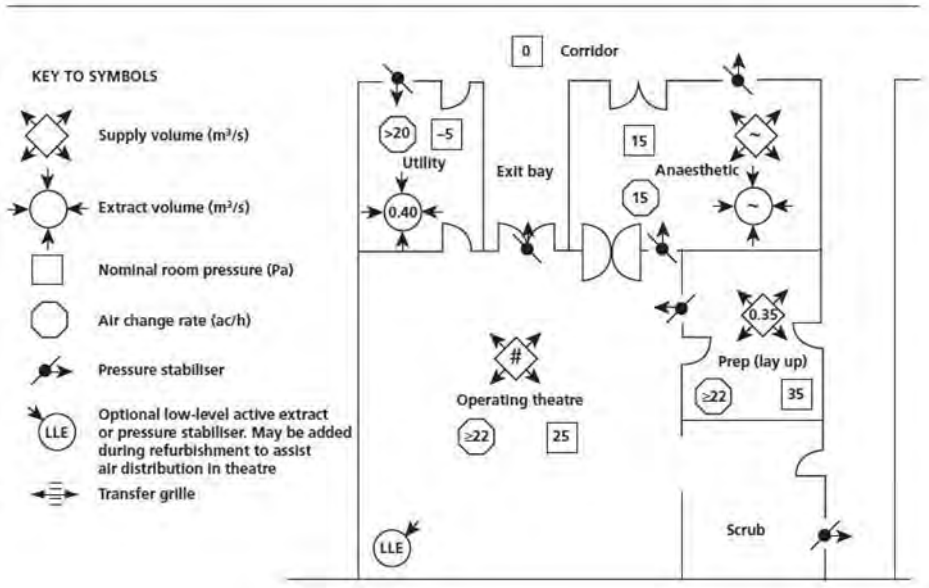
Total airflow related to volume of theatre to give ≥22 ac/h or door protection value = primary theatre supply + 0.28 m3/s from the Lay-up Prep pressure stabiliser

** See the “designers’ notes” in Appendices 4 and 5.

The utility layout design figures will remain the same if a hatch is fitted instead of a door onto the service corridor.

The extracts within the theatre and scrub may be either passive and fitted with pressure stabilisers or active and connected to the extract system. They should where possible be located at low level and positioned to promote the active ventilation and scouring of all areas of the space (see paragraph 8.92). Air transfer from theatre to anaesthetic room may be by pressure stabiliser or transfer grilles (see paragraphs A8.51 and A8.52 in Appendix 8). The anaesthetic room extract will be at low level (see Appendix 9).

Figure A10 (ex SHTM 2025 Plan 1b): single-corridor conventional operating suite with "lay-up" prep schematic layout



Standard layout 6 – (ex SHTM 2025 Plan 1a): single-corridor UCV operating suite with SPS prep

Note: This layout and data is for historical purposes only. The information is to be used for the evaluation of existing systems, the fitting out of existing shell schemes or rebalancing of such systems following cleaning. If difficulties are experienced with entrainment around the periphery of the UCV, adding a low-level active or passive extract in the location indicated will usually resolve the problem.

Table A11 (ex SHTM 2025 Plan 1a): single-corridor UCV operating suite with SPS prep design criteria

Room	Size	Air-change rate (ac/h)	Nominal pressure (Pa)	Flow rate (m3/s)
Theatre	* See Notes below	≥22	25	# See Notes below
Anaesthetic	* See Notes below	15	Design 15 Commissioned ≥10	~ Supply and extract to achieve the air change rate
Sterile pack store prep	* See Notes below	10	25	0.1
Scrub	* See Notes below	–	25	–
Utility	* See Notes below	–	–5	0.4

Notes:

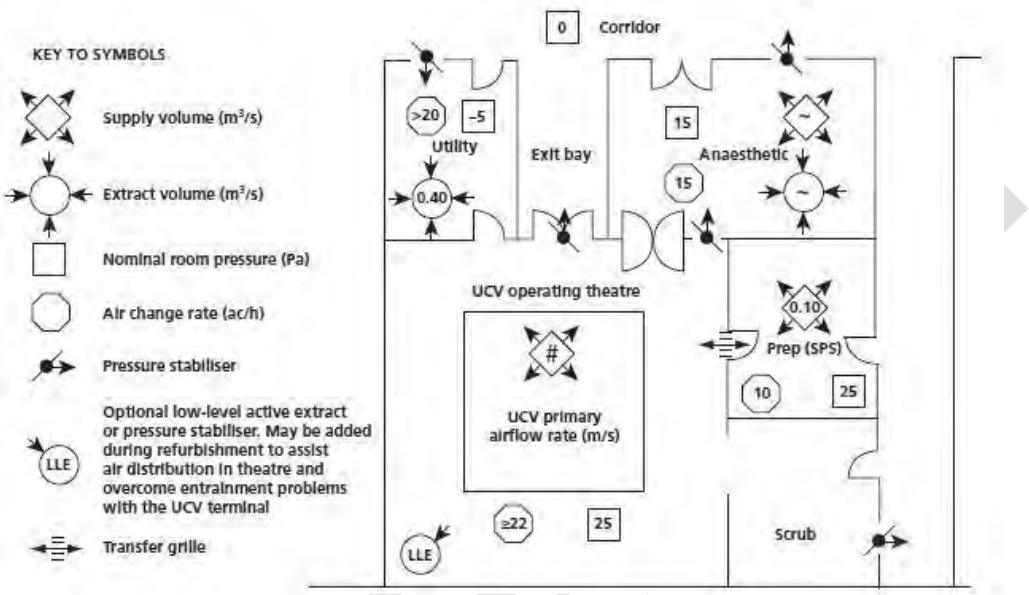
* Existing theatre suite to be measured on site

Theatre total airflow related to volume of theatre to give ≥22 ac/h or door protection value

The utility layout design figures will remain the same if a hatch is fitted instead of a door onto the service corridor.

The extracts within the theatre and scrub may be either passive and fitted with pressure stabilisers or active and connected to the extract system. They should where possible be located at low level and positioned to promote the active ventilation and scouring of all areas of the space (see paragraph 8.92). Air transfer from theatre to anaesthetic room may be by pressure stabiliser or transfer grilles (see paragraphs A8.51 and A8.52 in Appendix 8). The anaesthetic room extract will be at low level (see Appendix 9).

Figure A11 (ex SHTM 2025 Plan 1a): single-corridor UCV operating suite with SPS prep schematic layout



Standard layout 7 – (ex SHTM 2025 Plan 5b): two-corridor conventional operating suite with “lay-up” prep

Note: This layout and data is for historical purposes only. The information is to be used for the evaluation of existing systems, the fitting out of existing shell schemes or rebalancing of such systems following cleaning.

Table A12 (ex SHTM 2025 Plan 5b): two-corridor conventional operating suite with “lay-up” prep design criteria

Room	Size	Air-change rate (ac/h)	Nominal pressure (Pa)	Flow rate (m3/s)
Theatre	* See Notes below	≥22	25	# See Notes below
Anaesthetic	* See Notes below	15	Design 15 Commissioned ≥10	~ Supply and extract to achieve the air change rate
Lay-up prep	* See Notes below	≥22	35	0.35**
Scrub	* See Notes below	–	25	–
Utility	* See Notes below	–	0	0.1

Notes:

* Existing theatre suite to be measured on site

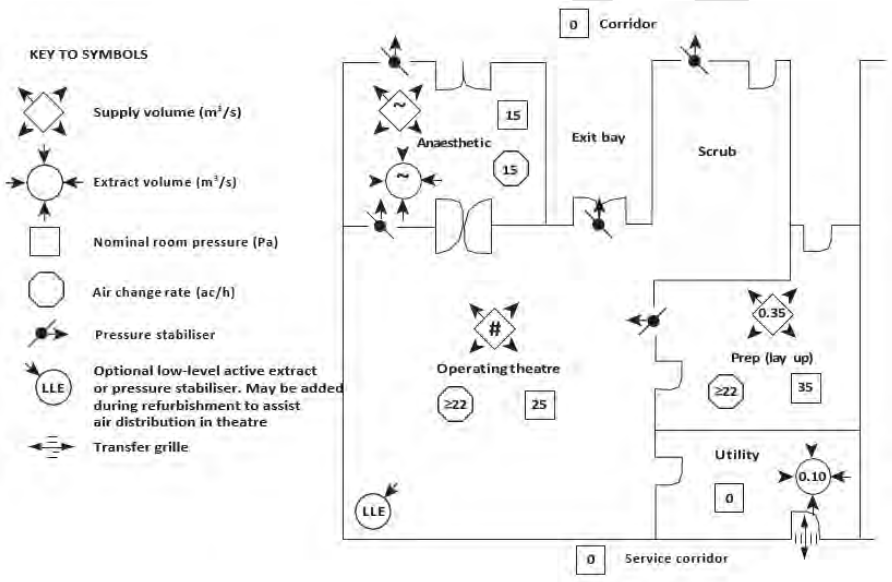
Theatre total airflow related to volume of theatre to give ≥22 ac/h or door protection = primary theatre supply + 0.28 m3/s from Lay-up Prep pressure stabiliser

** See the “designers’ notes” in Appendices 4 and 5

The utility design figures will remain the same if a hatch is fitted instead of a door onto the service corridor. Alternatively, if the operating department has a central waste processing station, the utility room may be omitted and replaced with a hatch between the theatre and service corridor.

The extracts within the theatre and scrub may be either passive and fitted with pressure stabilisers or active and connected to the extract system. They should where possible be located at low level and positioned to promote the active ventilation and scouring of all areas of the space (see paragraph 8.92). Air transfer from theatre to anaesthetic room may be by pressure stabiliser or transfer grilles (see paragraphs A8.51 and A8.52 in Appendix 8). The anaesthetic room extract will be at low level (see Appendix 9).

Figure A12 (ex SHTM 2025 Plan 5b): two-corridor conventional operating suite with “lay-up” prep schematic layout



Standard layout 8 – (ex SHTM 2025 Plan 5a): two-corridor UCV operating suite with SPS prep

Note: This layout and data is for historical purposes only. The information is to be used for the evaluation of existing systems, the fitting out of existing shell schemes or rebalancing of such systems following cleaning. If difficulties are experienced with entrainment around the periphery of the UCV, adding a low-level active or passive extract in the location indicated will usually resolve the problem.

Table A13 (ex SHTM 2025 Plan 5a): two-corridor UCV operating suite with SPS prep design criteria

Room	Size	Air-change rate (ac/h)	Nominal pressure (Pa)	Flow rate (m3/s)
Theatre	* See Notes below	≥22	25	# See Notes below
Anaesthetic	* See Notes below	15	Design 15 Commissioned ≥10	~ Supply and extract to achieve the air change rate
Sterile pack store prep	* See Notes below	10	25	0.1
Scrub	* See Notes below	–	25	–
Utility	* See Notes below	–	0	0.1

Notes:

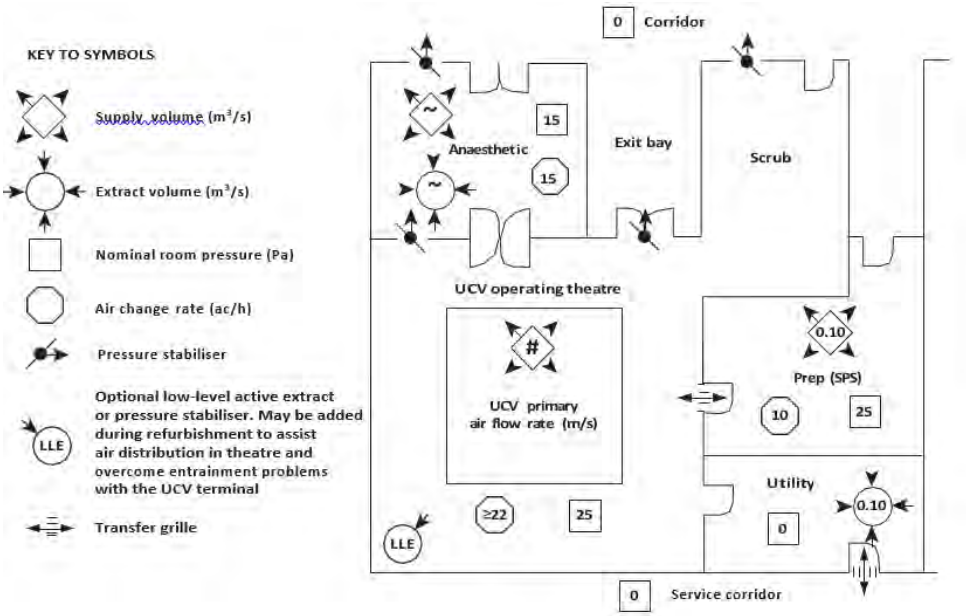
* Existing theatre suite to be measured on site

Primary fresh supply air for the UCV canopy is related to volume of theatre to give ≥22 ac/h or door protection

The utility design figures will remain the same if a hatch is fitted instead of a door onto the service corridor. Alternatively, if the operating department has a central waste processing station, the utility room may be omitted and replaced with a hatch between the theatre and service corridor.

The extracts within the theatre and scrub may be either passive and fitted with pressure stabilisers or active and connected to the extract system. They should where possible be located at low level and positioned to promote the active ventilation and scouring of all areas of the space (see paragraph 8.92). Air transfer from theatre to anaesthetic room may be by pressure stabiliser or transfer grilles (see paragraphs A8.51 and A8.52 in Appendix 8). The anaesthetic room extract will be at low level (see Appendix 9).

Figure A13 (ex SHTM 2025 Plan 5a): two-corridor UCV operating suite with SPS prep schematic layout



Appendix 8: Design of air- movement control schemes for operating theatres

General

A8.1 Standard operating suite design solutions are given in paragraphs 8.27–8.74 and Appendix 7. If these standard solutions cannot be used, the following procedure should be adopted, which will result in an acceptable design. Note that the method employed may equally be used to provide a design solution to a ventilated suite of rooms for any application.

A8.2 The method is concerned with the calculation of air-flow rates to ensure that correct air movement occurs between rooms when any one door is open. Under most circumstances, the air quantities required for air-movement control will approximate to those for either temperature control or bacterial contaminant dilution. This flow rate is sufficient to control the effects of any slight reverse flows occurring when a door is opened.

A8.3 The progression through the design procedure is shown in the air-flow design procedure chart (Figure A24) and is supported by worksheets WS1 to WS7 described in paragraph A8.4. It is recommended that a plan of the suite and an air-flow network be made (Figure A23) to collate all information. Flow rates, air- transfer devices etc should be entered as required. The remainder of this Appendix may be treated as reference data to assist in the various steps. The following symbols are used:

SS – supply air-flow rate for summer temperature control;

SW – supply air-flow rate for winter temperature control;

SD – supply air-flow rate for dilution of bacterial contaminants;

SL – supply air-flow rate for heat loss;

SG – supply air-flow rate for heat gain;

ED – extract air-flow rate for dilution of bacterial contaminants;

SF – final supply air-flow rates

EF – final extract flow rates;

SAMC – air-supply flow rate for air- movement control;

EAMC – air-extract flow for air- movement control;

LOUT – leakage air-flow rate outward;

LIN – leakage air-flow rate inward;

∑OUT - total air-flow rate outward;

∑IN total air-flow rate inward.

A8.4 To simplify the procedure, standard worksheets (WS1 to WS7) have been devised. For each operating suite, a set is required comprising one each of WS1, WS3, WS5, WS6a, WS6b and WS7, one WS4 for each corridor and one WS2 to cover each peripheral room. WS2 has five versions:

WS2a single flow,

WS2b parallel/series multi-flow,

WS2c parallel multi-flow or series multi-flow (unbalanced);

WS2d series multi-flow (balanced); and

WS2e bay (semi-open).

Peripheral room type

A8.5 The rooms in the operating suite other than the operating theatre and corridor are referred to as peripheral rooms. Peripheral rooms have been classified according to the flows in and out. These room classifications are defined in paragraphs A8.6–A8.11.

Single flow

A8.6 This is a room with only one door and a net surplus of supply or extract air.

Parallel multi-flow

A8.7 This is a room with two or more doors through each of which the air flows either outwards (high pressure) or inwards (low pressure) (for example the Prep (lay- up) in standard layout 5 in Appendix 7).

Parallel/series multi-flow

A8.8 This is a room having a net surplus of supply or extract and with two or more doors. One or more doors will be to an area of equal cleanliness and need not be protected; hence, the flow may vary between inwards and outwards, the remaining door being to an area of greater or lesser cleanliness (for example the Prep (SPS) in standard layout 6 in Appendix 7).

Series multi-flow (unbalanced)

A8.9 This is a room having a net surplus of supply or extract and with two or more doors. Air flows inwards through one or more doors and outwards through one or more doors.

Series multi-flow (balanced)

A8.10 This is a room as in paragraph A8.9 above, but having either no mechanical ventilation or no net surplus of supply or extract (for example an anaesthetic room).

Bay

A8.11 A room which has a permanent opening to the operating theatre may be considered as a bay off the latter (for example a scrub). Two categories exist:

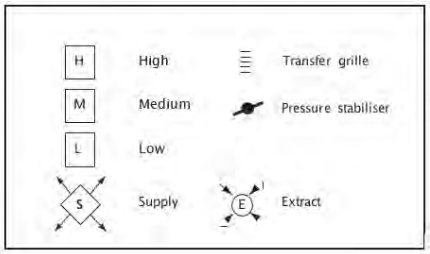
open bay – the opening is larger than a normal single door opening. The bay may be considered as part of the main room;

semi-open bay – the opening is no larger than a normal single door opening. In this case it is possible to protect the bay from the main room by provision of air supply or extract in the bay, or by passing air to or from another area.

Air-movement control in peripheral rooms

A8.12 For the design of air-movement control, two types of air-transfer device are considered. These are transfer grilles and pressure stabilisers. Each has a particular field of application within the design, as described in paragraphs A8.34– A8.43. Air movement is controlled in each of the different room types described in paragraphs A8.13–A8.31.

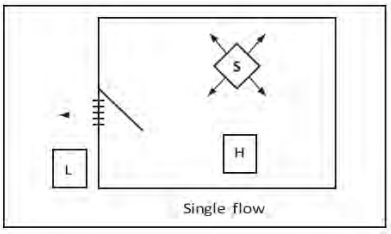
Figure A14 Key to symbols



Single flow rooms

A8.13 An appropriately-sized transfer grille should be located in or adjacent to the door of each single flow room to relieve the pressure differences across the door when closed.

Figure A15 Single flow room solution high–pressure room



Parallel multi-flow rooms

A8.14 The pressure difference across the closed doors should be relieved, but transfer grilles are not appropriate where two doors lead to areas of different pressures, because reverse flow could occur when the other door is open. For this reason, pressure stabilisers are used.

Figure A16 Parallel, multi-flow room solution high-pressure

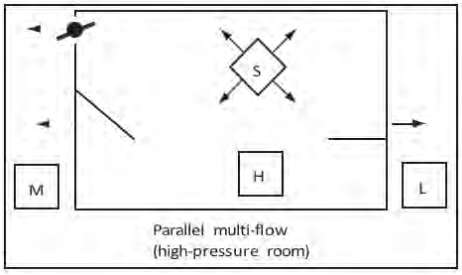
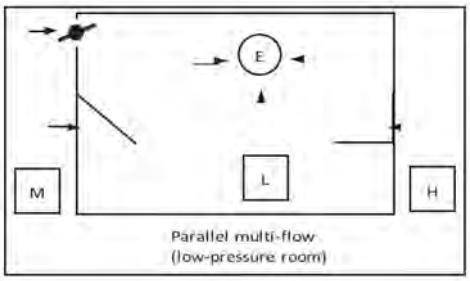


Figure A17 Parallel, multi-flow room solution low-pressure



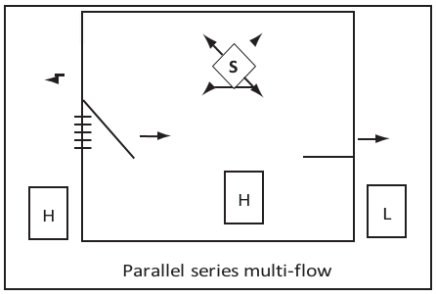
A8.15 These rooms will be either high- pressure or low-pressure with respect to the adjacent areas (see preparation lay-up room and disposal room, respectively, in standard layout 5 of Appendix 7). The pressure-relief damper is always situated between the room and area, which results in the smaller differential pressure to ensure best use of air.

A8.16 Just as reverse flow can occur if transfer grilles are used, it can similarly occur via door gaps when the other door is opened. It is not possible to avoid this, except by using air locks, but due to the low flow rates and short durations involved, this is not considered to be of importance.

Parallel-series multi-flow rooms

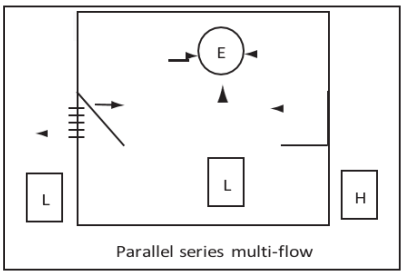
A8.17 These rooms are similar to those in paragraph A8.14 above, but because the room is of equal cleanliness to one of the adjacent rooms, the nominal pressures will be equal and air may flow through the adjoining doorway in either direction (for example the Prep (SPS) in standard layout 6 of Appendix 7).

Figure A18 Parallel, series multi-flow room solution high-pressure



A8.18 Where the nominal room pressure equals that of the higher-pressure adjacent room, the best use of air is by supplying air required for bacterial dilution only and allowing this to exhaust via a transfer grille to the area of equal cleanliness. The doorway to the lower pressure area is protected by the combination of the supply air and the air that will flow inwards through the transfer grille from the area of equal cleanliness.

Figure A19 Parallel, multi-flow room solution low-pressure

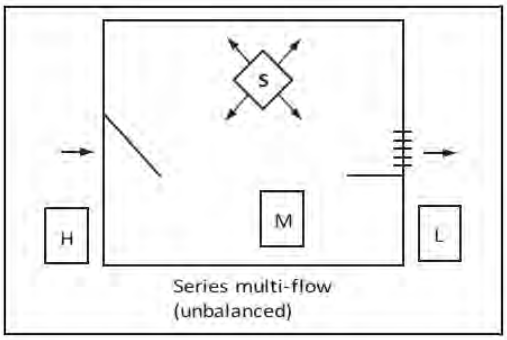


A8.19 Conversely, where the nominal pressure equals that of the lower-pressure adjacent room, extract ventilation and a transfer grille to the lower pressure adjacent room should be provided (for example the disposal room in standard layout 8 of Appendix 7).

Series multi-flow (unbalanced)

A8.20 These rooms are somewhat similar to those in paragraph A8.15 above, but because the pressure lies between that of the rooms on either side, the back-flow problem does not exist.

Figure A20 Series, multi-flow room solution medium-pressure



A8.21 Where the room has a net surplus of mechanical supply air, a transfer grille should be located in or adjacent to the door through which air flows outwards, and the mechanical supply flow rate to the room should be chosen to give protection when this door is open.

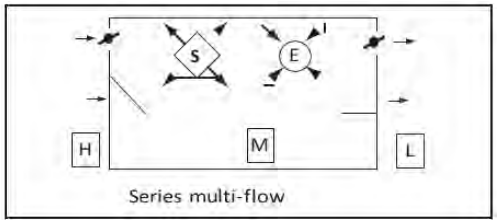
A8.22 Where the room has a net surplus of mechanical extract air, a transfer grille should be located adjacent to the door through which the air flows inwards, and the mechanical extract flow rate to the room should be chosen to give protection when this door is open.

A8.23 The grille should be sized for the protection requirement of the opposing door when open. When the room on the high-pressure side depressurises, there is a possibility of back-flow through gaps around the door, but this problem may be ignored.

Series multi-flow (balanced)

A8.24 In these rooms, a transfer device adjacent to each doorway is required in order to provide a flow path for the air required to protect the opposing door when opened.

Figure A21 Series, multi-flow room solution medium-pressure



A8.25 These transfer devices will normally be pressure stabilisers, although transfer grilles may be used where a large amount of excess air is to be exhausted from the operating theatre when all doors are closed (for example anaesthetic rooms).

A8.26 The calculation procedure is to assume that pressure stabilisers are being used; then – if there is sufficient excess air – change to transfer grilles as described in paragraph A8.50.

Bay

Open bay

A8.27 A bay of the open type (for example scrub-up) is considered to be part of the operating theatre. There should be an active or passive extract/pressure stabiliser under, or directly adjacent to, the scrub trough.

Semi-open bay

A8.28 In a bay of the semi-open type, protection of one area from the other is possible (for example scrub-up).

A8.29 As stated previously, the need for protection between operating theatre and scrub-room is not very great. Better use of air can therefore be achieved in this case by installing a pressure stabiliser between the scrub-room and clean corridor. This will allow a flow of air through the scrub-room at all times, except when a door is opened elsewhere in the suite. The pressure stabiliser will then close and the air will be diverted to the other door. When it is considered necessary to protect the scrub-room at all times, either a transfer grille to the corridor or mechanical extract in the scrub-room should be provided.

Operating theatre

A8.30 Once the peripheral rooms have been considered, the operating theatre requirements may then be decided and the supply flow rate required for air-movement control calculated. This flow rate should be such that, with any one door open, the correct air movement directions are maintained. There will be one door in the suite that will require the largest supply flow rate to the operating theatre for protection when open. This is called the “key door” and is discussed separately in paragraph A8.33. Use of this concept avoids repetitive calculations for each door in turn. Having established the required supply flow rate, a relief route should be provided to the clean corridor for any excess air when the doors are closed. This would be via transfer grilles or pressure stabilisers through a series-flow room or via pressure stabilisers to the clean corridor directly.

Corridors

A8.31 All surplus air from the suite, except that lost through structure leakage and any passing to the outer corridor, will arrive in the patient/staff corridor. Should this air be insufficient to achieve the required air- change rate (see Appendix 3), some additional air supply should be provided. (The air balance should take account of structural leakage.)

A8.32 Whereas the resulting pressures are dependent on ductwork layout, room relationships and characteristics of the fan, the generalisations shown in Appendix 6 may be used to estimate the change in room pressure when a door is opened.

A8.33 The “key door” will be the open double door which leaves the operating theatre at the highest pressure, and/or requires the largest air flow. This should be determined using the procedure in worksheet WS3.

Transfer grilles

A8.34 These may be used to limit the pressure differences across the closed door of a single-flow room or, in some instances, for protection of a series-flow or parallel-series-flow room. They allow air flow in both directions and may not be suitable for all applications.

A8.35 The free area of a grille is calculated from the following equation:

$$A = \frac{Q}{0.84\sqrt{\Delta P}}$$

where:

A is free area (m2)

Q is flow rate (m3/s)

P is pressure difference (Pa)

0.84 is the grille's resistance- correction factor.

A8.36 The flow through a grille at a different pressure may be found from the following equation:

$$Q_2 = Q_1 \sqrt{\frac{\Delta P}{\Delta P^1{}_2}}$$

where:

Q_1 and P_1 are original flow and differential pressure

Q_2 and P_2 are new flow and differential pressure.

A8.37 The transfer grille may be replaced by carefully proportioned door undercuts of the equivalent free area.

A8.38 The function of the transfer grille is to provide a means of air-flow control by which the volume and pressure loss can be established. If a grille is used, it should have an easily removable core to facilitate cleaning.

Pressure-relief dampers

A8.39 The functions of a pressure-relief damper are now carried out by pressure stabilisers. Accordingly, all mention of them has been removed from this document.

Pressure stabilisers

A8.40 Pressure stabilisers can be adjusted to hold the pressure constant over a wide range of flow rates. They are used where requirements exist for accurate room- pressure control or rapid shut-off on pressure fall.

A8.41 The installation of a grille or baffle in association with a stabiliser will alter the operating characteristics. It is recommended that a location be chosen to avoid the need for visual screening, for example, at high level. The location should be chosen to minimise the likelihood of damage.

A8.42 The stabilisers used should be virtually silent in operation, adjustable on site, maintenance-free and of a type which cannot be wrongly inserted. They should not be used in external walls or where the pressure difference is less than 5 Pa. The required size of a pressure stabiliser is dependent on the design pressure difference across it and flow rate through it. The manufacturer should provide data relating pressure difference to mean velocity (or flow rate per unit area). From this, the required area can be calculated and then rounded-up to the nearest size manufactured or nearest combination of smaller sizes.

A8.43 It is sometimes possible to arrange for a pressure stabiliser to perform two tasks. In an anaesthetic room, for example, the two pressure stabilisers may be made to pass the open door protection air, and also control the operating and anaesthetic room pressures with the door closed. To achieve this, the stabilisers are sized for the flow rate required with one of the doors open, but the pressure setting is adjusted to be the value required with the doors closed.

This is shown in Figure A22.

Door leakage flows

A8.44 For an air-movement control scheme to work satisfactorily, it is essential that the estimates of door-gap leakage made at the design stage are closely related to those which are achieved in practice. The calculation of gap-flows is complicated by the fact that such flows generally fall into the transition region between laminar and turbulent flow and hence do not follow the normal flow equations. The gaps assumed are 4 mm along the bottom, 3 mm at the top and sides, and 2 mm between double leaves. Doors should not have wider gaps than these. Tighter gaps would result in lower flow-rate requirements and hence lower fan power, but care should be taken to ensure that all doors in the suite have similar gap dimensions. It may be possible to

ignore the door leakage and so reduce the air-flow requirement (see the “designers’ notes” in Appendix 4).

Room temperature estimation

A8.45 The air-flow rate required to prevent back-flow through an open door is dependent on the temperature difference across the door. The design figures shown in Appendix 6 are based on the temperature differences that will normally occur in practice, assuming heat gains and losses in accordance with Appendix 4.

A8.46 At step 11 of the air-flow design process, the temperature differences across the doors of all rooms classed as “sterile” are calculated. Worksheet WS6 is recommended for the calculations, using the following criteria:

a. assume that the operating theatre is being controlled at 20ºC and calculate the incoming air-supply temperature as shown on worksheet WS6;

b. the calculation should be repeated for both summer and winter conditions, with an operation in progress;

c. assume all doors are closed;

d. use the room supply flow rates from WS1;

e. use the inward air flows through air-transfer devices and closed door leakages from WS2a to WS2E;

f. the formula used in worksheet WS6 is as follows:

$$T = \frac{(t_1 Q_1 + t_2 Q_2 + \ldots + t_n Q_n) + 0.828H}{(Q_1 + Q_2 + \ldots Q_n)}$$

where:

Q = flow rate from source (m3/s)

t = the temperature of source (ºC)

H = the room heat gain (kW).

A8.47 If the evaluated temperature differences between rooms do not exceed 2ºC, the solution is satisfactory; otherwise proceed as follows:

(i) check the assumption on which the heat gains are based;

(ii) take steps to reduce the heat gains;

(iii) if the door is to a corridor, the flow through the open door will be larger than the value given in Appendix 6. Calculate on WS3, assuming it is the “key door” with door-flow unknown, and the supply as known;

(iv) if the door leads to a room with mechanical supply, install a trimmer heater in the supply to the room controlled by either a differential thermostat or a

thermostat slaved to the operating theatre thermostat to ensure that T is minimised;

(v) if the door leads to a room with no mechanical supply, increase the door protection flow as follows:

$$Q_{new} = Q_{old} \quad \frac{2}{[\Delta T + 1]}$$

A8.48 These options should be considered in this order, and (i), (ii) and (iii) should be investigated thoroughly before proceeding to (iv) or (v). The mechanical supply may need to be increased in order to achieve the desired air-change rates.

Relief of excess air from operating theatre when all doors are closed

A8.49 As the mechanical supply to the operating theatre is sized to provide an appropriate flow outwards through any door which is opened, it follows that when all doors are closed, there will be more air supplied to the operating theatre than can exit from it via leaks etc. This “excess” air can be relieved by either of the two methods described in paragraphs A8.50– 8.54.

By transfer devices via the anaesthetic room

A8.50 The transfer device (pressure stabiliser or transfer grille) between the theatre and anaesthetic room needs to accommodate an air volume of 0.46 m³/s at 20 Pa (see Appendix 6) when the door between the anaesthetic room and corridor is open. An additional 0.11 m³/s will pass through the door gaps of the theatre to anaesthetic door to give a total door flow protection figure of 0.57 m³/s through the open door between the anaesthetic room and corridor. The optimum duty for this device with all the doors closed would be 0.33 m³/s at the room differential of 10 Pa. The following equation shows how this figure is arrived at:

$$Q = \frac{Q_1}{\left(\sqrt{\frac{\Delta P2}{\Delta P1}}\right)}$$

$$= \frac{0.46}{\left(\sqrt{\frac{\Delta 20}{\Delta 10}}\right)}$$

$$= 0.33 m^3/s$$

where:

Q = excess air to be vented with doors closed

$Q1$= airflow required for door protection through the transfer device

$\Delta P1$= nominal differential pressure with door to operating theatre closed and door to corridor closed

$\Delta P2$= nominal differential pressure between the operating theatre and anaesthetic room when the corridor door is open.

A8.51 If the excess air is less than 0.33 m3/s, a pressure stabiliser is required to ensure that the correct pressure and protection airflow is available to pass through the door.

A8.52 If the excess air is greater than 0.33 m3/s, a transfer grille is acceptable because at all times the airflow will exceed the flow required for pressure and door protection.

By pressure stabilisers to the corridor

A8.53 If it is undesirable to pass all the extra remaining air volume through the anaesthetic room after the door flow- protection volumes have been achieved, it may be passed from the theatre directly to the corridor via a separate pressure stabiliser.

A8.54 If there is sufficient excess air, the transfer grille solution at paragraph A8.52 should be adopted, as it provides the simplest solution and, once set up, will require no further maintenance. With less excess air, it is recommended that the air be passed through the anaesthetic room via the pressure stabilisers as at paragraph A8.51, thus keeping the number of pressure stabilisers to a minimum. Both these solutions increase the air-change rate in the anaesthetic room, but care should be taken to avoid passing excessive amounts through that would cause discomfort to the occupants.

Figure A22: Pressure stabilisers performing two tasks

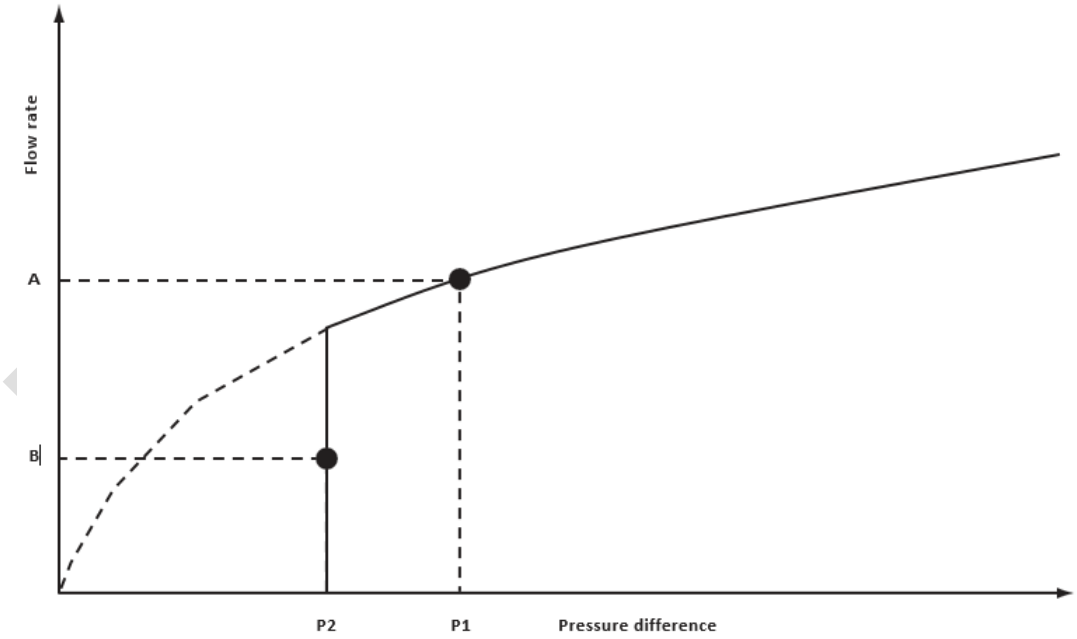


Figure A23: An example of an air-flow network

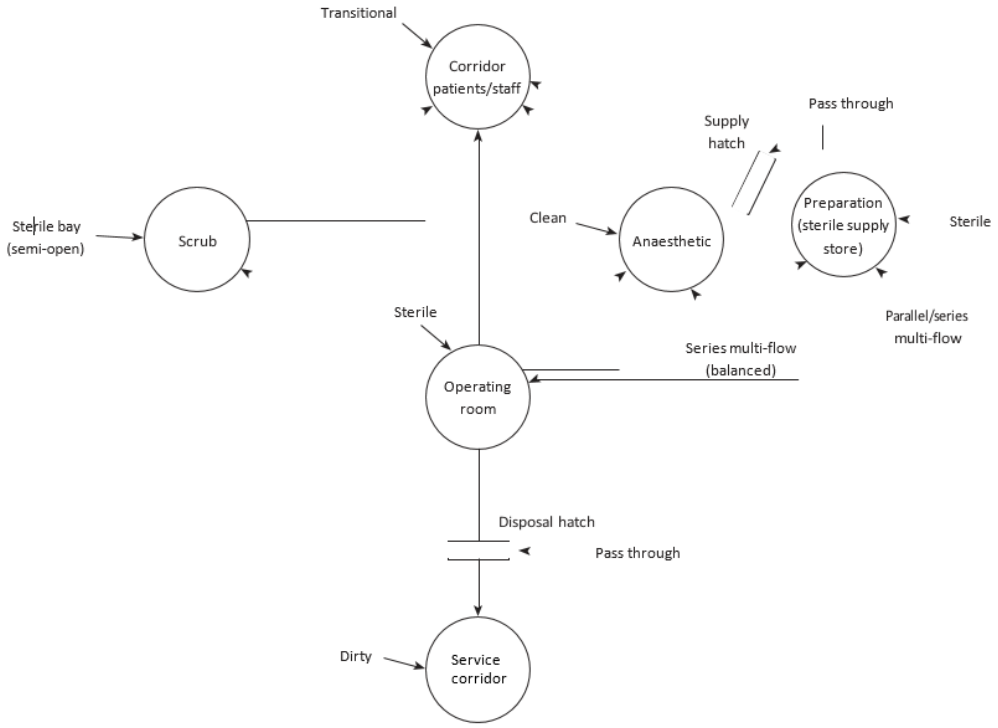
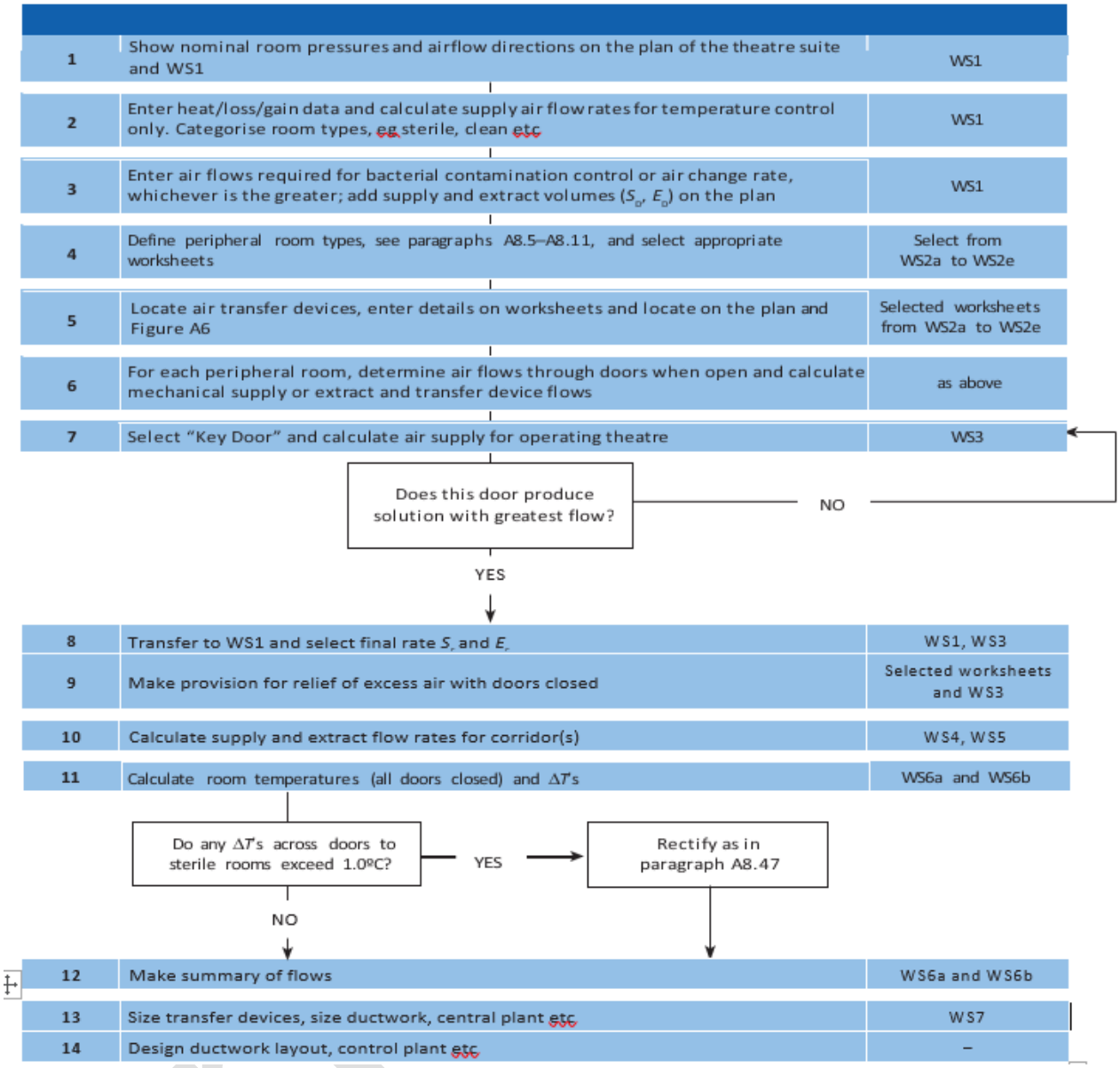


Figure A24: Air-flow design procedures



Calculation sheet for flow rates

Worksheet WS1
Reference:

Room name						
1. Summer temperature control Heat gain	kW					
2. Acceptable Δt	ºC					
3. Air flow rate (S_G) = $\frac{\text{Gain}}{\Delta t \times 1.2}$	m³/s					
4. Winter temperature control Heat loss	kW					
5. Acceptable Δt	ºC					
6. Air flow rate (S_L) = $\frac{\text{Loss}}{\Delta t \times 1.2}$	m³/s					
7. Dilution of bacterial contaminants Air flow rate S_D or E_D	m³/s					
8. Desired air change rate $\frac{\text{AC/hr} \times \text{room volume (m}^3\text{)}}{3600}$	AC/hr					
	m³/s					
9. Maximum of S_G, S_L, S_D or E_D or air change rate from step 8	m³/s					
10. Air movement control Air flow rate for air movement control S_{AMC} or E_{AMC} (from WS2, WS3 or WS4)	S m³/s					
	E m³/s					
11. Final supply flow rate (S_F)	m³/s					
12. Final extract	m³/s					
13. Total supply	m³/s					
14. Total extract	m³/s					

Designer ..... Date .....

Template A1 Worksheet WS1

Air movement control **Peripheral room ..... type, single flow**	**Worksheet WS2a Reference:** **Nominal pressure:_____Pa**

Consider door to ..... open

Flow required through doorway to give protection	Pa	Δ*t*	Air flow, m³/s Out	In	Remarks
Total					

S_{AMC} $(\sum_{OUT} - \sum_{IN})$ m³/s

or

E_{AMC} $(\sum_{IN} - \sum_{OUT})$ m³/s

Transfer S_{AMC} or E_{AMC} to WS1

Consider door to ..... closed

Closed door leakage	Pa	Δ*t*	Out	In	Remarks
Total					

Return S_F and E_F to WS1 _____ _____

Flow through transfer grille outward $(S_F - E_F - L_{OUT})$ _____

or

Flow through transfer grille inward $(E_F - S_F - L_{IN})$ _____

Designer ..... Date .....

Template A2 Worksheet WS2a

Air movement control **Peripheral room ..... type, parallel/series multi-flow**					**Worksheet WS2b Reference:** **Nominal pressure:_____Pa**
Door from this room to ..... (room of equal cleanliness) is not to be protected. A transfer grille is located in, or adjacent to, this door					
Consider other door to ..... open. Room pressure now becomes or or Pa (see Appendix 6)					
			Air flow, m3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
At above pressures leaks through closed doors	Pa	ΔP			
Mechanical supply or extract (S_F/E_F)					
		Total			
X ($\sum_{OUT} - \sum_{IN}$) or Y ($\sum_{IN} - \sum_{OUT}$)					
Transfer grille required from high-pressure zone Flow = X or at ΔPa to low-pressure zone Flow = Y Size of transfer grille (free area) A1					
Consider doors and hatch closed – room pressure becomes Pa (nominal)					
Closed door leakage from Appendix 4 (assuming no transfer grille)	Pa	ΔP	Out	In	Remarks
Mechanical supply or extract					
		Total			
Air flow required through transfer grille = IN – OUT = Z or OUT – IN = Z'' _____					
Transfer grille required flow Z or Z'' _____ @ _____ ΔP					
Size of transfer grille (free area) A2 = _____					
Select larger of A1 or A2 _____					

Designer ..... Date .....

Template A3 Worksheet WS2b

Air movement control **Peripheral room ..... type, parallel multi-flow high/low or series multi-flow (unbalanced)**					**Worksheet WS2c Reference:** **Nominal pressure:_____Pa**
Consider door from this room to ..... open. Room pressure now becomes or or Pa (see Appendix 6)					
Flow required through open doorway to give protection			Air flow, m³/s Out	In	Remarks
At above pressures leaks through closed doors are:	Pa	ΔP			
Total					
S_1 ($\sum_{OUT} - \sum_{IN}$) or E_1 ($\sum_{IN} - \sum_{OUT}$)					
Consider door from this room to ..... open. Room pressure now becomes or or Pa					
Flow required through open doorway to give protection			Out	In	Remarks
At above pressures leaks through closed doors are:	Pa	ΔP			
Total					
S_2 ($\sum_{OUT} - \sum_{IN}$) or E_2 ($\sum_{IN} - \sum_{OUT}$)					
Consider doors closed. Closed doors leakage from Appendix 4					
Door to:	Pa	ΔP	Out	In	Remarks
Total					
Return S_F and E_F from WS1 _____ Flow through transfer device outward ($S_F - L_{OUT}$) or _____ to ..... Flow through transfer device inward ($E_F - L_{IN}$) Transfer grille _____ Pressure relief damper from					

Designer ..... Date .....

Template A4 Worksheet WS2c

Air movement control **Peripheral room ..... type, series multi-flow (balanced)**					**Worksheet WS2d Reference:** **Nominal pressure:_____Pa**
Note: In this type of room the supply and extract air flow rates are equal and take no part in the air movement control (AMC)					
First, open door to higher pressure area. Room pressure then becomes or or Pa (see Appendix 6)					
			Air flow, m3/s		
			Out	In	Remarks
Flow required through open doorway to give protection. See Appendix 6					
At above pressures leaks through closed doors are:	Pa	ΔP			
Total					
$Q_1 (\Sigma_{IN} - \Sigma_{OUT})$ (+ve inwards) _____					
Next, open door to lower pressure area. Room pressure then becomes or or Pa					
			Out	In	Remarks
Flow required through open doorway to give protection					
At above pressures leaks through closed doors are:	Pa	ΔP			
Total					
$Q_2 (\Sigma_{OUT} - \Sigma_{IN})$ (+ve outwards)					

Flow through transfer device (TD1) to protect

door 1 = *Q*1 _____ at resultant

Δ*P* .....

Flow through transfer device (TD2) to protect

door 2 = *Q*2 _____ at resultant

Δ*P* .....

Designer ..... Date .....

Template A5 Worksheet WS2d

Air movement control **Peripheral room ..... type bay (semi-open)**	**Worksheet WS2e Reference:** **Nominal pressure:_____Pa**

Note: If the room is of the open bay type (ie opening is larger than normal single doorway), the room should be considered part of the main room. No air movement control considerations need then be made, and this sheet can be discarded. Supply and/or extract flow will be based on air distribution considerations.

Consider permanent opening

			Air flow, m3/s		
			Out	In	Remarks
Flow required through opening to give protection					
Leaks through closed doors to:	Pa	ΔP			
		Total			

E_{AMC} _____ or flow outward through transfer device ($\sum_{IN} - \sum_{OUT}$) _____

Transfer S_{AMC} or E_{AMC} to WS1

Transfer device – transfer grille _____

– pressure stabiliser _____

Size select transfer device for flow rate _____ @ ΔP _____

Note: A door from the bay is considered with the peripheral room to which it leads or, if it leads to the corridor, it is considered with the main room

Designer ..... Date .....

Template A6 Worksheet WS2e

Air movement control Operating room	**Worksheet WS3 Reference:**
	Nominal pressure:_____Pa

Note: To avoid considering each door open in turn, the "key door" concept is introduced. This is the door which requires the greatest mechanical flow when open. See paragraph A8.33

Select "key door" (see above).

Consider this door open – room pressure now becomes _____ Pa (see Appendix 6)

See Appendix 7 for room pressures

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
Air flow "out" or "in" via doors, transfer devices etc	Pa	ΔP			
Mechanical extract					
Total					

S_{AMC} ($\Sigma_{OUT} - \Sigma_{IN}$) _____ transfer S_{AMC} to WS1

Consider all doors closed.

Return S_F from WS1 _____ Room pressure now_____ Pa (nominal)

Air flow "out" or "in" via door leakage, transfer devices etc	Pa	ΔP	Out	In	Remarks
Mechanical extract and supply					
Total					

Flow ($\Sigma_{IN} - \Sigma_{OUT}$) through transfer device _____ @ΔP _____ to .....

For final selection of transfer device see paragraphs A8.50–A8.54

Designer ..... Date .....

Air movement control Corridor			**Worksheet WS4 Reference:**		
			Nominal pressure:_____Pa		
Consider all doors closed					
			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
Leaks through closed doors, transfer devices, permanent openings etc	Pa	ΔP			
Total flow inwards (S_1)					
Add mechanical input (S_2) if necessary to increase S_1 to give 7 AC/hr					
Total flow outwards and inwards					
$S_{AMC} = (\sum_{OUT} - \sum_{IN} + S_2)$ _____ Transfer to WS5					
or $E_{AMC} = (\sum_{IN} - \sum_{OUT} + S_2)$ _____ Transfer to WS5					

Note: this sheet to be used for each individual operating theatre suite (or pair of suites if they share a preparation room)

Designer ..... Date .....

Template A8 Worksheet WS4

Air movement control		**Worksheet WS5** **Reference:**
Summary of air supply and extract for an operating suite		
Air flow to corridor	All doors closed	Anaesthetic (key door open)
	m^3/s	m^3/s
From preparation		
From operating theatre		
From scrub		
From anaesthetic		
Total (a)		
Air flow to corridor From utility		
From other source		
Total (b)		
Other room supplies ..... Total (c)		
Total air supply (a) + (b) + (c)		
Consider corridor ventilation (see Appendix 3) and calculate air volume required, based on 7 AC/hr (see Note 1)		
Air flow required to ventilate corridor (m^3/s)		
Air flow required to ventilate service corridor (see Note 2) (m^3/s)		
If the air flow from the operating suite (a) and (b) is greater than the calculated required volume, no further supply air is necessary		
Additional air to ventilate corridor (m^3/s)		
Additional air to ventilate service corridor (see Note 2) (m^3/s)		
Air extract (m^3/s) The size of the extract plant should be of the order of 10% below the supply to assist in maintaining the department under positive pressure relative to the outside departments		
Extract plant = Supply less leakage (m^3/s)		
Less 10% of supply		
Total extract (see Note 3)		

Notes:

1. In the case of a multi-theatre operating department, the air balance for the corridor should be considered as a separate exercise, taking into account the final dispersal of excess air.
2. Omit these if only one corridor in operating suite.
3. The extract volume includes 0.24 m^3/s from the anaesthetic room for a balanced condition

Designer ..... Date .....

Template A9 Worksheet WS5

Room temperature – summer	**Worksheet WS6a Reference:**

Find summer supply temperature $T_{ss} = 20 - 0.828H(O/R)$ _____

$= T_{ss}$ $Q(O/R)$ _____ _____ºC

Note: the temperature of a space may be calculated from

$$T = \frac{t_1Q_1 + t_2Q_2 + \ldots\ldots\ldots + t_nQ_n + (0.828H)}{Q_1 + Q_2 + \ldots Q_n}$$

Where t_1 is temperature of source 1 (ºC)
Q_1 is flow from source 1 when all doors are closed (m^3/s)
H is heat gain in space (kW)

Room	Heat gain kWh	Supply		Flows inwards										Temperature ºC T
		Q	T_{ss}	From		From		From		From		From		
				Q	t	Q	t	Q	t	Q	t	Q	t	

Check doors to sterile areas

Door between	Calculated room ΔT (ºC)	Maximum ΔT permitted	Remarks

Designer ..... Date .....

Template A10 Worksheet WS6a

Room temperature – winter	**Worksheet WS6b Reference:**

Find winter supply temperature $T_{sw} = 20 - 0.828H(O/R)$ _____

$= T_{sw}$ _____ ºC

$Q(O/R)$ _____

Note: the temperature of a space may be calculated from

$$T = \frac{t_1Q_1 + t_2Q_2 + \ldots\ldots\ldots + t_nQ_n + (0.828H)}{Q_1 + Q_2 + \ldots Q_n}$$

Where t_1 is temperature of source 1 (ºC)
Q_1 is flow from source 1 when all doors are closed (m^3/s) H is heat gain in space (kW)

Room	Heat gain kWh	Supply		Flows inwards										Temperature ºC T
		Q	T_{sw}	From		From		From		From		From		
				Q	t	Q	t	Q	t	Q	t	Q	t	

Check doors to sterile areas

Door between	Calculated room ΔT (ºC)	Maximum ΔT permitted	Remarks

Designer ..... Date .....

Template A11 Worksheet WS6b

Transfer grilles, pressure relief dampers and pressure stabilisers	Worksheet WS7 Reference:

Transfer grilles – see paragraphs A8.34–A8.38

No	Location	Pressure difference Pa	Flow rate m^3/s	Free area m^2	Model	Resultant Δp Pa	Remarks

Pressure relief dampers – see paragraph A8.39

No	Location	Pressure difference Pa	Flow rate m^3/s	Free area m^2	Pressure setting Pa	Remarks

Pressure stabilisers – see paragraphs A8.40–A8.43

Note: where a stabiliser is acting both as series room door protection and operating pressure control, “pressure difference” and “flow rate” are from WS2d; “pressure setting” is from WS3

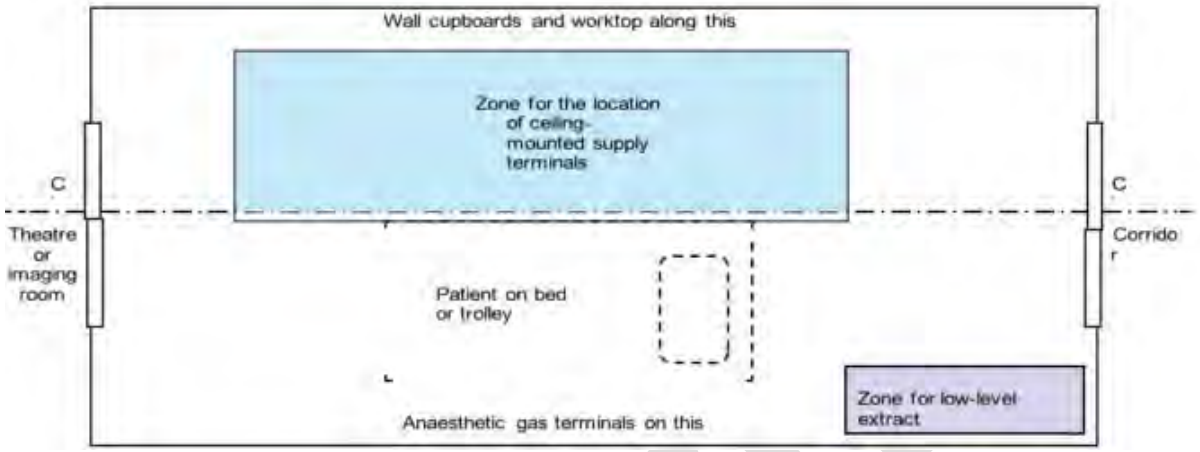
No	Location	Pressure difference Pa	Flow rate m^3/s	Free area m^2	Pressure setting Pa	Remarks

Designer ..... Date .....

Appendix 9: Design of air- movement control scheme for anaesthetic room

General

Figure A25 Schematic of suitable supply and extract solution



The above shows the typical zones for the positioning of ceiling-mounted supply and low-level extracts in an anaesthetic room. The objective is to comply with the COSHH Regulations and SHTM 03-01 Part A by providing a clean airflow path for staff working in anaesthetic rooms and so reduce their risk of casual exposure to waste/leaking anaesthetic agents.

Note 1: Supply terminals should not be positioned above wall-mounted cupboards as this will prevent their output being measured directly with a balometer. It will also negatively impact on the air distribution within the room.

Note 2: See photographs below for details of the recommended low-level extract installation.

Note 3: Low-level extracts should have a spring-clip-retained pull-off grille face for ease of cleaning.

Low-level extract installation

Traditional installation (not recommended)

- Low-level extract easily obstructed by equipment
- Extra corners to clean around

Figure A26 Low level extract traditional installation (not recommended)

Recommended installation

- low-level extract cut back at 80º and stops short of the floor;
- no added detail to floor covering or coving;
- no additional corners to clean around;
- not easily obstructed by equipment;
- pull-off grille face for ease of cleaning;
- grille still accessible for airflow measurement.

Figure A27 Low level extract recommended installation

The photograph is for illustrative purposes only and shows a cutback of approximately 65º. This was found to make airflow measurement quite difficult, hence the change to an 80º cutback so that measurement can be easily taken with a balometer.

Operating theatre to anaesthetic room air-transfer device

The air-transfer device between an operating theatre and anaesthetic room may be either by a transfer grille or pressure stabiliser. The choice will be determined by the volume of air to be transferred.

Paragraphs A8.51 and A8.52 in Appendix 8 give details.

Appendix 10: Example cause-and- effect check-sheets

Example cause-and-effect check-sheet for general theatre or imaging suite

Site			Date		
Area served			System ID		

	Test	AHU Checks	Y/N	TCP Indication	Y/N
1	AHU Off	Supply and extract dampers closed		Red	
2	Switch AHU "On"	Supply damper open Extract damper open		Red	
		Supply fan start and run Extract fan start and run		Red	
		Prove airflow		Green	
3	Switch AHU to "Set Back"	Supply fan slows Extract fan slows		Red	
4	Switch AHU to Operational speed	Supply fan speeds up Extract fan speeds up		Green	
5	End of day 10 minute warning that system will switch to "Set Back" *(Not all TCPs have this facility)*			Yellow display information box	
	Do nothing	System goes to "Set back"		Red	
	Reset to full speed			Green	
6	End of day 10 minute warning that system will switch to "Set Back" *(Not all TCPs have this facility)*			Yellow display information box	
	Press "Continue"	System stays at full speed for 1 hour		Green	
7	Supply fan fail	System shuts down		Red	
	Reset system to normal			Green	
8	Extract fan fails	Warning on TCP and BMS. AHU locks out if fault not rectified by following day		Yellow display information box	
	Reset system to normal			Green	
9	Theatre/Imaging room temperature to be stable at 20°C at the start of this test.				
	Reduce set point temperature to lowest possible on TCP	Chiller battery valve opens fully Record min temp reached and time taken to stabilise.		Set temp: °C Measured: °C Ind (TCP) °C Time taken mins	
10	Increase set point temperature to highest possible on TCP	Heater battery valve opens fully. Record max temp reached and time taken to stabilise.		Set temp: °C Measured: °C Ind (TCP) °C Time taken mins	
	Reset set point to 20°C			Green	
11	Switch AHU "Off"	Extract fan stops Supply fan stops Extract damper closes Supply damper closes		Red	

Template A13 Example cause-and-effect check-sheet for general theatre or imaging suite

Example cause-and-effect check-sheet for ultra-clean theatres

Site		**Date**	
Area served		**System ID**	

	Test	AHU/UCV Checks	Y/N	TCP Indication	Y/N
1	AHU Off	Supply and extract dampers closed		Red	
2	Switch AHU "On"	Supply damper open Extract damper open		Red	
		Supply fan start and run Extract fan start and run		Red	
		Prove airflow UCV "Off"		Red	
3	Switch AHU to "Set Back"	Supply fan slows Extract fan slows		Red	
4	Switch AHU to Operational speed	Supply fan speeds up Extract fan speeds up		–	
5	AHU at operational speed	Switch UCV on in "Low speed"		Amber = "Conventional Theatre mode"	
	Press "UCV mode"	UCV goes to "Full speed"		Green "UCV Theatre Mode"	
	Press "Conventional Theatre mode"	UCV goes to "Low speed"		Amber	
6	Switch AHU to "Set Back"	UCV goes to "Low speed" or "Off"		Red	
	Reset system to normal	UCV stays in "Low speed"		Amber	
7	Switch UCV "Off"	UCV fans stop		Red	
	Reset system to normal with UCV at full speed			Green	
8	Fail each UCV quadrant fan in turn and Coanda fans (4 + 2)			Red	
	Reset system to normal with UCV at full speed			Green	
9	Trigger HEPA filter high pressure switch			Green plus Blue light	
10	End of day 10 minute warning that system will switch to "Set Back" or "Off" *(Not all Theatre Control Panels have this facility)*			Yellow display information box	
	Do nothing	AHU & UCV go to "Set back" or "Off"		Red	
	Reset to full speed including UCV			Green	
11	End of day 10 minute warning that system will switch to "Set Back" or "Off" *(Not all Theatre Control Panels have this facility)*			Yellow display information box	
	Press "Continue"	System stays at full speed for 1 hour		Green	
12	Supply fan fails	System shuts down. UCV to "Low speed or Off"		Red	
	Reset system to normal			Green	
13	Extract fan fails	Warning on TCP and BMS.AHU locks out if fault not rectified by following day		Yellow display information box	
	Reset system to normal and UCV to full speed			Green	

Site		**Date**	
Area served		**System ID**	

Test		AHU/UCV Checks	Y/N	TCP Indication	Y/N
14	Theatre temperature to be stable at 20°C at the start of this test.				
	Reduce set point temperature to lowest possible on TCP	Chiller battery valve opens fully Record min temp reached and time taken to stabilise		Set temp: °C Measured: °C Ind (TP) °C Time taken mins	
15	Increase set point temperature to highest possible on TCP	Heater battery valve opens fully Record max temp reached and time taken to stabilise		Set temp: °C Measured: °C Ind (TP) °C Time taken mins	
	Reset set point to 20ºC			Green	
16	Switch AHU “Off”	Extract fan stops Supply fan stops Extract damper closes Supply damper closes UCV drops to “Set back”		Red	
Note any additional tests or checks below					

Template A14 Example cause-and-effect check-sheet for ultra clean theatre

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Note: In all cases the most recent version of any Legislation, Regulation, Standard or Guidance document should be consulted

Appendix 12: Abbreviations used in this document

Table A15: Abbreviations and their meanings

Abbreviation	Meaning
ac/h	Air changes per hour
ACDP*	Advisory Committee on Dangerous Pathogens*
ACOP	Approved Code of Practice
AE(V)	Authorising Engineer (ventilation)
AGP	Aerosol-generating procedure
AHU	Air handling unit
AP(V)	Authorised Person (ventilation)
BESA	Building Engineering Services Association
BIM	Building Information Model
BMS	Building Management System
BEMS	Building Energy Management System
BS EN	British Standard European Number
BSRIA	Building Services Research and Information Association
CCA	Critical care area (Level 2 & 3 care)
cfu	Colony forming unit
CIBSE	Chartered Institution of Building Services Engineers
COSHH	Control of Substances Hazardous To Health
CP(V)	Competent Person (ventilation)
CT	Computed tomography (imaging)
DIPC	Director of Infection Prevention and Control
DOP	Dispersed oil particles
DX	Direct expansion (refrigeration cycle)
EC	Electronicaly commutated (fan)
EPA	Efficiency particulate air filter (E10 to E12)
ErP	Energy related products
EU GGMP	European Guide to Good Manufacturing Process (pharmacy)
GRP	Glass reinforced polymer
HBN	Health Building Note
HEPA	High efficiency particulate air filter (H13 to H14)
HIS	Healthcare Infection Society
SHTM	Health Technical Memoranda
IAP	Inspection, assembly and packing (room)
ISO	International Standards Organisation
Level 0 care	Patients whose needs can be met through normal ward care in an acute hospital
Level 1 care	Patients at risk of their condition deteriorating, or recently relocated from higher levels of care, whose needs can be met through normal ward care with additional advice and support from the critical care team.

Abbreviation	Meaning
Level 2 care	Patients requiring more detailed observation or intervention, including support for a single failing organ system or post-operative care and those 'stepping down' from higher levels of care.
Level 3 care	Patients requiring advanced respiratory support alone or monitoring and support for two or more organ systems. This level includes all complex patients requiring support for multi-organ failure.
LEV	Local exhaust ventilation
LSAPC	Light scattering airborne particle counter
MDR-TB	Multi-drug-resistant tuberculosis
MRI	Magnetic resonance imaging
NICU	Neonate intensive care unit
PFI	Private Finance Initiative
PPVL	Positive pressure ventilated lobby (isolation room)
PVC	Polyvinyl chloride
RH	Relative humidity
SCBU	Special care baby unit
SPATA	The Swimming Pool and Allied Trades Association
SUP	Supply air quality
SVHSoc	Specialised Ventilation for Healthcare Society
TB	Tuberculosis
TCP	Theatre control panel
UCV	Ultra clean ventilation
ULPA	Ultra low particulate air filter (U15 to U17)
UV	Ultraviolet
VAV	Variable air volume
VCD	Volume control damper
VSG	Ventilation Safety Group
WEL	Workplace exposure limit

Table A16: Symbols

Symbol	Meaning
ºC(db)	Degrees centigrade (Dry bulb) temperature
K	Kelvin (temperature difference)
% RH	Percentage relative humidity
L/s	Litres per second
µm	Micrometres, microns
ePM1, 2.5, 10	Particle size in micrometres
≥	Equal to or greater than

* ACDP Containment levels

Category 1 biohazard: a biological agent unlikely to cause human disease

Category 2 biohazard: a biological agent that can cause human disease and may be a hazard to employees; it is unlikely to spread to the community and there is usually effective prophylaxis or effective treatment available.

Category 3 biohazard: a biological agent that can cause severe human disease and presents a serious hazard to employees; it may present a risk of spread to the community, but there is usually effective treatment or prophylaxis available.

Category 4 biohazard: a biological agent that causes severe human disease and is a serious hazard to employees; it is likely to spread to the community and there is usually no effective prophylaxis or treatment available.

Note: This publication can be made available in a number of other formats on request.

NHS National Services Scotland

Scottish Health Technical Memorandum 03-01

Ventilation for healthcare premises
Part A – Design and validation

Health Facilities Scotland
Engineering and Environment

February 2014

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Contents

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Preface

About Scottish Health Technical Memoranda

Engineering Scottish Health Technical Memoranda (SHTMs) give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare.

The focus of Scottish Health Technical Memorandum guidance remains on healthcare-specific elements of standards, policies and up-to-date established best practice. They are applicable to new and existing sites, and are for use at various stages during the whole building lifecycle.

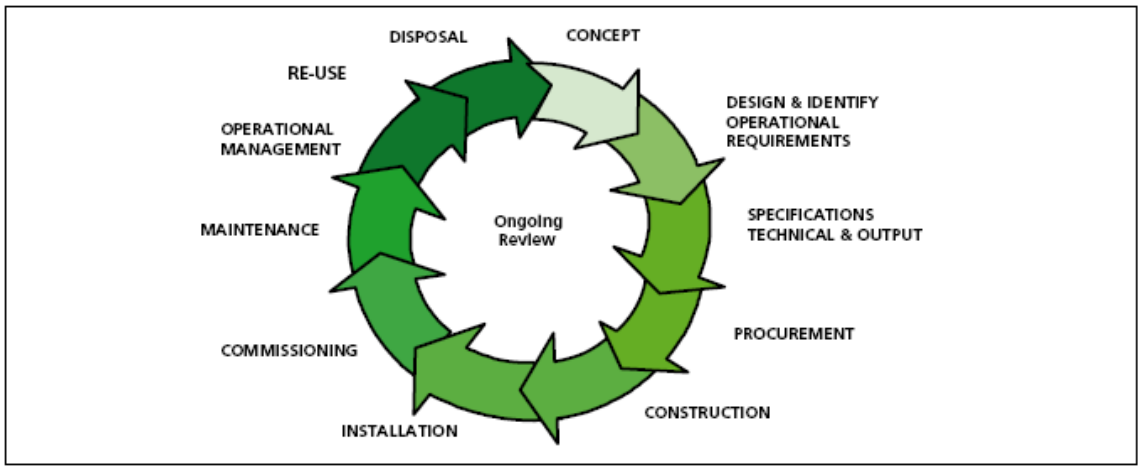
Healthcare providers have a duty of care to ensure that appropriate engineering governance arrangements are in place and are managed effectively. The Engineering Scottish Health Technical Memorandum series provides best practice engineering standards and policy to enable management of this duty of care.

It is not the intention within this suite of documents to repeat unnecessarily international or European standards, industry standards or UK Government legislation. Where appropriate, these will be referenced.

Healthcare-specific technical engineering guidance is a vital tool in the safe and efficient operation of healthcare facilities. Scottish Health Technical Memorandum guidance is the main source of specific healthcare-related guidance for estates and facilities professionals.

The core suite of eight subject areas provides access to guidance which:

- is more streamlined and accessible;
- encapsulates the latest standards and best practice in healthcare engineering;
- provides a structured reference for healthcare engineering.



Healthcare building lifecycle

Structure of the Scottish Health Technical Memorandum suite

The series of engineering-specific guidance contains a suite of eight core subjects:

Scottish Health Technical Memorandum 00: Policies and principles (applicable to all Scottish Health Technical Memoranda in this series).

Scottish Health Technical Memorandum 01: Decontamination.

Scottish Health Technical Memorandum 02: Medical gases.

Scottish Health Technical Memorandum 03: Heating and ventilation systems.

Scottish Health Technical Memorandum 04: Water systems.

Scottish Health Technical Memorandum 05: Reserved for future use.

Scottish Health Technical Memorandum 06: Electrical services.

Scottish Health Technical Memorandum 07: Environment and sustainability.

Scottish Health Technical Memorandum 08: Specialist services.

Some subject areas may be further developed into topics shown as -01, -02 etc and further referenced into Parts A, B etc.

Example: Scottish Health Technical Memorandum 06-02 Part A will represent: Electrical Services – Electrical safety guidance for low voltage systems.

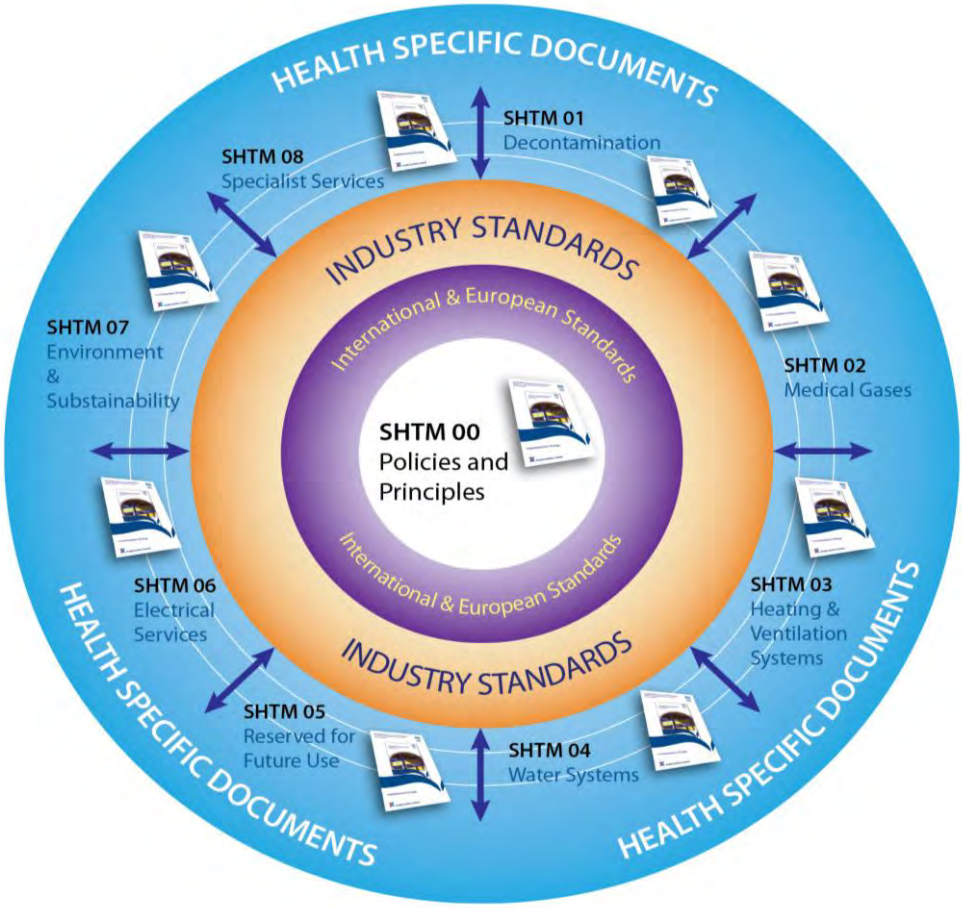
In a similar way Scottish Health Technical Memorandum 07-02 will simply represent:

Environment and Sustainability – EnCO_2de.

All Scottish Health Technical Memoranda are supported by the initial document Scottish Health Technical Memorandum 00 which embraces the management

and operational policies from previous documents and explores risk management issues.

Some variation in style and structure is reflected by the topic and approach of the different review working groups.



Engineering guidance

1. Introduction

1.1 Ventilation is used extensively in healthcare premises or primary patient treatment in operating departments, high dependency units and isolation facilities. It is also installed to ensure compliance with quality assurance of processed items in pharmacy and sterile supply departments and to protect staff from harmful organisms and toxic substances, for example, in laboratories.

1.2 This edition of Scottish Health Technical Memorandum 03 'Ventilation in healthcare premises' is published in two sections. It is equally applicable to both new and existing sites. It gives comprehensive advice and guidance to healthcare management, design engineers, estate managers and operations managers on the legal requirements, design implications, maintenance and operation of general and specialised ventilation in all types of healthcare premises.

1.3 Current statutory legislation requires both 'management' and 'staff' to be aware of their collective responsibility.

1.4 'Ventilation' is also provided in healthcare premises for the comfort of the occupants of buildings. More specialised ventilation will also provide comfort but its prime function will be to control closely the environment and air movement of the space that it serves in order to contain, control and reduce hazards to patients and staff from airborne contaminants, dust and harmful micro-organisms.

1.5 Ventilation systems in themselves present little danger to patients or staff. However, they do possess the ability to transmit hazards arising from other sources to large numbers of people. The danger may not become apparent until many patients and staff have been affected.

1.6 The sophistication of ventilation systems in healthcare premises is increasing. Patients and staff have a right to expect that it will be designed, installed, operated and maintained to standards that will enable it to fulfil its desired functions reliably and safely.

1.7 The Health and Safety at Work etc Act 1974 (HSW Act 1974) is the core legislation that applies to ventilation installations and these installations are intended to prevent contamination, control closely the environment, dilute contaminants or contain hazards. Their very presence indicates that risks to health have been identified.

Statutory requirements

1.8 The Control of Substances Hazardous to Health (COSHH) regulations place upon management an obligation to ensure that suitable measures are in place to protect their staff and others affected by the work activity. These methods may include both safe systems of work and the provision of a specialised

ventilation system. In laboratories the requirements are often met by the provision of fume cupboards and safety cabinets.

1.9 The existing requirements to provide ventilation, implicit under HSW Act 1974 and COSHH, have been made explicit by the Management of Health and Safety at Work Regulations 1999, the Workplace (Health, Safety and Welfare) Regulations 1992 and the Provision and Use of Work Equipment Regulations 1998, all issued as a result of European Directives.

1.10 Where specialised ventilation plant is provided as part of the protection measures there is a statutory requirement that it be correctly designed, installed, commissioned, operated and maintained. The local exhaust ventilation (LEV) section of the COSHH regulations requires that the plant be inspected and tested at least every 14 months by an independent organisation and that management maintain comprehensive records of its performance, repair and maintenance.

1.11 Certain substances have Occupational Exposure Limits (OEL) set out in Guidance Note EH 40 published annually by the Health and Safety Executive. If special ventilation systems are provided in order to achieve these standards they will be subject to the COSHH regulations as above.

1.12 All ventilation systems should conform to the principles set out in the Approved Code of Practice and guidance document entitled “Legionnaires’ disease: the control of *Legionella* bacteria in water systems” (commonly known as ‘L8’) published by the Health and Safety Executive and Scottish Health Technical Memorandum SHTM 04-01: The control of *Legionella*, hygiene, “safe” hot water, cold water and drinking water systems.

1.13 Special ventilation plants installed in laboratories dealing with research, development or testing, whether involving drugs, animals or genetically modified organisms, may be subject to particular legislation with regard to their operation in addition to that mentioned above. Further information is given by the Health and Safety Executive Health Services Advisory Committee in:

- safe working and prevention of infection in clinical laboratories;
- safe working and prevention of infection in clinical laboratories: model rules for staff and visitors;
- safe working and prevention of infection in clinical laboratories in the mortuary and post-mortem room.

1.14 Plants installed in units manufacturing medicinal products to the standards set out in the current European Guide to Good Manufacturing Practice may also be subject to particular legislation with regard to their operation in addition to that mentioned above.

1.15 Records should be kept of equipment design and commissioning information. The Health and Safety Executive, Medicines Inspectorate and other interested bodies have a statutory right to inspect them at any time. All records should be kept for at least five years.

1.16 The fire regulations require that if ventilation ductwork penetrates the fabric of a building it should be designed and installed so as to contain the spread of fire. (for further information refer to Firecode Series SHTMs 81, 83 and 85)

1.17 Increased health risks to patients will occur if the more specialised ventilation systems installed to supply high quality air to operating departments do not achieve and maintain the required standards. The link between post-operative infection and theatre air quality has been well established. Plants serving conventional operating departments, for instance, will be required to ensure the separation of areas within the suite by maintaining a specific direction of air flow between rooms, even when doors are opened. They will also maintain the selected operating department environmental conditions regardless of changes in the outside air conditions or activities within the space. In addition ultra-clean operating ventilation systems that are designed to provide an effectively particle-free zone around the patient while the operation is in progress, have been shown to reduce significantly post-operative infection in patients undergoing deep wound surgery. Their use for other forms of surgery may well be required.

1.18 Ventilation systems that can be shown to be inappropriate, inadequate or ineffective and that give rise to proven failures can result in a civil suit by the patient against the operators.

1.19 If the plant has been installed to dilute, extract or contain harmful substances (the definition of which now includes microorganisms) its failure may expose people to unacceptable levels of hazard. Proven failures can give rise to a civil suit against the designers and operators by the individuals who have been affected. This would be in addition to the actions brought as a result of breaching the statutory requirements.

1.20 There is a statutory requirement to provide ventilation in all enclosed workspaces. It may be provided by either natural or mechanical means. The following are some of the factors that determine the ventilation requirements of a workspace:

- human habitation (minimum fresh air requirement);
- the activities of the department, that is, extraction of odours, aerosols, gases, vapours, fumes and dust – some of which may be toxic, infectious, corrosive, flammable, or otherwise hazardous (see Control of Substances Hazardous to Health (COSHH) regulations;
- dilution and control of airborne pathogenic material;
- thermal comfort;
- the removal of heat generated by equipment (e.g. catering, wash-up, sterilising areas, electrical switch rooms, uninterruptible power supply (UPS) cupboards and some laboratory areas);
- the reduction of the effects of solar heat gains where other forms of reducing the solar effect is not available or practical, i.e. solar blinds;
- the reduction of excessive moisture levels to prevent condensation (for

example Hydrotherapy pools);

- combustion requirements for fuel burning appliances (see BS5376, BS5410 and BS5440);
- 'make-up' supply air where local exhaust ventilation (LEV) etc., is installed.

Mechanical ventilation systems are expensive in terms of capital and running costs, and planning solutions should be sought which take advantage of natural ventilation either where the use of the area in question is not critical to airflow patterns or pressures, or where backup systems are available when natural ventilation cannot be achieved.

1.21 When new ventilation systems are accepted for use, full information as to their designed mode of operation together with recommended maintenance procedures should be provided as part of the handover procedure.

Requirement	Reason	Application
Statutory	Health and Safety at Work etc Act	Operating department Laboratories Pharmacy
	COSHH regulations	Areas containing identified biological or chemical hazards Areas containing oxygen displacing gases
	Local Exhaust Ventilation (LEV)	Enclosed work-spaces Workshops
Functional	Comfort	Situations where the quality of the environment for staff and patients is critical to their general performance and well-being
Clinical	Post-operative infection reduction	Operating suites used for general surgery, casualty, obstetrics/gynaecological and maternity procedures
	Reduction of deep wound sepsis	Ultra-clean operating suites for transplant, deep wound surgery, hip replacement, bone grafting and bone marrow transplant procedures
	Isolation from contact with bio hazards	Isolation units for patients who present a biological, chemical or radiation hazard to others. Isolation units for patients with a reduced immune system

Table 1: Reasons for providing ventilation

Functional overview – Terms in use

1.22 The terms 'ventilation' and 'air-conditioning' are often incorrectly used to describe the same equipment. A general explanation of the terms is given below.

Ventilation

1.23 Ventilation is a means of removing and replacing the air in a space. In its simplest form this may be achieved by opening windows and doors. Mechanical ventilation systems provide a more controllable method. Basic systems consist of a fan and either collection, (extraction) or distribution (supply) ductwork. More complex systems may include the ability to heat and filter the air passing through them. Ventilating equipment may be required in order to remove smells, dilute contaminants and ensure that a supply of 'fresh' air enters a space.

Air-conditioning and mechanical cooling

1.24 Air-conditioning is the ability to heat, cool, dehumidify and filter air. For full air-conditioning, humidification may also be provided. This means that the climate within a space being supplied by an air-conditioning plant can be maintained at a specific level regardless of changes in the outside air conditions or the activities within the space. Mechanical cooling may be provided where close control of 'comfort conditions' within a space is required but humidity control is not needed.

Special ventilation

1.25 In healthcare premises, certain activities will necessitate the provision of ventilation equipment with additional special features in order to achieve and maintain specific conditions. These may be needed in order to assist with the treatment of patients or maintain the health and safety of staff. The precise reason for providing special ventilation will depend upon the intended application. The list below indicates some of the more typical reasons:

- to remove, contain or dilute specific contaminants and fumes;
- to ensure the isolation of one space from another;
- to preserve a desired air flow path from a 'clean' to a 'less clean' area;
- to provide control of the cleanliness of a space;
- to provide 'close' control of temperature;
- to provide 'close' control of humidity.

1.26 The following departments will usually have specialised ventilation requirements, either for a single room or throughout a suite of rooms:

- operating department;
- laser surgery unit;
- intensive treatment unit;
- infectious diseases isolation unit;
- manufacturing pharmacy;
- specialised imaging, X-ray and scanning unit;

- pathology containment laboratories;
- mortuary and dissection suite;
- research laboratory;
- sterilising and disinfecting unit (SDU);
- endoscopy unit;
- renal dialysis suite;
- ultrasound facilities;
- audiology room.

1.27 Ventilation may be provided in a wide variety of ways. These will include:

- extensive purpose-built air-conditioning units housed in their own plant rooms;
- proprietary 'packaged' systems often sited outside on a roof or;
- wall-mounted electric fans located at the point of use.

1.28 A fixed volume of air may be supplied, often expressed in terms of the resulting number of air changes per hour (ac/h) within the space being ventilated. It may also be expressed in terms of litres/second/person. Alternatively the volume of air supplied may be varied in order to maintain a specific pressure relationship between the area supplied and other surrounding areas. In some situations a combination of both methods may be adopted.

1.29 Modern plants are fitted with the means to recover energy from the extract air where this can be justified without causing contamination of the incoming supply air.

1.30 Ultra-clean systems use the same basic plant and equipment as standard air-conditioning but are in addition fitted with a terminal device that supplies the air in a unidirectional manner to the working area. Their standard of filtration will be capable of delivering air with a very low particle count to the space that they serve.

Local exhaust ventilation

1.31 Local exhaust ventilation (LEV) is a term used to describe systems installed to prevent hazardous substances from entering the general atmosphere of the room in which they are being used. Their primary function is to protect staff from the effects of their work activity.

1.32 Simple LEV systems comprise a capture hood, extract ductwork and fan. These are used to contain industrial types of hazard such as fumes from welding processes, gas discharges from standby battery banks and dust from woodworking machinery. The vapour given off when large quantities of chemicals are decanted into ready-use containers and fumes from X-ray film processing units are further examples of chemical hazards often controlled by LEV systems.

1.33 In laboratories, pharmaceutical manufacturing facilities and operating suites, LEV systems usually take the form of semi-open fronted cabinets within which the hazardous substance is manipulated. These cabinets either have their own filtered air supply or are fed with air from the room. The air extracted from the cabinet is passed through a high-efficiency filter before being discharged either to the atmosphere or back into the room. Microbiological safety cabinets, laboratory fume cupboards, cytotoxic drug cabinets and fixed or mobile disinfection enclosures are all examples of this type of facility.

1.34 Mortuaries and dissection suites may have LEV systems incorporated within the dissection table, specimen bench and bone saw.

Management action

1.35 The guidance contained in this SHTM should be applied in full to new installations and major refurbishments of existing installations.

1.36 Ventilation will need to be provided:

- as a requirement for patient care;
- in order to fulfil a statutory duty.

1.37 In assessing the need for more specialised ventilation and the standards desired for patient care, managers will need to be guided by their medical colleagues and by information published by Health Facilities Scotland.

1.38 The statutory need for ventilation falls into two categories:

- in the first, the need for specialised ventilation and the standards to be adopted are clearly set out in specific pieces of legislation. An excellent example of this is the current legislation surrounding the manufacture of medicinal products in the European Community. The managers of the departments affected by this type of legislative requirement should be aware of their needs and be able to advise on the standards to be achieved;
- the second type of statutory requirement arises due to the interpretation of both the Health and Safety at Work etc Act and the Control of Substances Hazardous to Health (COSHH) regulations. The person tasked with conducting COSHH assessments will be able to advise as to the need for, and standard of, ventilation in each particular case.

Design and validation process

1.39 It is essential when undertaking the design of a specialised ventilation system that the project be considered as a whole. The process model set out below should ensure that all relevant factors are considered.

Step	Question	Design statement and information required	Comment
1	Why is the system required?	Healthcare applications Statutory elements Non-healthcare applications	
2	What is the required system performance?	Room air flow pattern Air change rate Differential pressures Air quality Room air condition Noise limits	
3	What are the constraints on the distribution system?	Location, Size, Materials Dampers, Access, Insulation Fire considerations Room terminals	
4	What are the minimum requirements for the AHU(s)?	Intake / Discharge positions *Legionella*, Health and Safety Access, Fire, Electrical safety Leaks, Insulation, Cleanliness Filtration, Drainage	
5	What control functions are required?	User control requirements Estates control functions Energy management Environmental conditions Control sequence logic Run, Set back, Off philosophy	
6	How will the system performance be validated?	Validation methodology Instruments used Design information required [*Design air flow rates* *Design air velocities* *Pressure differentials* *Noise levels* *Air quality* *Installation standard*]	
7	The system will only be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life.		
8	Handover to client	Basic design information Commissioning results Validation report	

Table 2: Design and Validation process model

Use and function of typical equipment used in ventilation plant

1.40 Typical equipment used in ventilation systems is listed below together with a brief description of both function and use.

General

1.41 The equipment built into the ventilation system and its ductwork should be of a type that will neither cause nor sustain combustion. No materials that could sustain biological activity should be used in the construction or assembly of the system.

Air Intake

1.42 An uncontaminated air supply to the system is essential. In order to achieve this, the air intake will be positioned so that air discharged from extract systems or other dubious sources cannot be drawn in. Exhaust fumes from vehicles can present particular problems. The area surrounding the intake will need to be kept clean and free of vegetation and waste material in order to reduce the possibility of biohazards or fire. The intake itself will be protected by a louvre and mesh screen to prevent rainwater, vermin and insects etc from entering the system.

Damper

1.43 Several types may be fitted:

- automatic dampers fitted immediately behind the air intake and extract louvres. They will automatically close when the system is shut down in order to prevent an uncontrolled circulation of air;
- balancing dampers are fitted into each branch of the air distribution ductwork system so that the design air flow rate can be set during the commissioning process;
- where ductwork passes through a fire compartment wall, ceiling or floor a fire and/or smoke damper may be required;
- plant isolating dampers are fitted so that the main plant can be isolated from its air distribution duct system. They are manually operated and enable cleaning and maintenance of the air-conditioning equipment to be carried out.

Ducting

1.44 The means by which air is conveyed from the intake to its point of use. Ducting is usually constructed of galvanised steel and will normally be insulated to reduce noise and conserve energy. Ducts can also be formed in concrete, brickwork, stainless steel or plastic and may be rigid or flexible.

Fan

1.45 A series of rotating blades that move the air in the direction required. Fans are usually powered by electric motors either directly connected to them or driven through belts and pulleys. A fan may be arranged either to force air into or draw air from a ductwork system.

Attenuator / silencer

1.46 A device that will contain and absorb the noise emitted by a fan. They may be required to reduce disturbance caused by noise breaking out through the air intake and also noise transmitted along the ductwork to the conditioned space.

Filter

1.47 A filter consists of a labyrinth of fibrous material contained in a frame. It is designed to capture and hold particles being carried in the airstream. Because of the size range and number of particles that exist in air no filter can remove them all. The purpose of filtration is to reduce their number and size range to an acceptable level. Filters of progressively higher grades are fitted through the ventilation system:

- primary filters (coarse) are designed to collect the larger particles and are intended to keep the air-conditioning plant clean;
- secondary filters (fine) will remove the staining particles from air and keep the conditioned space visibly clean;
- high efficiency particulate air filters (HEPA/absolute) will remove virtually all particles from air. These may be required in order to reduce contamination in the working area either biologically or in terms of particle count.

Filters may be fitted to extract systems to protect energy recovery devices. They may also be fitted to remove biological, radiation or chemical hazards and if so, are often contained in a 'safe change' facility in order to protect those carrying out maintenance.

Activated carbon filters will reduce odours in extracted or recirculated air.

Heater battery / heater coils

1.48 A series of heater batteries or heating coils with or without fins through which steam or hot water is circulated. Heat is given up to the air passing over the battery thus increasing its temperature. Heating is usually carried out in stages, the final battery being controlled by the end user. Small batteries may be electric.

Humidifier

1.49 A device for increasing the humidity of air by adding moisture. For ventilation in healthcare premises this is normally achieved by releasing 'clean' steam into an air supply duct. The steam will be completely absorbed into the air, increasing its humidity. The level of humidity may be preset or controlled by the end user.

Cooler battery / cooling coil

1.50 A series of finned coils mounted in the air supply duct. Either chilled water or refrigerant is circulated through the coils causing heat to be removed from the air. This will reduce its temperature and may also condense moisture out of the

air. As free moisture in a duct can be a source of contamination the coil will be fitted with an eliminator and drainage system.

Eliminator

1.51 A device for catching and removing water droplets from an air stream. It may form part of a cooling coil or be a separate device.

Drainage system

1.52 A means of removing water from ductwork and disposing of it safely. Typically it will consist of a tray mounted in the duct to catch moisture, a glass water seal trap, continuously falling drainage pipework and an air break in the drain run to prevent waste water returning and contaminating the duct.

Access doors and observation ports

1.53 Doors and removable panels providing access for routine maintenance and cleaning. The doors should be fitted with glazed ports and suitable lighting provided so that the correct operation of devices such as cooling coils, humidifiers and filters can be easily observed without needing to switch off the plant.

Energy recovery

1.54 Many plants are fitted with the means to recover energy from the extract air without causing contamination of the incoming supply air. These devices will be fitted with a drainage system and may incorporate an eliminator. Several types of energy recovery systems are available.

1.55 Precise definitions of ventilation and air-conditioning terms are given in the Chartered Institution of Building Services Engineers (CIBSE) Guide B.

Typical plant

1.56 The layout of a typical plant that conforms to the requirements for healthcare applications is shown in Figure 1 overleaf. It contains most of the equipment described above.

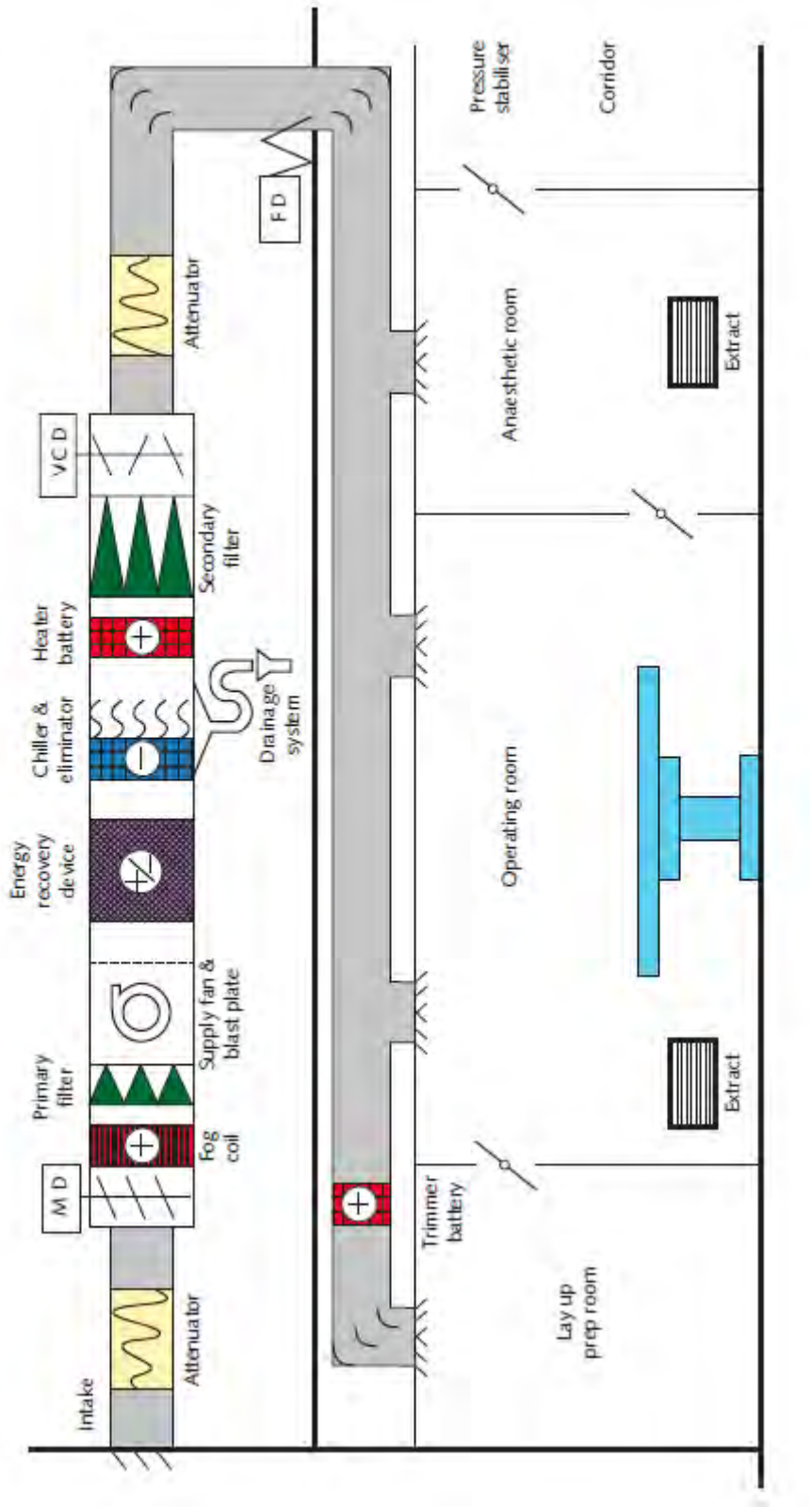


Figure 1: Design and Validation process model

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2. Provision of ventilation in healthcare buildings

2.1 It is acknowledged that planning constraints imposed by the building shape and/or functional relationships of specific areas will invariably result in some measure of deep planning thus reducing the opportunity for natural ventilation. However, ventilation costs can be minimised by ensuring that where practicable, core areas are reserved for rooms that have a functional requirement for mechanical ventilation. Examples are sanitary facilities, dirty utilities and those rooms where clinical or functional requirements have specific environmental needs; and where for reasons of privacy, absence of solar gain etc., windowless accommodation is acceptable. Other spaces appropriate to core areas are those that have only transient occupation and therefore require little or no mechanical ventilation, for example circulation and storage areas.

Natural ventilation

2.2 Natural ventilation is usually created by the effects of wind pressure. It will also occur if there is a temperature difference between the inside and the outside of the building. The thermo-convective effect frequently predominates when the wind speed is low and will be enhanced if there is a difference in height between inlet and outlet openings. Ventilation induced by wind pressures can induce high air change rates through a building provided air is allowed to move freely within the space from the windward to the leeward side.

2.3 As the motivating influences of natural ventilation are variable, it is almost impossible to maintain consistent flow rates and ensure that minimum ventilation rates will be achieved at all times. This variability is normally acceptable for general areas including office accommodation, general wards, staff areas, libraries rooms, dining rooms and similar areas which should, where possible, be provided with opening windows of a design that facilitates natural ventilation.

2.4 Current guidance restricts the amount windows can be opened for safety reasons and as many designs are top-hung, their ability to permit natural ventilation is limited. It may therefore be necessary to provide dedicated ventilation openings in the fabric of the building to allow a sufficient natural flow of air into and out of the space. Paragraph 2.20 also refers.

2.5 In all cases, excessive heat gain, indoor air quality requirements or external noise may limit or preclude the use of natural ventilation.

Extract ventilation systems

2.6 Separate extract ventilation will be required for sanitary facilities, lavage areas, dirty utilities and in rooms where odorous, but non-toxic fumes are likely, in order to ensure air movement into the space. 10 air changes per hour have been found necessary, particularly in geriatric and psychogeriatric accommodation. This will assist with infection control procedures. A single

fan/motor unit can be suitable for individual rooms, but multi-room systems should be provided with duty and standby fans or motors to meet this need.

2.7 Toilets should have an extract ventilation rate as set out in the building regulations. Where WC's are located in shower and bathroom spaces, the ventilation required for the WC will normally be adequate for the whole space.

Supply only ventilation

2.8 Mechanical supply ventilation will be required in areas where it is important to maintain a positive pressure in order to prevent the ingress of less clean air, e.g. in pharmacy aseptic suites, sterile supply packing rooms, operating theatres and their preparation rooms (air change rates are given in Table A1).

Supply and extract ventilation

2.9 Mechanical supply and extract ventilation should be provided in rooms where there is a need to control room pressure in relation to adjacent spaces. Intensive Care Units, (ICU), isolation suites and treatment areas are typical applications.

Mechanical or comfort cooling

2.10 Cooling is very expensive in terms of energy costs and should be provided only where necessary to maintain a comfortable environment for staff and patient, or to ensure satisfactory operation of equipment. The imaging department in particular may require cooling to offset the equipment load.

2.11 Calculations and thermal modelling should be undertaken to ensure that during the summertime, internal temperatures in patient areas do not exceed 28ºC (dry bulb) for more than 50 hours per year taking into account the level of design risk for the application.

2.12 Certain non-patient areas may also require cooling and will typically include some laboratories, central wash-up and other areas that are subject to high equipment heat gains.

2.13 Where deep planning of other continuously occupied spaces, for example offices, is unavoidable, there will also be occasions when acceptable levels of comfort can only be maintained by cooling. Planning solutions of this type however will be exceptional.

2.14 Refrigeration plant should be of sufficient capacity to offset heat gains and maintain areas at a temperature that does not exceed the external design shade temperatures by more than about 3ºC taking into account the level of design risk for the application.

Air-conditioning

2.15 Full air-conditioning is only required in a very small number of areas within healthcare buildings and due to the capital and running cost its inclusion should be kept to a minimum. Paragraphs 3.14 - 3.15 and 4.91 - 4.93 also refer.

2.16 Areas whose functions may warrant the installation of air-conditioning include operating departments, intensive therapy units, manufacturing pharmacies and areas with particularly sensitive equipment.

Specialised ventilation

2.17 Due to the nature and extent of activities carried out in healthcare buildings, there will be a need for a wide range of specialised ventilation systems. The types of system which are generally required in individual departments and typical arrangements are given in Section 7.

2.18 The activities within some departments will require the provision of local exhaust ventilation (LEV). This is a statutory requirement under COSHH wherever the escape of chemicals, toxic fumes, biological material or quantities of dust into the general area would present a hazard to the occupants.

Ventilation for general areas

2.19 Table A1 provides recommended air change rates, temperatures and pressures for general areas that require mechanical ventilation in healthcare buildings.

Use of natural ventilation

2.20 The air tightness of new buildings has improved to the point that infiltration through building leakage can no longer be relied upon to provide sufficient air-flow. Attention must therefore be given to the provision of purpose-made ventilation openings to achieve the necessary flow rates. The air entering the openings may need to be controlled by motorised dampers linked to temperature and / or occupancy sensors in the ventilated space.

2.21 Internal partitions, fire compartment walls and closed doorways can often impede the flow path, and when this happens, the process will be more dependent on single-sided ventilation. Nevertheless, even with this degree of compartmentation, acceptable ventilation may still be achieved without window openings that would prejudice safety, security or comfort.

2.22 Some types of window, for example, vertical sliding, can enhance single sided air change by temperature difference, and these will improve the overall rate of natural ventilation in protected or sheltered areas where the effect of wind pressure is likely to be minimal.

2.23 It is generally considered that natural cross-flow ventilation is able to give reasonable air distribution for a distance of up to 6 metres inwards from the external façade, provided that reasonably clear air paths are maintained. Beyond this distance in areas where clear air paths cannot be maintained and in areas where high minimum air change rates are specified, mechanical ventilation should be provided.

2.24 Further information can be found in SHTM 55 ‘Windows’, BS5925 ‘Code of practice for ventilation principles and designing for natural ventilation’ and

CIBSE Applications Manual AM10: 'Natural ventilation in non-domestic buildings'.

Mixed mode ventilation

2.25 This comprises an assisted form of natural ventilation. Fans are fitted in the purpose made damper-controlled ventilation openings. Alternatively a separate ventilation unit may be installed. In both cases the dampers and fans are controlled under the dictates of temperature and occupancy sensors to ensure a minimum air flow rate while taking advantage of natural ventilation effects when present.

2.26 Where natural or mixed mode ventilation is adopted with complex air paths, the designer should produce an air flow diagram in order to ensure correct provision of air transfer devices. CIBSE Applications Manual AM13: 'Mixed mode ventilation in non-domestic buildings' gives guidance.

Mechanical extract ventilation

2.27 General extract systems can vary in complexity from a single wall-mounted fan to a ducted air system with dual extract fans.

2.28 Replacement air is generally provided by a central supply system (as described below). Unless special precautions are taken, the latter may result in an unacceptable level of draughts occurring in winter, and possible risk of unacceptable levels of noise transmission.

2.29 If individual systems are used, the ventilation can be operated intermittently, provided it continues to run for at least 15 minutes after the room is vacated, as with light switch-operated fans in individual toilets.

2.30 If general exhaust systems are used; it is recommended that filtered and tempered replacement air is provided via a central supply plant to adjoining lobbies or corridors, to prevent the risk of discomfort caused by the ingress of cold air. Fire compartmentation requirements must be maintained.

2.31 Information on specialised extract systems is given in Section 7.

Mechanical supply systems

2.32 Where mechanical supply systems are required, the fresh air should be tempered and filtered before being delivered to the space, to avoid discomfort.

2.33 The air should be heated using a constant or variable temperature source, but generally only to the space air temperature. In most instances, the low-pressure hot water heating (LPHW) should offset any fabric loss, so that setback room temperatures can be maintained during unoccupied periods without the need for the ventilation system to operate.

Balanced ventilation

2.34 Balanced ventilation systems are merely a combination of a supply and extract systems of equal volume; and either a single space or a whole building may be considered to be balanced. A balanced system is necessary in instances where it is essential to maintain consistent air movement within an area, for example, treatment rooms.

Cascade ventilation

2.35 In operating departments it is normal practice to supply air to the operating room, and allow it to pass through less clean areas – corridors, utility rooms etc. (from where it is eventually extracted).

Recirculation systems

2.36 Due to the nature of the use of mechanical ventilation systems within healthcare buildings, there are few opportunities for the application of recirculation air systems. They are however normally used for HEPA filtered clean room applications where the extract air is significantly cleaner than the outside supply. Recirculation is also routinely used in the canopy section of Ultra Clean Operating theatre ventilation systems.

2.37 Where the designer is considering the installation of a recirculation air system, due account must be taken of:

- minimum fresh air supply volume required by the Building (Scotland) Regulations 2004 (currently 20%);
- prevention of contamination of supply air from vitiated air in extract systems;
- prevention of stratification occurring within plenum chambers and mixing boxes which may result in freezing of downstream coils;
- ensuring sufficient velocities through control dampers (ideally 5-6m/s) to provide suitable authority; and good shut-off;
- modulating control of mixing to provide optimum on-plant conditions;
- use of ‘free cooling’ by cycling the dampers to minimum fresh air when the enthalpy of the outside air is above that of the extract air under conditions when cooling is required.

Chilled beams

2.38 The use of chilled beams for the provision of heating, cooling and ventilation is increasingly common in healthcare premises. The use of Active Chilled Beams providing tempered filtered air to a heating / cooling device within the room can provide effective local control of environmental conditions.

2.39 Care should be taken in positioning chilled beams to ensure the avoidance of cold draughts particularly when used in the cooling mode. The control settings should ensure that the external elements of the beam are always above dewpoint.

2.40 Consideration should be given to the ease with which specific types of chilled beam units can be accessed for cleaning having regard to the need to control the infection risk. The impact of maintenance requirements on room availability should also be considered.

Split comfort air-conditioners

2.41 Split comfort air-conditioners, room conditioners or cassette units are used increasingly where there is a small local requirement for cooling for operational purposes. They can provide an effective economic solution to cooling needs, where a central refrigeration system is not practicable.

2.42 The units re-circulate room air so provision for a fresh air make up, either by natural or mechanical means, to the standard required by the Building (Scotland) Regulations must be provided.

2.43 The recirculation of room air presents problems with indoor air quality (IAQ) and may increase the risk of healthcare associated infection (HAI). Split units should not therefore be used in critical patient areas.

2.44 Split units may be used for single room applications or as multiple linked units that can independently provide either heating or cooling, all served by a single outdoor unit. These systems enable good temperature control of a number of rooms with maximum energy efficiency.

2.45 Whether single or multiple systems are used, it is essential that the designer gives due consideration to the source of electrical supply, location of the heat rejection unit, environmental effects to the refrigerant used and drainage provision for the cooling coil condensate.

2.46 The units will require routine maintenance for filter change and cleaning; they should therefore be installed in an accessible position.

Dilution ventilation and clean air flow paths

2.47 Dilution ventilation has in the past been used to control levels of hazardous substances in a space. This approach is no longer considered acceptable. The COSHH Regulations require that known hazardous substances should be substituted by safe alternatives. If this is not possible then they should be controlled at source by the use of closed systems such as anaesthetic gas scavenging units or exhaust protective enclosures such as fume cupboards.

2.48 The exposure of staff to casual spillages of substances such as medical gases in anaesthetic rooms should in the first instance be dealt with by establishing a clean airflow path. Air should be supplied at high level and extracted at low level directly behind the anaesthetic equipment position. The philosophy of establishing a clean air-flow path from the supply point; to the staff; on to the patient and out via a low level extract would also apply in recovery rooms and maternity delivery rooms including labour, delivery, recovery & post partum (LDRP) Rooms. A suitable air change rate will provide dilution ventilation as an additional safeguard; see Table A1, Table A2 and Note c.

2.49 In operating theatres the patient will be on a closed breathing circuit in a room with a high air change rate. Under these circumstances the dilution effect would be considered sufficient to control any casual exposure to anaesthetic gases.

Mechanical ventilation systems

System selection

2.50 Natural ventilation is always the preferred solution for a space, provided that the quantity and quality of air required, and the consistency of control of ventilation to suit the requirements of the space, are achievable with this method. If this is not the case, a mechanical ventilation system will be required.

Choice of central/local plant

2.51 Mechanical ventilation is expensive to operate, and as such, should be controlled to operate when the space being served requires to be ventilated. In addition, loads on refrigeration plant are rarely constant owing to changes in solar gain, occupancy and use of heat-generating equipment and lights, therefore control of temperature is critical.

2.53 If the ventilation loads throughout a department or building are in phase, or are not significant, a central plant with single zone control can be adopted. However, this is rarely the case, and elsewhere, the condition or quantity of supply air to different areas or zones of the building must be varied accordingly. This can be done by providing either individual plants to each zone, or separate zone terminal control. Where there is a high density of rooms with similar ventilation requirements in an area of a building or department, it is usually economical to combine them into a central system.

2.54 In large buildings, a choice between a single distribution system and multiple smaller systems may arise. Large distribution systems and their plant can have the advantage of lower operating costs, but require more space for vertical shafts and horizontal distribution. In general, very long runs of ducting should be avoided to prevent undue heat losses or gains, excessive leakage, and difficulties in balancing during commissioning. As the pressure losses in the long runs will be greater and a higher initial static pressure will be required, this will lead to a more expensive class of ductwork. Multiple smaller distribution systems may be more expensive in capital and operating costs but they avoid long runs, large ducts and vertical shafts, and this may reduce overall building costs. They also provide a more robust service as the failure of an individual system does not prevent the use of the rest of the building.

Zoning of the building

2.55 The efficiency and effectiveness of any ventilation or air-conditioning installation depends largely on the zoning and control of the installation. The factors to consider when determining the zoning of a ventilation system for a building or department are:

- periods of occupancy;

- fresh air/ventilation requirements;
- smoke control.

2.56 Where the ventilation system is not merely tempering the air, but also providing the heating and/or cooling requirements, the following additional factors will need to be considered:

- internal or peripheral location;
- orientation of windows;
- variation in internal loads;
- level of control required.

2.57 For single zone plant in staff areas, local control (with a run-on timer if required) is recommended, as this can be turned off when the space is not in use, thus saving both thermal and electrical energy. Most supply and extract systems, conversely, are required to operate continuously while the department is occupied, thus some form of time or use control is necessary.

2.58 The control of individual plant items is covered in Section 4, with examples of typical control strategies in Section 6. For control of particular specialised ventilation and air-conditioning systems refer to Section 7 of this document.

2.59 On very rare occasions a duplicate standby air handling plant may be justified. If installed it must be provided with a gas-tight damper at its junction with the supply distribution duct, so that no back-flow can occur. Standby plants can become sources of contamination if warm moist air is allowed to dwell within them. Their design and control system must ensure that this cannot happen.

Specific requirements for hospital departments

2.60 Specific requirements for individual spaces and departments are included in the Health Building Notes (HBNs) and Activity Database (ADB) A-Sheets, or Scottish Health Planning Notes (SHPNs).

3. Assessment of service requirement

Selection of design criteria

External design conditions

3.1 The most accurate data that is available for the summer and winter conditions at the site should be used. The Metrological office can supply data for the United Kingdom.

3.2 Healthcare mechanical ventilation systems will normally be 'full fresh air'.

3.3 Local adjustments such as for height above sea level, exposure factor, or other climate peculiarities, should be made as appropriate.

Internal design conditions

3.4 The design conditions selected within patient areas must strike a balance between the comfort requirements of staff and patients, who often have very different levels of clothing and activity.

3.5 Recommendations for the dry resultant temperature and humidity of individual spaces are shown on Activity Database (ADB) A-Sheets. Table A1 gives a summary.

Minimum fresh air requirements

3.6 For most applications involving human occupancy, the dilution of body odours is the critical factor in determining ventilation requirements. Where natural ventilation or mechanical full fresh-air systems are used, all ventilation air will be fresh.

3.7 Where odour dilution is the overriding factor, it is recommended that 10 litres/second/person should be taken as the minimum ventilation rate.

3.8 Smoking is not permitted in healthcare premises. If permitted for example in residential care, it will be confined to designated areas. It therefore follows that these areas will contain a high percentage of smokers so the ventilation rate would be at least 36 litres/second/person for these applications (CIBSE Guide A; Table 1.10 refers).

3.9 In non-standard applications such as laboratories, aseptic suites, operating departments, etc., the particular requirements for each area should be considered independently in order to determine the overriding minimum requirement for ventilation.

Limiting supply air conditions

3.10 For most applications in healthcare buildings, it is the temperature differential between the supply and room air, rather than the actual temperature of the

supply air which is the critical factor. The maximum recommended supply-to-room air temperature differential is:

summer cooling: - 7K

winter heating: + 10K

3.11 It is also necessary to keep supply air humidity below 70% during winter in order to minimise risks associated with condensation.

Air purity

3.12 In healthcare premises, the standard of filtration will depend on the activities within the occupied spaces. With the exception of special areas, (for example manufacturing pharmacies), the requirement for aerobiological needs is not stringent and filtration is only required to:

- maintain hygienic conditions for the health and welfare of occupants, or for processes such as food preparation;
- protect finishes, fabrics and furnishings; to reduce redecoration costs;
- protect equipment either within the supply air system; that is, to prevent blocking of coils, or in the space itself to prevent dust collection.

3.13 Given that almost all viable particles will originate from the occupants of a space and not from the incoming air, dilution is the more important factor aerobiologically. Therefore, for general areas a G4 filter will be suitable. More critical areas will require a F7 filter. HEPA filters will only be required in Ultra Clean systems.

Humidity control requirements

3.14 Providing humidification is expensive in terms of plant, running costs and maintenance, and therefore its use should be restricted to where it is necessary for physiological or operational reasons.

3.15 Humidification was originally required for some healthcare applications, e.g. operating theatres, in order to control the risk associated with the use of flammable anaesthetic gases. The use of such gases has now ceased. Humidification is therefore no longer required unless there is a very specific application requirement.

Maximum noise levels

3.16 Noise will be generated in an air distribution system by the fan, ductwork fittings, dampers and grilles. The specified maximum noise level will depend on the activities within the occupied spaces.

3.17 The overall noise levels should not exceed the values given in Scottish Health Technical Memorandum 08-01: ‘Acoustics’, although general requirements are given in Table 3.

3.18 Attenuation should be incorporated into the ductwork system or plant arrangement as necessary to reduce noise from fans and plant items in order to achieve the acceptable limits within the rooms at the design air flows.

3.19 Plant noise should not be greater than 80dB(A) within the plant room from the fans, coolers, heaters, humidifiers etc. when starting up or running, and should be reduced to lower noise levels where the plant is near to departments sensitive to noise.

3.20 Attention must be given to the reduction of tonal components. High tonal components from air diffusers etc. can seriously disturb concentration over longer periods even when the overall noise level is low. Broadband noise causes less annoyance. Reference should be made to SHTM 08-01: 'Acoustics'.

3.21 The designer requires knowledge of the total hospital layout and operational policies, to assign acceptance magnitudes to all the possible noise sources, in order to arrive at the correct rating.

Room	Overall noise level - NR	Ventilation plant commissioning - NR	Ventilation plant design - NR
Operating department	50 (55)	45	40
Ward areas	33	30	30
Sanitary facilities	45	40	35
Industrial areas	50	45	40
Circulation areas	50	45	40

Table 3: Interior noise level

3.22 In Table 3, above, the overall noise level takes account of all internal and external noise sources. The commissioning noise level is the level measured with a sound level meter in the unoccupied room, taking account of the external noise together with the noise generated by the ventilation system. When occupied and in use, this commissioning level will constitute a continuous background noise which will allow the overall noise level to be achieved. The ventilation plant design noise level is that generated by the plant alone with no other noise source being considered. The levels suggested make recognised allowance for the ingress of environmental noise that must be considered in the overall design, that is, in specifying the attenuation of walls, partitions, ceilings, etc.

3.23 The recommended criterion is measured as the "A" weighted sound pressure level expressed in decibels, which should not be exceeded for more than 10% of the time.

3.24 The designer must also consider noise escaping to the external environment and this must not be unacceptable to occupants of adjacent buildings.

Calculation of building loads

Air infiltration

3.25 Air infiltration occurs due to a complex combination of wind pressure, thermal effects, location relative to other features and the construction standard of the building. The infiltration rate is governed by the size and number of openings in the building envelope and the complexity of internal air paths.

3.26 CIBSE Guide A (2006) Section 4 provides information and formulae for the calculation of air infiltration and natural ventilation of buildings. In all cases the requirements of the appropriate section of the Building (Scotland) Regulations must be met.

Summertime temperatures

3.27 The calculation method for determining the summertime temperature is described CIBSE Guide A (2006) Section 5. However, it is very important to select the time of day and time of year of peak loadings for the calculations. These will be dependent on the orientation and proportion of solar to total heat gain. In establishing outside design values, the design risk having regard to the function and occupancy of the building should be considered.

3.28 Where calculations indicate that internal temperatures will frequently exceed the selected design external shade temperature by more than 3K for a period that exceeds the building design risk, methods of reducing temperature rise should be implemented. Options include: - reducing solar and casual gains, the use of chilled beams or ceilings, increasing ventilation rates or providing mechanical cooling. In some situations it may be possible to alter the thermal mass of the structure to 'move' the peak temperature event time so that it occurs outside of the occupancy period. Calculations and thermal modelling should be undertaken to ensure that during the summertime internal temperatures in patient areas do not exceed 28°C dry bulb for more than 50 hours per year. It has been found that there is a relationship between preferred indoor temperatures and mean outside temperature. Fig A2 in CIBSE Guide A indicates this relationship.

Peak heating load

3.29 Peak heating local calculations are necessary on all mechanical supply systems to establish the size of heater batteries and subsequently the central plant.

3.30 Where ventilation systems provide tempered air to spaces that have supplementary LPHW to offset the building fabric losses, the plant heating load should be calculated based on the external winter design temperature, the design internal air temperature, and the calculated total air volume (including a suitable allowance for leakage).

3.31 Where the ventilation system is the only means of heating a space, an increase in load equivalent to the calculated fabric heat losses from the space should be added to the ventilation load. A check of supply temperature difference should

be made. If it exceeds 10K the ventilation supply volume should be increased to suit.

Condensation risk

3.32 A check should be made to ensure that the selected air condition will not lead to surface condensation on low-temperature elements of the ventilated space.

3.33 Where there are local sources of moisture that would require excessive levels of ventilation to avoid condensation, the designer should consider the capture and removal of moisture at the source of the evaporation via an exhaust hood or similar device.

3.34 In intermittently heated buildings, it is necessary to consider the condensation risk at night setback conditions as well as during normal operation. Calculation methods for this assessment are given in CIBSE Guide A.

Peak cooling load

3.35 In addition to the base data of airflow rates and temperatures, when calculating cooling loads, the designer must take into account:

- solar cooling loads;
- surface conduction cooling loads;
- internal gain cooling loads;
- cooling loads due to high-level humidity control;
- method of control of internal conditions;
- fluctuations in internal temperatures.

3.36 When the peak internal loads have been assessed and a suitable allowance made for non-coincidence, the supply temperature can be calculated.

3.37 Once the lowest required supply temperature of the air handling unit has been established, and an allowance made for temperature rise through the fan and ductwork (usually 1K for low pressure systems), the off-plant enthalpy can be established from a psychrometric chart or table.

3.38 The cooling loads for all plants on the chilled water system should be calculated at each of the individual peak times in order to establish accurately the required (diversified) capacity of the chiller.

Annual energy consumption

3.39 Annual energy consumptions of heating-only ventilation systems are simple to calculate based on supply-to-external air temperature rise, and frequency of occurrence of external temperatures as given in CIBSE Guide A.

3.40 Minimum air volumes are usually fixed by the room loads or fresh air requirements. However, the designer may increase airflow to some rooms or

zones in order to balance loads, as detailed in the following paragraphs on "Calculation of plant requirements."

3.41 The method of zoning and control can significantly influence energy consumption.

3.42 The nature of air-conditioning operation, comprising cooling and reheating for humidity or zonal temperature control, makes prediction of energy consumption very complex. It is imperative that these calculations are performed to ensure optimum energy efficiency.

3.43 The concept of load and plant operation charts is outlined in the CIBSE Guide A. The method requires the designer to establish the minimum and maximum loads on all zones across the range of external temperatures between winter and summer design conditions. Once the load chart is complete, the plant chart converts the loads to supply temperatures, which are then superimposed on external air temperatures.

3.44 When all temperatures for all zones are plotted on the plant operation chart, set points and resetting schedules can be established. From this information, the outputs of individual heaters, coolers and humidifiers can be established at any given external temperature. When those loads are computed against annual frequency of occurrence of external temperatures as given in CIBSE Guide A, the annual energy consumption of individual elements, and thus the air-conditioning system, can be established.

3.45 In order to prevent surface condensation occurring, it is necessary to provide sufficient ventilation to maintain the maximum and ambient dew-point temperature below the lowest surface temperature, the coldest usually being the glazing. Paragraphs 3.33 and 3.34 also refer.

Calculation of plant requirements

Air supply volumes

3.46 The minimum air supply volume for a room is determined by the greatest of these three criteria:

- the minimum fresh-air requirement;
- the minimum supply volume for the room load as determined by the maximum heating or cooling supply temperature differential;
- the desired/required air change rate.

Plant sizing

3.47 Once the design airflow has been established the cross-sectional area of the air-handling unit can be calculated based on a maximum coil face velocity of 2.0 m/s.

3.48 In order to establish the length of the air-handling unit, it will be necessary to refer to manufacturers' literature, ensuring all necessary access panels and components are included as detailed in Section 4.

3.49 The fan duty should be calculated by adding the resistances of all elements that contribute to the pressure drop of the index circuit.

3.50 The main elements that must be considered are:

- inlet or discharge louvres;
- plant entry and discharge;
- attenuators;
- components within the air-handling unit;
- duct-mounted heaters and filters (including a dust allowance);
- ductwork distribution;
- ductwork fittings, including: fire dampers, volume control dampers, bends and sets, tees, changes of section;
- air terminal device;
- discharge velocity.

3.51 Where packaged air-handling units are installed, the fan pressure drop is usually quoted as external plant resistance, and thus the designer does not need to calculate the resistances of individual plant items. The designer should, however, ensure that an allowance has been made for filter clogging; and confirm whether the fan pressure quoted is fan total or static pressure.

3.52 Resistances of ductwork and fittings may be obtained from the CIBSE Guide A. However, the designer should exercise some care when using tabulated pressure loss information for fittings that are relatively close together.

3.53 Upon completion of the resistance calculation exercise, the designer should make allowances for calculation and construction tolerances as indicated in Table 4.

Criteria	Low pressure systems	Medium/high pressure systems
Volume flow rate margin for leaking and balancing requirements	+5%	+5%
Total pressure loss margin A. for increase in volume flow rate (above)	+5%	+5%
B. for uncertainties in calculation	+5%	+10%
Combined total pressure loss margin	+10%	+15%

Table 4: Typical fan volume and pressure margins

Plantroom size and location

3.54 The ventilation plant and associated equipment should be positioned to give maximum reduction of noise and vibration transmitted to sensitive departments; while at the same time, achieve an economic solution for the distribution of services.

3.55 It is not recommended that noise and vibration generating plant be housed either directly above or below sensitive areas (for example, operating or anaesthetic rooms) unless there is no alternative, in which case, additional care and attention must be given to the control measures.

3.56 The plant must also be located so that it is remote from possible sources of contamination, heat gains and adverse weather conditions. The design should ensure that wind speed and direction have a minimal effect on plant throughput.

3.57 Safe access to and around plant is essential to facilitate inspection, routine maintenance, repair and plant replacement.

Provision of primary services

3.58 Where more than one air-handling plant requires cooling, remote central cooling plants with piped chilled water are preferred. In the case of a single plant, a multi-stage direct-expansion cooling coil with refrigerant piped from an adjacent compressor/condensing plant could be considered. If this option is selected, a refrigerant gas detector mounted in the base of the duct and an alarm system audible to the end-user will also need to be provided (as dictated by COSHH Regulations).

3.59 Clean dry steam is preferred for humidification, provided that the boiler water treatment does not render the steam unusable for direct humidification.

3.60 If a suitable supply of steam cannot be obtained from the steam main, a steam generator should be provided locally, or a self-generating humidifier installed. Electric humidifiers require considerable electrical loads and if a gas supply can be derived, this would be preferable. The location of a local steam generator is critical if condensate is to drain back into it.

Inlet and discharge sizing and location

3.61 Air intakes and discharge points should preferably be located at high level, to minimise the risks of noise nuisance to surrounding buildings, contamination and vandalism.

3.62 Intakes and discharges should be designed and located so that wind speed and direction have a minimal effect on the plant throughput.

3.63 Helicopter landing pads in the vicinity of ventilation intakes and discharges can result in large short-term pressure changes. This can cause pressure surges in supply systems and reverse airflows in extracts. Exhaust fumes from the helicopter may also be drawn into intakes. For general information, refer to Health Building Note (HBN) 15-03 – Hospital helipads.

3.64 Intake points should also be situated away from cooling towers, boiler flues, vents from oil storage tanks, fume cupboards and other discharges of contaminated air, vapours and gases, and places where vehicle exhaust gases may be drawn in.

3.65 Where intakes have necessarily to be sited at or near ground level, the area around them should be paved or concreted to prevent soil or vegetation being drawn in. They should also be caged or located within a compound to prevent rubbish being left in the vicinity. The likely proximity of vehicle exhausts should also be taken into account when determining the protected area around the intake.

3.66 The discharge from an extract system must be located so that vitiated air cannot be drawn back into the supply air intake or any other fresh-air inlet. Ideally, the extract discharge will be located on a different face of the building from the supply intake(s). In any event, there must be a minimum separation of 4 metres between them, with the discharge mounted at a higher level than the intake.

3.67 Discharges from LEV systems should preferably be vertical and usually not less than 3m above roof level. They should not be fitted with a cowl that could cause the discharge to be deflected downwards.

3.68 Each intake and discharge point should be fitted with corrosion-resistant weatherproof louvres or cowls to protect the system from driving rain. Louvres should be sized based on a maximum face velocity of 2 m/s in order to prevent excessive noise generation and pressure loss.

3.69 The inside of the louvres should be fitted with a mesh of not less than 6mm and not more than 12mm to prevent leaves being drawn in and infestation by vermin.

3.70 The duct behind louvres should be self-draining. If this is not practicable, it should be tanked and provided with a drainage system.

3.71 Cleaning access must be provided either from the outside via hinged louvres or by access doors in the plenum behind the louvre. Where a common plenum is provided, cleaning access should be via a walk-in door.

Heat rejection devices

3.72 The design conditions given in Section 2 make no allowance for the elevated temperatures that can occur on the roof of buildings. Refrigeration condensers should, if practicable, be shaded from direct solar radiation, or the design adjusted to take account of the gain.

3.73 Air-cooled condensers must always be the first choice for heat rejection from any refrigeration plant. Evaporative cooling systems must not be used in healthcare premises.

3.74 Reference should be made to Scottish Health Technical Memorandum 04-01: 'The Control of *Legionella*, hygiene, 'Safe' hot water, cold water and drinking

water systems, Part A: Design, Installation and Testing, and Part B: Operational Management, published by Health Facilities Scotland, 2011.

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4. Air handling unit design and specification guidance

General requirements

Location and access

4.1 Air-handling units should be located in an accessible area secured from unauthorised entry. Siting units in ceiling voids above occupied spaces is not appropriate.

4.2 Units located on roofs must have a safe means of access together with suitable precautions to prevent personnel or equipment falling or being blown off during maintenance activities.

4.3 Units located at ground level should be secured within a locked compound to prevent unauthorised access. Measures should be taken to exclude vehicles from the vicinity to ensure that exhaust fumes will not be drawn into intakes.

4.4 Units may have a working life of approximately 20 years. It can be anticipated that over this period there will be a need to access every element within the unit for deep cleaning. It is also quite possible that the main fan and individual heater and chiller batteries will need replacement. Suitably positioned service connection joints and adequate spacing should permit these items to be withdrawn without the need to dismantle other installed plant or equipment. Batteries significantly wider than 1 metre should be split to permit withdrawal from both sides.

4.5 It is essential that air-handling units are positioned so that all parts are easily and safely accessible for routine inspection and service. If a unit is located against a wall or backs onto another unit then access to all parts must be available from the front. Units greater than 1 metre wide should preferably have access from both sides or access doors large enough to permit the full and safe entry of maintenance personnel.

4.6 Water may be used during routine cleaning or spilt when maintenance is being undertaken. The area around the unit should be tanked to prevent water penetration to adjacent areas and adequately drained.

4.7 Fire precautions should be incorporated in accordance with Firecode. Guidance is available in BS5588: Part 9 and Sections 5 and 6 of this document.

4.8 Combustion equipment must not be located in a fire compartment that houses air-handling equipment.

Technical requirements

4.9 The basic technical requirements of the whole of the ventilation system should meet the relevant clauses of the Model Engineering Specification. It should be noted that the Specification contains a menu of clauses that cover a wide range

of applications, so it is important to select only those that are relevant to the specific application.

Note 1: At the time of writing, Model Engineering Specification C04 was listed for revision in order to bring it into line with the revised standards as set out in this Scottish Health Technical Memorandum. Where conflicts in specification arise, the Scottish Health Technical Memorandum takes precedence.

4.10 It is essential that the main plant/ductwork is located far enough above the floor to permit the correct installation of drainage systems for cooling coils, humidifiers and heat recovery systems. Easy access for maintenance of drainage systems and their associated pipework must be provided.

4.11 Organic materials or substances that can support the growth of microorganisms must not be used in the construction of the plant or its distribution system. The water fittings and materials directory lists suitable materials for sealants and gaskets.

4.12 The plant and its distribution system must not contain any material or substance that could cause or support combustion.

4.13 Plants should have a high standard of air-tightness. The double-skin method of construction with insulation sandwiched between two metal faces is recommended. The panels may be available in a variety of colours at no additional cost. This can aid identification by colour coding of units in a plant room (for example green for general ventilation; blue for theatres; red for laboratories and isolation facilities; grey for extract etc).

4.14 The inside of the plant should be as smooth as possible. Channels, rolled angles or formed sections that could trap or hold moisture should be kept to a minimum. If stiffeners are required, they should be fitted externally. If internal bracing has to be fitted it must be of a design that will not trap or hold moisture.

4.15 Airflow across air treatment components such as filters, heat exchangers and humidifiers will be influenced by the pattern of the approaching airstream. If unsatisfactory conditions are created, the performance of the component will be reduced.

4.16 Access to items that require routine service such as filters, frost batteries and chiller batteries should be via hinged doors. The doors should be large enough (for example 500mm minimum) to allow easy access. Items requiring infrequent access such as attenuators may be via bolted-on, lift-off panels. All doors and panels should be close-fitting and without leaks.

4.17 Care should be taken during installation to ensure that electrical and mechanical services are not installed in positions that will reduce or impede access.

4.18 It can be difficult to turn off AHUs in order to inspect filters and drainage trays. Viewing ports and internal illumination will therefore facilitate routine inspection of such items. Viewing ports should be at a convenient height so that temporary ladders are not required. Internal illumination should be provided by

fittings to at least IP55 rating. Fittings should be positioned so that they provide both illumination for inspection and task lighting. All of the lights in a unit should be operated by a single switch.

4.19 Access to AHUs and items in the distribution system such as filters or heater / chiller batteries should be via fixed ladders and platforms or pulpit-style moveable steps. The installation of distribution ductwork and other electrical or mechanical services should provide sufficient clearance to allow the pulpit steps to be easily wheeled into position.

AHU drainage system

4.20 All items of plant that could produce moisture must be provided with a drainage system. The system will comprise a drip tray, glass trap, air break and associated drainage pipework.

4.21 The drip-tray should be constructed of a corrosion-resistant material (stainless steel is preferred) and be so arranged that it will completely drain. To prevent 'pooling', it is essential that the drain connection should not have an upstand; and that a slope of approximately 1 in 20 in all directions should be incorporated to the drain outlet position. The tray must be completely accessible or, for smaller units, easily removable for inspection and cleaning.

4.22 Each drip tray should be provided with its own drain trap. The drain trap should be of the clear (borosilicate) glass type. This permits the colour of the water seal to be observed thus giving an early indication of corrosion, biological activity or contamination within the duct. The trap should have a means for filling and incorporate couplings to facilitate removal for cleaning. It should be located in an easily visible position where it will not be subject to casual knocks. The pipework connecting it to the drainage tray should have a continuous fall of not less that 1 in 20.

4.23 Traps fitted to plant located outside or in unheated plant rooms may need to be trace-heated in winter. The trace-heating must not raise the temperature of water in the trap above 5°C.

4.24 Water from each trap must discharge via a clear air gap of at least 15mm above the unrestricted spill-over level of either an open tundish connected to a foul drainage stack via a second trap, or a floor gully (or channel). A support should be provided to ensure that the air gap cannot be reduced. More than one drain trap may discharge into the tundish providing each has its own air break.

4.25 Drainage pipework may be thermoplastic, copper or stainless steel. Glass should not be used. The pipework should be a minimum diameter of 22mm and a fall of at least 1 in 60 in the direction of flow. It should be well supported and located so as not to inhibit access to the AHU.

Layout of air handling unit

4.26 The AHU should be arranged so that the majority of items are under positive pressure. Any item of plant requiring a drain should be on the positive pressure side of the fan. A recommended layout is given in schematic from in Figure 3.

4.27 A separate extract unit will generally be required for the area served by each supply unit.

4.28 An energy recovery system will normally be fitted between the supply and extract units.

Provision of dampers

4.29 Fire- or smoke-actuated dampers shall be provided at the locations required by Firecode. (See Paragraphs 5.17 - 5.21).

4.30 Motorised low-leakage shut-off dampers should be located immediately behind the intake and discharge of each supply and extract system respectively. They should be of the opposed-blade type, opening through a full 90° and must close automatically in the event of power failure or plant shutdown to prevent any reversal of the system airflow.

4.31 The quality of motorised dampers is critical. They should be rigid, with square connections fitted with end and edge seals of a flexible material and with minimal play in linkages. The leakage on shut-off should be less than 2%.

4.32 A manually operated isolating damper should be installed between the main AHU and its distribution system to enable the unit to be isolated when cleaning is in progress.

4.33 Good practice will require the fitting of a main volume control damper so that the design airflow rate can be set at commissioning. The damper should be lockable in any position. If it will also be used for plant isolation, it should be capable of being reset to give the design airflow without the need for re-measurement.

4.34 Internal plant isolating dampers or provision for the fitting of shut-off plates between items within a unit are not required.

Vibration

4.35 Vibration from a remote plantroom can be transmitted by the structure of the building, may be regenerated and may sometimes be magnified many times. Units should be selected to have the minimum vibration generation and installed on suitable anti-vibration mounts. Pipe and ductwork should incorporate anti-vibration couplings, preferably in two planes at right angles, as close to the vibration source as possible. Consideration should be given to the use of anti-vibration pipe hangers and supports.

Sequence of components

4.36 The following arrangement of plant components is typical although in many instances not all elements will be required:

- fresh air intake;
- motorised isolation damper;

- frost / fog coil;
- pre-filter;
- energy-recovery device;
- attenuator;
- fan;
- blast plate;
- attenuator;
- chiller battery;
- eliminator;
- heater battery;
- humidifier;
- final filter;
- isolation / volume control damper.

Note 2: Attenuators may be located in the intake and discharge duct if they are of a suitable type (See Paragraphs 4.159 - 4.162)

There may be instances where the above arrangement is not appropriate and the plant arrangement should be planned accordingly.

Fans

General requirements

4.37 The fan should be selected for good efficiency and minimum noise level, but the overriding factor should be the selection of a fan characteristic such that the air quantity is not greatly affected by system pressure changes due to filters becoming dirty or external wind effects.

Acceptable types

4.38 Fans can be of the axial, centrifugal, cross-flow, mixed-flow or propeller type, depending upon the requirements of the system.

4.39 Where used, centrifugal fans should preferably be of the backward-blade type. Alternatively, where noise levels are more critical and pressure requirements are lower, forward-curved blade fans are acceptable. For high-power applications, aerofoil-blade fans may be appropriate.

Selection

4.40 Generally, large ventilation systems will use centrifugal fans due to their efficiency, non-overloading characteristics, and developed pressures.

4.41 Forward curved centrifugal fans can overload if allowed to handle more air than they are designed for.

4.42 Alternatively, it may be appropriate to use mixed flow fans in high-pressure systems.

4.43 Axial flow or propeller fans are generally only used in local through-the-wall systems, or systems with very low pressure requirements.

4.44 Cross-flow fans have very low operating efficiencies, and thus their use is restricted to applications such as fan coil units.

Location and connection

4.45 Fans are normally positioned to 'blow through' the central plant so that the cooling coil and humidifier drains will be under positive pressure.

4.46 The fan performance figures given by manufacturers in their catalogue data are based on tests carried out under ideal conditions, which include long uniform ducts on the fan inlet/outlet. These standard test connections are unlikely to occur in practice, the designer should therefore ensure as far as is practical that the fan performance will not be significantly de-rated by the system. This objective can be approached by ensuring that the fan inlet flow conditions comprise uniform axial flow velocities with low levels of turbulence.

4.47 Where the outlet duct is larger than the fan discharge connections, there should be a gradual transition, with a following section of straight duct, having a length equivalent to three duct diameters.

4.48 The design of the fan intake connection must be carefully considered to avoid swirl in the airstream. When the air spins in the same direction as the impeller, the performance and power consumption of the fan are reduced. When the air spins in the opposite direction to the impeller the power consumption and noise will increase with hardly any pressure increase. Airstream swirl is usually induced by large variations across the fan intake caused by the air passing round a tight bend immediately before the intake.

4.49 Where a centrifugal fan is located with an open intake, the clear distance between the suction opening and the nearest wall should be not less than half the diameter of the inlet. If two fans with free inlets are positioned within the same chamber, their adjacent suction openings should be at least 1 diameter apart.

4.50 Airtight flexible joints should be provided at fan inlet and outlet connections. They should be equal in cross-section to the points of connection and be neither longer than 200mm nor shorter than 100mm.

4.51 For centrifugal fans, a diffuser screen / blast plate should be fitted immediately downstream of their discharge.

Supply fan drive arrangements

4.52 Where the fan drive is via a motor-driven belt and pulley, it should be external to the air stream. This arrangement has the following advantages:

- the fire risk is reduced;
- the drive is visible so it is simple to check that the belt is still there;
- particles shed from the drive belt are outside of the air stream;
- if the belt slips, the “burning rubber smell” is not transmitted down into occupied areas of the premises;
- noise generated by the motor and drive will not be transmitted along the ductwork;
- waste heat is excluded from the system;
- the drive may be through a vee or toothed belt and pulley. The latter have the advantage of eliminating belt squeal on start up and have a longer service life. They are particularly suitable where the fan drive motor is fitted with a soft start and should be located external to the air stream.

4.53 The drive train should be easily visible without the need to remove access covers. Protecting the drive train with a mesh guard is the preferred option. For weatherproof units designed to be located outside, the fan drive will be external to the duct but enclosed. It should be easily visible through a viewing port with internal illumination and access via a lockable hinged door.

4.54 For direct-coupled fan and motor units, the motor should be out of the air stream.

4.55 For induction drive ‘plug’ motor arrangements (where the motor is fitted within the fan and is integral to it) and in line axial fans with a pod motor; the fan / motor combination may be within the air stream provided the motor windings are protected from over temperature by a thermister and lockout relay.

Extract fan drive arrangements

4.56 The preferred method where the fan drive is via a motor driven belt and pulley arrangement will be to locate it external to the air stream.

4.57 The fan drive and motor may be located inside the duct within the air stream provided the motor windings are protected from over-temperature by a thermister and lockout. The drive train should be easily visible through a viewing port, have internal illumination and access via a lockable hinged door.

4.58 Where the system air is explosive, aggressive or has high moisture content, the extract fan motor must be located outside the air stream. This is generally achieved with axial fans by using a bifurcated unit.

Control

4.59 Fans in healthcare applications are normally either single or two-speed. Where there is a requirement for two-speed operation, this is generally via a local user control (for example, in a hood extract system to provide a boost facility) or via a time schedule for energy saving during unoccupied periods.

4.60 Normally only a single motor is required with a standby motor available for fitting as necessary or fitted but not belted. Twin, run and standby motors - with the standby being jockeyed around - are not required.

4.61 Where there is a specified requirement for standby fans, the system should incorporate an automatic changeover facility activated via an airflow sensor. Fault indication should be provided.

4.62 The control of fans in terms of start-up and run is increasingly being vested in computer software. Inverter-drive, variable-speed, soft-start systems are becoming a standard approach. It should be remembered that most healthcare applications require known amounts of air to be delivered while the system is in use. Constant volume systems that deliver specified air-change rates are therefore the norm. Duct- or room-pressure-controlled, variable-speed systems have a very limited application in healthcare.

4.63 It is necessary to ensure that - should the computer control system or its software develop a fault - then the fan can be switched to a direct-start, fixed-speed, manual operation. This is particularly important for critical care systems serving operating suites, high-dependency care units of any type, patient isolation facilities, laboratories and pharmaceutical production suites. Off-site software support is no substitute for the ability of on site staff to override the automatic control and keep the system operating in an emergency. Under these circumstances actions that may shorten the life of the plant are considered of secondary importance to that of preserving the health and safety of patients and staff.

Heater batteries / heater coils

General requirements

4.64 Frost batteries are installed to protect the downstream filters from low-temperature, high-humidity intake air conditions. As they handle unfiltered air they should be constructed of plain tubing without fins and be as near to the outside as possible to minimise condensation during cold weather. Access for cleaning will need to be provided to both sides of the coil.

4.65 Where steam coils are used for a frost battery, they may be constructed using spiral-finned copper tube. As they will be prone to fouling the tube layout and spacing should permit easy access for regular cleaning.

4.66 Main and branch heater-batteries should be constructed of solid-drawn copper-tube coils with copper fins, generally connected in parallel.

4.67 Where there is a wet heating system in the areas served, the main heater-battery should be sized for the ventilation requirements only, and not for the fabric loss.

4.68 Access for cleaning must be provided to both sides of all frost batteries and heater-batteries.

Acceptable types

4.69 Electric, water or steam heater-batteries may be considered. However, electric heater-batteries are expensive to operate and where there are alternatives, their use should be restricted to low-power use (for example trimming control).

4.70 Where steam-supplied heater-batteries are used, their control, venting and trapping systems should be designed so that a vacuum cannot occur within the coil. The condensate drainage arrangements should not allow pressure to build in the main resulting in a back-up of condensate in the coil.

Location

4.71 Where possible, wet-trimmer heater-batteries should be located in plant areas.

4.72 Where it is necessary to locate heater-batteries in false ceilings etc, consideration should be given to the use of electric heaters. If this is not practicable, drip-trays should be installed under both the battery and the control valve assembly to protect the ceiling. A moisture sensor and alarm should be fitted in the tray. In any event, to facilitate maintenance access, they should be located above corridors or other non-critical areas and never above patient occupied spaces.

4.73 Auxiliary fan coil units should not be installed in the ceiling above an occupied space. They should be accessible for routine maintenance and cleaning without the need to cause significant disruption to the operation of the department that they serve.

Control

4.74 LPHW frost coils should be controlled by an off-coil temperature sensor operating a motorised valve to provide a minimum plant “on temperature” of between 2°C and 5°C. The off-coil temperature of the frost coil is generally sensed by a serpentine thermostat downstream of the coil or upstream of the next plant item. This thermostat will shut the fan down if any part of the air stream is below the minimum set-point.

4.75 Steam-supplied frost coils should be fitted with an on/off control operated by a temperature sensor mounted upstream of the battery. These are normally set to open the control valve fully when the outside temperature drops to +1°C. This will ensure that there is no standing condensate in the base of the coil.

4.76 The main heater-battery should be controlled in the same manner under the dictates of either an off-coil temperature sensor, or a room temperature sensor, depending on the plant configuration and method of control. Trimmer heater-

batteries are generally controlled by one or more averaging temperature sensors within the room or rooms in the zone.

4.77 Heater-battery control valves should drive to a closed position on system shutdown or fan failure. The control system should then automatically set to provide frost protection.

Cooling coils

General requirements

4.78 Cooling coils will need to be decontaminated periodically. They must have good access both up and downstream. Hinged access doors with viewing ports and illumination inside the duct should be provided both sides of the coil.

4.79 An eliminator will be required downstream of all cooling coils. The eliminator may take the form of an extension of the coil fins or be a separate device. If a separate device it should be removable as a unit to permit cleaning of the coil face.

4.81 4.80 All cooling coils must be fitted with their own independent drainage system as specified above. A baffle or similar device must be provided in the drip tray to prevent air bypassing the coil. The tray should be large enough to capture the moisture from the eliminator, bends and headers. Where coils are greater than 1m high, intermediate drip-trays will be required.

4.82 Condensate traps manufactured from Borosilicate Glass will allow easy visual inspection and incorporate a self-cleaning smooth non-porous internal surface, complying with ISO 3585 and BS2589 Part 1.

Selection

4.83 Cooling coils supplied with chilled water are the preferred option. For small loads or where chilled water is not available, direct expansion coils may be used.

4.84 Care must be taken in selection to minimise electrolytic action resulting from condensation on the airside. Coils constructed from copper tubes with copper fins extended on the downstream side in the form of an eliminator and electro-tinned after manufacture are preferred. Aluminium fins should only be used if vinyl-coated.

4.85 All parts of the coil and its associated ductwork in contact with moisture must be manufactured from corrosion-resistant materials. Pressed steel coil headers, even if treated, have been shown to be prone to corrosion over time and should not be used. Steel mounting frames and casings present similar problems hence stainless steel is preferred.

Location

4.86 Microorganisms that multiply in moisture cannot be avoided when the coil is dehumidifying. However, locating the final filter downstream of the coils will reduce the risk of infection.

4.87 Cooling coils in AHUs should be located upstream of the final filter.

4.88 Where any cooling coil has to be located above a ceiling, drip-trays should be installed under both the coil and the control valve assembly to protect the ceiling. A moisture sensor and alarm should be fitted in the tray. To facilitate maintenance access, they should be located above corridors or other non-critical areas and never above patient occupied spaces.

Control

4.89 There are two basic methods of control for cooling coils:

- off-coil control – used in multi-zone systems or single-zone systems where close humidity control is required, to provide a constant maximum off-plant condition which satisfies the temperature and high humidity requirements of the zone with the highest load;
- sequential control – used in single-zone systems, or multi-zone systems with averaging sensors where close control is not required. A room or duct temperature sensor controls the cooling coil and heater battery in sequence to maintain constant room conditions.

4.90 The advantage of off-coil control is that accurate humidity control can be provided without relying on humidity sensors, which are prone to inaccuracy and drift. Off-coil control is however, expensive to operate in terms of energy consumption, due to the fact that there is no feedback of room loads, and thus at low loads and in systems where there are large zonal variations, significant over-cooling and reheating will occur.

4.91 On systems with two-speed operating, it is usual to isolate the cooling coil upon selection of low speed. In addition, on system shutdown, low airflow or fan failure, the cooling coil must be isolated.

Humidifiers

Design need

4.92 Humidification was originally required for some healthcare applications in order to control the risk associated with the use of flammable anaesthetic gases. The use of such gases has now ceased. Humidification is therefore no longer required unless there is a very specific application requirement.

4.93 Operating-theatre AHUs do not generally require humidifiers but provision for their retrofitting in terms of space provision and a capped drainage system should be provided.

4.94 Where humidification is required, it will be subject to the specific requirements set out below. These are intended to ensure that the unit will operate safely and not become a source of contamination.

General requirements

4.95 The most important requirement for a humidifier is to create complete mixing of the steam with the air. The manufacturers' instructions should be followed regarding minimum distances which should be allowed before bends or other components. This is particularly important with respect to a filter mounted downstream. If it becomes saturated by the humidifier, organisms can grow through the filter and be released into the duct. These may then be carried on the airstream into an occupied space.

4.96 The section of ductwork containing the humidifier may need to be periodically decontaminated. Hinged access doors with viewing ports and internal illumination should be provided. A label warning that the device emits live steam and should be isolated prior to opening should be affixed to the access door.

4.97 All parts of the humidifier and its associated ductwork in contact with moisture must be manufactured from corrosion-resistant materials. Stainless steel is preferred.

4.98 The electrodes of self-generating electrode-boiler type humidifiers should be stainless steel.

4.99 All humidifiers must be fitted with their own independent drainage systems as detailed in Paragraphs 4.20 - 4.25 or 4.72 and 4.87.

4.100 For self- and locally-generated steam humidifiers, the cleanliness of the water supply is essential for their safe operation. Provision should be made for draining down supply pipework and break tanks for periodic disinfection and cleaning during periods when they are not required in service.

4.101 The addition of treatment chemicals for continuous control of water quality for humidifier/air handling units should be avoided. Consideration could be given to installing a UV system to control microbiological growth. Given the limitations of UV systems, however, this will require filtration to high quality to ensure the effectiveness of exposure of organisms to the UV irradiation. As with all water treatment systems the unit should be of proven efficacy and incorporate UV monitors so that any loss of transmission can be detected.

Acceptable types

4.102 Only steam-injection manifold-type humidifiers are considered suitable for use in health building air-conditioning systems. Water humidifiers of any type should not be used.

4.103 Steam may be derived from the central steam supply provided that it does not contain any treatment carry-over, or generated locally either within or adjacent to the humidifier.

4.104 The introduction of steam should be by an appliance specially designed to discharge dry steam into the air-conditioning system without objectionable noise or carry-over of moisture.

4.105 During the design stage, consideration should be given to the proposed methods for the regular cleansing of the humidifier(s) and their components.

Selection

4.106 The number and length of steam-injection manifolds to be used is dependent on various factors such as duct cross-sectional area, air velocity, dry-bulb temperature and manifold design. Guidance from the manufacturer should be followed closely.

4.107 A mains steam humidifier can be noisy and will be difficult to control if it is operated at an excessive steam pressure. It should be sized for an operating pressure of approximately 1 bar. The pipework supplying it should be provided with a dirt pocket, pressure reducing valve and steam trap installed as close as practicable to the humidifier, so that the steam condition at entry is as dry as possible. A temperature switch on the condensate line (or equivalent design provision by the humidifier manufacturer) should be incorporated to prevent 'spitting' on start-up.

4.108 Most operational problems with mains steam humidifiers arise because of back-pressure in the condensate discharge line which will result in flooding into the duct. Unless the condensate from the device can be discharged and collected at atmospheric pressure, it should be discharged directly to drain.

4.109 A local steam generator, where used, must be fed with potable quality water. Additional water treatment to the standard set out above may be required. If the humidifier is unused for a period exceeding 48 hours, it must automatically drain its water content, including that contained in the supply pipework, right back to the running main and leave itself empty.

4.110 Some steam generators are of a type that requires regular cleaning and descaling. The design must allow for them to be installed such that they can be physically isolated from the air duct in order to prevent contamination of the supply by cleaning agents while this is taking place.

Location

4.111 Careful siting of the humidifier injection manifold is required to prevent the steam impinging onto the side(s) of the duct, condensing and generating excess moisture.

Control

4.112 Accurate humidity control can only be provided on single-zone systems, or multi-zone systems with zonal humidifiers. In the above systems, humidity sensors control the humidifier for low-level humidity control, and override the temperature controls to open the cooling coil valve for high-limit humidity control.

4.113 Multi-zone systems are more usually controlled by a minimum humidity sensor located in the supply duct(s) following the last heater-battery.

4.114 Overriding controls separate from the normal plant humidistat should be installed. Their purpose is to prevent excessive condensation in the conditioned space when starting up. A time delay should be incorporated into the humidifier control system such that the humidifier does not start until 30 minutes after the ventilation/plant start-up. In addition, a high-limit humidistat should be installed to limit the output of the humidifier so that the saturation in the duct does not exceed 70%. This humidistat is to control the added moisture. It is not necessary to install a de-humidifier to reduce the humidity of the incoming air if it already exceeds 70%. The humidifier control system should ensure that the humidifier is switched off when the fan is not running.

4.115 On systems with two-speed operating, it is usual to isolate the humidifier upon selection of low speed. In addition, on system shutdown, low airflow or fan failure, the humidifier should be isolated.

Filtration

General requirements

4.116 The purpose of filtration is to reduce the level of airborne contamination in an air stream. It is generally carried out in stages.

4.117 Filters must be securely housed and sealed in well-fitting frames that minimise air by pass. Air by pass significantly reduces filter efficiency, the higher the filter grade the greater the effect. Mounting frames should be designed so that the air flow pushes the filter into its housing to help minimise air bypass. Mounting frames that withdraw so that the filter can be changed without having to reach into the unit are preferred.

4.118 Neither the filter media, nor any material used in the construction of the filters, should be capable of sustaining combustion. The filter media should be such that particles of it do not detach and become carried away by the airflow.

4.119 Filters need to be readily accessible for replacement so a hinged access door should be provided. The upstream side of the filter should be visible for inspection through a viewing port with internal illumination.

4.120 All filters should be provided with a means of visually checking the differential pressure across them. Direct-reading dial-type gauges marked with clean and dirty sectors are preferred.

4.121 A complete spare set of filters must be provided at handover.

Definition of filter terms

4.122 Particulate air filters are divided into four categories:

- general ventilation filters grades G1 to G4;

- fine filters grades F5 to F9;
- high efficiency particulate filters (HEPA) graded H10 to H14;
- ultra-low particulate air filters (ULPA) graded U15 to U17.

4.123 General filters are graded in terms of their 'Synthetic dust weight 'Arrestance'. This represents the percentage of a test dust captured by a filter. 'Arrestance' provides a good indication of a filter's ability to remove the larger, heavier particles found in outdoor air. These are of a size to block finned batteries and large enough to settle out in the air distribution system.

BS EN 779 grade (Eurovent grade)	% Arrestance	Notes and typical healthcare application
G1 - (EU1)	< 65	Metal mesh grease filter
G2 - (EU2)	65 to < 80	Coarse primary filter
G3 - (EU3)	80 to < 90	Primary air intake; return air; energy recovery device protection
G4 - (EU4)	> 90	General purpose tempered air supply

Table 4: General Filters

4.124 Fine filters are graded in terms of their 'Atmospheric dust spot Efficiency'. This is a measure of the filter's ability to remove the very fine staining particles found in outdoor air. It will indicate how 'visibly' clean a filter will keep a ventilated space. The staining particles are approximately the same size as most common bacteria so it is also a rough measure of the filter's ability to remove microorganisms.

BS EN 779 grade (Eurovent grade)	% Efficiency	Notes and typical healthcare applications
F5 - (EU5)	40 to 60	General purpose panel / bag filter
F6 - (EU6)	60 to < 80	Basic grade bag filter
F7 - (EU7)	80 to < 90	Medium grade bag or pleated paper Conventional operating theatre supply air
F8 - (EU8)	90 to < 95	High grade bag or pleated paper
F9 - (EU9)	> 95	Basic HEPA filter – Level 8 clean rooms

Table 5: Fine Filters

4.125 High efficiency filters (HEPA and ULPA) are graded in terms of their ability to capture their 'Most Penetrating Particle Size' (MPPS). High-efficiency filters self-select the particle that they are least able to trap, hence the MPPS. They are then tested against that size of particle. These filters are designed to provide very high-efficiency filtration of particles in the sub-micron size range.

BS EN 1822 grade (Eurovent grade)	% Efficiency @ MPPS	Notes and typical healthcare application
H10 - (EU10)	85	Ultra-clean theatre terminal
H11 - (EU11)	95	
H12 - (EU12)	99.5	
H13 - (EU13)	99.95	
H14 - (EU14)	99.995	Pharmacy aseptic suite Category 3 room extract
U15 – U17	-	Not generally used in healthcare

Table 6: High Efficiency (HEPA) Particulate Filters

Selection primary filters

4.126 All filters should be of the dry type. Panel filters are cheap and disposable with relatively low dust-holding capacity. They are generally used as pre-filters to eliminate large particles that would otherwise clog or cause damage to the fan and finned heating and cooling batteries. Stainless steel frames that hold disposable pre-cut filter pads are preferred.

4.127 General ventilation supply plant should incorporate primary air filters of grade G3, sized for a maximum face velocity of 2.0 m/s. Additional coarse pre-filters may be justified where the intake air is exceptionally polluted. They are sometimes fitted as a temporary measure when building work is being carried out in the vicinity of the air intake.

Secondary filters

4.128 Where a higher standard of filtration is required, secondary bag or pleated paper panel filters would be used. Rigid frame filters incorporating pleated paper elements are preferred over bag filters for critical care applications such as operating theatres.

4.129 In urban or other areas of high atmospheric pollution, a higher standard of filtration may be justified to reduce the level of staining to internal finishes.

Extract air filters

4.130 Extract filtration will generally only be required where heat-recovery devices are installed. There are a very limited number of specialised applications (microbiological safety cabinets and similar LEV systems) where contaminated air is required to be filtered prior to discharge to atmosphere. If it is safe for staff to work in a room without wearing respiratory protective equipment, it is safe to discharge the room air to atmosphere without filtration.

Return-air filters

4.131 They are used to reduce the load on HEPA filters in recirculating applications such as Ultra Clean operating suite ventilation canopies and pharmacy aseptic suites.

High-efficiency filters – HEPA and ULPA

4.132 HEPA filters are expensive so their use should be kept to a minimum. Applications requiring HEPA filters include the air supply to aseptic suites in manufacturing pharmacies, the discharges from microbiological safety cabinets and isolation facilities.

4.133 If used, HEPA filters should be of the replaceable panel type with leak-proof seals. They should be installed in a manner that permits on-site validation of the filter and its housing. This may involve the release of a Dispersed Oil Particle (DOP) challenge smoke through an injection point upstream of the filter and a measurement of the DOP penetration across the downstream face. Alternatively a particle-counting method may be used.

4.134 HEPA filters are sometimes fitted in extract systems to capture hazardous substances or organisms. Design provision must be made for the subsequent safe handling of contaminated filters by maintenance staff. This may be achieved by:

- sealing the hazardous substance into the filter before it is removed;
- providing a system to fumigate the filter to kill any organisms;
- housing it in a ”safe change” unit that permits the filter to be ejected into a bag and sealed without staff having to come into direct contact with it.

4.135 In view of the costs and problems associated with placing HEPA filters in extracts, it is recommended that a full risk assessment be carried out at the design stage. This should include defining the true need for HEPA filters in an extract; validation of its performance at installation; the method of safely changing a contaminated filter; and its subsequent disposal.

4.136 ULPA filters are very expensive and are designed to remove particles below a size that are either surgically or aerobiologically significant. There would have to be exceptional circumstances in order to justify their use in healthcare ventilation systems.

Activated carbon filters

4.137 Activated carbon filters are able to remove gases and vapours from an air stream and are graded according to the range of substances they can remove. They are not normally fitted in air-conditioning supply systems.

4.138 They are occasionally fitted retrospectively because the main air intake has been poorly sited and is drawing in traffic fumes. Where used they must be protected by a particulate air filter.

4.139 Activated carbon filters are more commonly used in specialised fume extraction systems when the location of the discharge means that dilution cannot be relied upon to disperse noxious fumes.

Location

4.140 The primary filter should be positioned on the inlet side of the supply fan, downstream of the frost coil. The secondary filter, when fitted, should be on the positive-pressure side of the fan. This will prevent air being drawn into the system after the filter and capture any particles shed by items of equipment within the AHU.

4.141 The filter installation must be arranged to provide easy access to filter media for cleaning, removal or replacement, with side or front withdrawal as required.

Control

4.142 Differential-pressure transducers should be provided to monitor and alarm remotely on excessive filter pressure drop. In critical areas dirty-filter indication lights should be provided at the point-of-use.

Energy-recovery

General requirements

4.143 Energy recovery will normally be fitted to all healthcare ventilation systems. It may be omitted only where it would clearly be uneconomic. Where the economic case is marginal, space should be allowed for the retrofitting of an energy recovery system.

4.144 For systems in healthcare premises, a plate heat exchanger or 'run-around coil' system is suitable. Thermal wheels may be used providing they are fitted with a purge sector. The small amounts of air leakage across those devices are not considered significant. Other systems such as heat pumps or heat pipes are also suitable. Selection should be based on relative locations of the supply and extract units, ease of maintenance and practicality. Cleaning access will be required to both sides of any energy-recovery device.

4.145 The following are the minimum energy transfer efficiencies required for devices handling equal air volumes:

- run-around coil – 45%;
- plate heat exchanger – 50%;
- thermal wheel – 65%;
- any other energy-recovery device – 50%.

4.146 If a plate heat exchanger is chosen, the plates should be constructed of metal. Plastic should not be used for internal bypass dampers and drive gears.

4.147 Whichever energy-recovery device is chosen the extract side will need to be protected by a G3 filter and provided with a drainage system as described in Paragraphs 4.20 - 4.25, to remove condensate.

Location

4.148 Energy-recovery devices should be located downstream of the frost battery and pre-filter, prior to the cooling coil or main heater battery on the supply side.

Control

4.149 It is essential to consider the control of both the energy recovery device and the frost battery when assessing the economics of recovery, as all energy provided by the frost battery will directly reduce the heat exchange of the recovery device. To this end, the off-coil setting of the frost coil should be the minimum possible to protect the primary filter (for example +2°C).

4.150 The energy-recovery device should be controlled in sequence with the main heater battery, and should incorporate a control to prevent the transfer of unwanted heat when the air-on condition rises above the required plant set point.

4.151 In instances where the plant is cooling the air, it may be possible to remove heat from the supply air at high ambient conditions, under the dictates of enthalpy sensors in the intake and extract ducts.

Attenuation

General requirements

4.152 Noise will be generated in an air distribution system by the fan, plant items and airflow. The ductwork is a very effective transmitter of this noise hence there is generally a need to limit the noise transmission to meet the requirements of the building. This normally involves the provision of sound attenuation treatment as part of the overall ductwork system design.

4.153 A thorough assessment of the design should be made to assess the noise impact. This should take into account the following primary factors:

- fan- and plant-noise generation;
- air-flow generated noise in ductwork fittings and dampers;
- noise generated at grilles, diffusers and other terminals;
- noise break-in and break-out of ductwork;
- cross-talk and similar interference;
- the noise limitations for the building and surrounding areas;
- external noise generation.

4.154 A method of assessment of these factors and the sound attenuation requirements of ductwork systems is given in CIBSE Guide B.

4.155 The fan is usually the main source of system noise. The sound power that it generates varies as the square of the fan pressure, and thus to limit the fan noise level the system resistance should be kept as low as economically

possible. As a general rule the selected fan should operate close to its point of maximum efficiency to minimise its noise generation. Where there is disturbance to the airflow at the fan inlet, the manufacturer's stated fan noise levels should be increased by up to 5 dB(A). More precise guidance on this aspect may be available from the manufacturers.

4.156 Fans radiate noise through both the inlet and outlet connections and it may be necessary to provide attenuation to limit the noise from both of these connections. It is always preferable and more economic to control noise and vibration at source, or as close to source as possible. It should be noted that attenuators offer a resistance to airflow. The resistance must be included in the fan and ductwork calculations.

4.157 Provided care is taken in the design and construction of low-pressure systems to avoid significant noise generation in the ductwork, attenuation should only be needed to absorb fan noise.

4.158 Noise breakout from all equipment housed in the plantroom must be taken into consideration if control is to be satisfactory. Any ductwork within the plantroom after the silencer should be acoustically insulated to prevent noise break-in or the silencer relocated at the point of entry or exit of ductwork to and from the plant room.

4.159 There is no complete means of control over external noise generation from such as road traffic, aircraft, factory and community noise. Consideration must be given to this at the design and planning stage.

Acceptable types and location

4.160 The noise levels produced by ventilation and other plant should be reduced by either lining the inside of the duct with sound-absorbing material or fitting bespoke attenuator units.

4.161 In supply systems, sound-absorbing material should not be applied to the inside surface of a duct system downstream of the final filter, owing to the risk of mechanical damage and the subsequent dispersal of the media into the ventilation system.

4.162 In supply and extract systems, sound-absorbing material must not be applied to the inside of a duct within 1 metre of a fire damper. The material should be non-particle-shedding and fire-resistant (further guidance can be found in SHTM Firecode suite of documents). Where sound-absorbing material is applied in a section of duct that will be routinely exposed during maintenance activities it should be protected from mechanical damage.

4.163 Bespoke attenuator units with a sound-absorbing infill suitable for the quality of air being handled and protected by a perforated sheet metal casing are the preferred option for critical systems. Absorption of moisture, dirt and corrosive substances into the 'in-fill' and the release of fibrous particles into the airstream should be prevented by the use of a membrane. The membrane material should have a declared service life of at least 25 years. If these conditions can be met then the attenuator may be located in the supply ductwork downstream

of the final filter. When so located, cleaning access should be provided at both ends of the attenuator unit.

5. Air distribution system

Air distribution arrangements

Ductwork distribution systems

5.1 Ductwork systems for ventilating and air-conditioning applications are referred to by their velocity or pressure category, that is, as low, medium or high velocity (or pressure) systems. Heating & Ventilating Contractors Association (HVCA) limits are up to 10 m/s or 1,000 Pa; 20 m/s or 1,750 Pa: and 40 m/s or 3,250 Pa in the case of conventional low, medium and high pressure systems respectively. High-pressure systems are disappearing because of the constraints of the Building Regulations but existing systems may sometimes need to be altered or extended.

5.2 For normal applications in healthcare buildings, low velocity systems are recommended. The use of higher velocities than those recommended is not likely to be economical. Future trends are likely to be towards even lower optimum duct velocities; however, velocities below 2 m/s are unlikely to be justified.

5.3 The site will often dictate the main routing of ductwork systems, but in general, the design should seek to make the layout as symmetrical as possible; that is, the pressure loss in each branch should be as nearly equal as possible. This will aid regulation and may reduce the number and variety of duct fittings that are needed.

5.4 Main distribution ductwork should not be routed above sleeping areas. Where there is no alternative route, additional acoustic insulation will be required.

5.5 Where auxiliary cooling units, fans, filters or trimming devices are installed in the distribution system, they must be independently supported and fitted with a suitable drainage system where appropriate. If they are a source of vibration they should be linked to the distribution ductwork via flexible connections.

5.6 The fan of a Local Exhaust Ventilation (LEV) system provided under the COSHH Regulations should be located outside of the building so that all of the ductwork within the building is under negative pressure. Where the fan has to be within the building it should be located as close as practicable to the outside with an absolute minimum run of discharge ductwork within the building. The discharge ductwork within the building will be under positive pressure so it must not be penetrated by test holes or inspection hatches.

Ductwork materials and construction

5.7 The choice of duct material should take account of the nature of the air or gas being conveyed and the environment in which the duct will be placed.

5.8 Galvanised-sheet-steel is generally suitable and most economical for normal ventilating and air-conditioning applications. Its inherent mechanical strength

renders it resistant to casual damage both during the construction phase and throughout its service life when mechanical and electrical services around it are altered. It also readily withstands the impacts sustained when rotary equipment is used to for internal cleaning.

5.9 In instances where moisture levels and/or corrosive elements in the air being conveyed are very high, aluminium, stainless steel, PVC or GRP (glass-reinforced plastic) ducts should be used. Stainless or black steel are the only suitable materials for high-temperature ductwork.

5.10 In inherently wet areas, such as the base of fresh air inlet ducts and some extract systems, the ductwork may require draining to prevent a build-up of standing water. The layout of the drains should be as specified in Paragraphs 4.20 - 4.25.

5.11 Where builderwork plenum chambers or ducts are used, these may be constructed of various materials. However all such ducts must be rendered and sealed to prevent dust shedding. A greater allowance may need to be made for leakage.

5.12 Galvanised, black and stainless steel ductwork should be manufactured and installed to the current HVCA specification for sheet metal ductwork DW144, but excluding the use of bolt-through supports.

5.13 GRP and PVC ductwork should be manufactured and installed to the current HVCA specification for plastic ductwork DW154.

5.14 Where phenolic-board ductwork is considered, care should be taken to ensure that it is fabricated to a quality standard and installed strictly in accordance with the manufacturers' instructions. Its pressure rating and degree of support should be suitable for the application and ducts should be fitted with mechanical protection where required. Designers should be fully conversant with installation techniques and Installers should be experienced having received training in the techniques required and certified to this effect by the manufacturers. Due consideration should be given to the impact on ductwork pressures created by the closing of dampers. Phenolic-board ducting should not be installed in plant rooms or any other areas where it could be vulnerable to impact damage. Internal cleaning using mechanical (rotary) means is also liable to cause damage to the integrity of surfaces.

5.15 Flexible ductwork is unsuitable for air distribution in healthcare applications. It should only be used to make the final connection to a terminal (See Paragraphs 5.54 and 5.55).

5.16 The inside of the ductwork should be free from structural projections and as smooth as possible. Flanged, gasketed joints are preferred.

Fire aspects, damper types and locations

5.17 It is essential that all relevant fire aspects of ducting systems are agreed with the fire officer before the design is finalised.

5.18 Ductwork must be fire-stopped where it penetrates fire compartment walls, floors and enclosures, cavity barriers and sub-compartment walls or enclosures, and provided with weatherproof collars where roofs or external walls are penetrated.

5.19 Fire/smoke dampers shall be provided at the locations required by SHTM Firecode. The fire-damper mounting frame must be securely attached to the building fabric. Where a fire-damper is not mounted directly in a fire compartment wall, it must be correctly supported and the ductwork between it and the firewall must posses the same fire rating as the firewall that it penetrates. The fire-rated portion of ductwork must not be penetrated by test holes or inspection hatches. All fire/smoke dampers shall be capable of remote re-setting via the Building and Energy Management System (BEMS) or equivalent, after periodic testing procedures.

5.20 An access hatch shall be provided adjacent to each fire damper so that its correct operation can be directly observed.

5.21 Smoke-diverting dampers must be provided on recirculation air systems to divert automatically any smoke-contaminated return air to the outside of the building in the event of a fire; and arranged so that the normally open smoke-diverting damper on the return-air branch to the input unit closes and all the return air is exhausted through the extract fan. Guidance is available in SHTM 81 and BS5588: Part 9.

Duct sections

5.22 Ducting is generally available in rectangular, circular and flat oval sections, although other sections may be made for special situations.

5.23 Rectangular ducting is most common on low-pressure systems, for the following reasons:

- it can readily be adapted to fit into the space available;
- fittings are cheaper than those for circular or flat oval ductwork;
- it can readily be joined to such component items as heating and cooling coils, and filters.

5.24 When sizing ductwork, the designer should take into account:

- both installation and operating costs;
- space limitations imposed by the structure and other services;
- operating noise levels;
- requirements of regulation at the commissioning stage.

5.25 For overall economy and performance, the aspect ratio should be close to 1:1, since high aspect ratios increase the pressure loss, heat gains or losses and overall cost (for example, changing the aspect ratio from 1:1 to 1:4 can typically

increase the installed cost of the ductwork by 40% and add 25% to the heat gains or losses).

5.26 Rectangular ducting should not be the first choice for high pressure systems, and should be avoided in systems operating at high negative pressures, because the strengthening of the flat sides and the sealing requirements necessary to make rectangular ducts suitable for these high pressures are costly.

5.27 Circular ducting is preferable for high-pressure systems, and for systems operating at high negative pressures. In the case of the latter, additional stiffening rings may be necessary. Machine-formed spirally-wound ducting and a standard range of pressed and fabricated fittings can sometimes make circular ducting more economical, particularly in low pressure systems having a relatively low proportion of fittings.

5.28 Flat oval ducting provides an alternative to circular ducting, principally where there is a limitation on one of the dimensions in the space available for the duct run.

5.29 Other sections may be used, such as triangular sections to pass through roof trusses. Such sections present difficulties in the provision of fittings, and connections to standard plant items, and are likely to be more expensive than traditional sections.

Standard ductwork fittings

5.30 All fittings should conform to current HVCA specification DW144. Wherever possible, long radius bends, large radius main branches, not more than 45° angle sub-branches and long-taper transformations should be used.

5.31 Fittings should be arranged with vanes in sub-branches connected directly to grilles and diffusers, and turning vanes in square bends (when used). When vanes are used, additional cleaning access will be required.

5.32 The number of duct fittings should be kept to a minimum and there should be a conscious attempt to achieve some standardisation of types and sizes. Increasing the number and variety of fittings in a system can markedly raise its overall cost.

5.33 Bad design in relation to air flow can lead to vibration of flat duct surfaces, increases duct-generated noise and pressure loss, unpredictable behaviour in branch fittings and terminals, and adverse effects on the performance of installed plant items (such as trimmer batteries).

Branches

5.34 There are many designs of branches and junctions in use. The important features are that the flow should be divided (or combined) with the minimum interference and disturbance. Changes in duct sizes should not be made at the branch but a short distance downstream (or upstream). A good dividing branch

design cannot be effective if the flow entering the branch is not uniform across the section.

Changes of section

5.35 The expansion of a duct section should be formed with sides having a total included angle of no more than 30°, and preferably less than 20°. If the angle of expansion is greater, the flow is not likely to remain attached to the walls of the duct and large eddies will be formed with flow reversal at the walls. This leads not only to a high-pressure loss, but also to non-uniform velocity pattern at the outlet. Where there is insufficient space for a gentle expansion and a greater angle is necessary, internal splitters should be used.

5.36 A contraction in a duct section is less critical, but the total included angle of the taper should not exceed 40° (or 20° where the contraction is made on one side of the duct only)

5.37 The most economical way to change the section of a rectangular duct is to restrict the change of duct size to one side only. If the calculated reduction or increase to the side dimension is 50mm or less, it is usually not economical to change the size at the position. The minimum size of a rectangular duct should usually be 150mm x 100mm.

Other fittings

5.38 As a general rule, fittings should avoid abrupt changes in direction and also sharp edges that cause the flow to separate and form eddies, thus limiting pressure loss and causing noise generation. If the fitting leads to the flow preferentially attaching to one side of the outlet, then a significant length of straight downstream duct is necessary before the next branch or fitting; this length should be greater than five equivalent diameters.

Thermal insulation

5.39 Thermal insulation is applied to ductwork to reduce heat exchange, and to prevent condensation.

5.40 In a duct system, the air temperature changes can be significant, especially when passing through untreated space, and these have the effect of reducing the heating or cooling capacity of the air and of increasing the energy input to the system. The heat transmission to and from the surrounding space can be reduced by effective insulation of the ducts. Extract ductwork conveying air from which heat recovery will be derived should be thermally insulated to the same standard as with associated supply ventilation ductwork.

5.41 Condensation can arise in ductwork systems conveying cooled air and, apart from creating conditions conducive to corrosion of ductwork, condensation affects the heat and vapour-resisting properties of insulating materials themselves which may induce further condensation.

5.42 In normal circumstances, the insulation thickness for heat resistance is sufficient to prevent surface condensation, but in extreme conditions the

insulation thickness for vapour resistance may be greater than that for heat resistance. When cold ducts pass through areas of high dew-point, carefully selected vapour barriers should be applied externally to the insulation.

Noise generation within the ductwork

5.43 Noise is generated in ductwork at sharp edges, by tie rods, damper blades, duct obstructions and sharp bends etc. This air-flow-generated noise becomes an important factor if it is about the same or greater level than the upstream noise level. (Air-flow-generated noise is often referred to as “regenerated noise”).

5.44 The noise level generated by airflow in ductwork is very sensitive to the velocity. The sound power of this noise is approximately proportional to the sixth power of the velocity; that is, a doubling of the duct velocity will increase the sound power by a factor of 64. The duct velocities should therefore be kept as low as possible. In general, duct fittings that have lower pressure loss factors in similar flow conditions will generate less noise.

5.45 Ductwork serving quiet areas should not be routed through noisy areas where noise break-in can occur and increase the noise level in the ductwork.

5.46 Grille, register and louvre noise should be kept to the minimum by selecting types having low noise-producing characteristics, without high tonal noise, and should be fitted with acoustically treated external inlet and outlet louvres.

5.47 Cross-talk attenuators may be necessary where noise intrusion between adjacent spaces can arise and where individual room confidentiality is required. They will normally be of the ‘through-the-ceiling, ‘up-and-over’ type and may include a fire damper if required.

Volume control damper locations

5.48 Manually operated balancing dampers are needed generally:

- in the main duct downstream of the fan;
- in branches of zone ducts;
- in sub-branch ducts serving four or more terminals;
- at terminals not covered by the previous item.

5.49 Dampers integral with terminals should only be used for final trimming of air volumes, otherwise noise and air distribution problems may ensue.

5.50 Dampers in rectangular ducts should be single-bladed when the longer side is up to 450mm but be of the opposed-blade multi-leaf type above this size. In circular ducts, iris-type dampers are recommended. Dampers must be accessible, incorporate a position indicator and means of locking in the commissioned position. Dampers should be located as far away as possible from adjacent branches or plant items.

Cleaning and access door locations

5.51 Cleaning and access doors are required to facilitate access to plant items and ductwork components for inspection, maintenance, cleaning and replacement, and must be of sufficient size to permit safe access for the required functions. Consideration should also be given to the number of doors to be provided. Older installations may be deficient in the provision of access doors and consideration will be necessary to have these incorporated in the course of any refurbishment in the accommodation served.

5.52 Recommended locations for access doors are given in the current HVCA specification DW144 and are generally provided to give access to:

- every regulating damper;
- every fire and motorised damper;
- filter (to facilitate filter withdrawal);
- both sides of cooling/heating coils;
- humidifiers;
- fans; and
- motors and impellers.

5.53 Care should be taken when siting access doors to ensure that no other services to be installed will prevent reasonable access.

Flexible ducting

5.54 Flexible ductwork may be used for final connections to grilles and diffusers provided it is constructed to meet the fire precautions recommended in BS8313. It must not pass through fire compartment walls, floors or enclosures of sub-compartment walls or enclosures, or through cavity barriers.

5.55 Flexible ducting will cause a significant frictional loss and may be difficult to clean and should never be used in lieu of a bend. Where installed it should take the most direct route and be as short as possible, never exceeding 1 metre in length.

Diffuser and grille selection and sizing

5.56 The effectiveness of all ventilation and air-conditioning systems depends on the methods by which air is introduced to, and vitiated air is removed from, the space. The usual results of poor air-terminal selection and/or positioning are: draughts, stagnation, poor air quality, large temperature gradients and excessive noise.

5.57 Air can be supplied to a space in a number of ways, although any device can be broadly placed into one of two categories: that producing a diffused supply, or that producing a perpendicular jet. Diffusers may be radial or linear, and normally utilise the Coanda effect (that is, adhesion of the air stream to an adjacent surface), to reduce the risk of excessive room-air movement. A

perpendicular jet is formed by discharging air through grilles, louvres or nozzles, which are generally adjustable.

5.58 Air-flow patterns produced by both types of terminal are dependent to a large extent on the presence of the Coanda effect.

5.59 Supply air terminals can be incorporated into any room surface, for example, floors, walls (high or low level), desktop etc.

5.60 As they operate on the jet principle, the use of sidewall and linear grilles is restricted to areas where air change rates are low, that is, less than 10 per hour. Perforated rectangular diffusers can provide acceptable conditions within the occupied zone at up to 15 air changes per hour. In areas where a higher air change rate is required, square or circular ceiling mounted diffusers should be used.

5.61 The performance of supply air terminal devices is provided, based on three criteria: throw, spread and drop.

- **throw** is defined as perpendicular or parallel distance from the terminal to the point at which the air velocity is 0.5 m/s isovel;
- **spread** is defined as the width of the 0.5 m/s isovel; and
- **drop** is defined as the vertical distance from the centre line of the terminal to the bottom edge of the 0.25 m/s isovel.

5.62 It is necessary to consider each of these parameters in both summer and winter conditions to ensure satisfactory operation of the air-terminal device, as warm jets behave very differently from cold jets.

5.63 A warm jet tends to rise until it attaches itself to a horizontal surface, while a cold jet falls. Care must be taken to ensure that this does not lead to unacceptable temperature gradients in winter or excessive air velocities in the occupied zone in summer.

5.64 In order to ensure satisfactory air movement within a space, it is necessary to consider interaction between air movement from adjacent terminals, and ceiling mounted fixtures (light fittings etc), as well as interaction between air movement and room surfaces.

5.65 If the supply and extract terminals are too close, short-circuiting may occur, while if they are too far apart, stagnant zones may be formed. Where two opposing air streams meet, the individual velocities must not be greater than 0.25 m/s.

5.66 Supply and extract grilles and diffusers should be fitted with opposed-blade dampers for fine balancing purposes.

5.67 Further guidance on the selection of grilles and diffusers is given in the CIBSE Guide B.

5.68 In operating theatres, the supply terminals must be able to produce a down-flow movement of air in the operating zone 1 metre above floor level. Ceiling mounted diffusers with fixed directional vanes that provide a downward turbulent airflow are the preferred option. Plenum boxes fitted with perforated screens to produce a parallel downward flow are also acceptable. Nozzles or jets of any type are not acceptable. Sidewall-mounted linear diffusers that utilise the Coanda effect to send air across the ceiling and 'drop' it into the operating zone are also not suitable. However linear ceiling mounted diffusers that provide a direct downward airflow around the operating zone may be used.

Transfer grille - size and location

5.69 Air-transfer grilles in walls, partitions or doors form an integral part of the building's air distribution system. Modern doorsets have very low leakage rates so cannot be relied upon to permit even quite small airflows. Failure to make adequate provision for air to move from room to room will result in excessive pressure differentials and 'door whistle'.

5.70 Transfer grilles are required in locations where there is a significant imbalance between the supply and extract rates in a room. They will relieve any pressure differentials that may affect the operation of the spaces and/or the ventilation system and permit airflow in a known direction. However, transfer grilles are vulnerable to damage and, in many instances, as long as the equivalent free area is provided, they can be substituted with undercut door.

5.71 Care needs to be taken to ensure that the positioning of transfer grilles does not interfere with the fire or smoke integrity of the building. In general, the air-transfer grilles should not be installed within fire-resisting boundaries, although if this is unavoidable, they should be fitted with fire- or smoke-dampers.

5.72 Where installed, transfer grilles should be of the non-vision type, sized for a maximum face velocity of 1.5 m/s.

5.73 In photographic dark rooms, lightproof transfer grilles will be required.

5.74 Cross-talk attenuators may be necessary where noise intrusion between adjacent spaces can arise and where individual room confidentiality is required. (See also Paragraphs 5.43 - 5.47).

Pressure stabilisers - size and location

5.75 Pressure stabilisers are required in lieu of air-transfer grilles in areas where it is necessary to maintain pressure differentials between adjacent rooms to prevent reversal of airflows for example, in operating suites, isolation facilities and clean rooms. (See also Paragraphs 7.24 - 7.28).

5.76 Fire precautions for pressure stabilisers are the same as for transfer grilles. For sizing criteria, refer to Paragraph 7.23

5.77 Pressure stabilisers should be of the balanced-blade type, with the facility to make fine adjustment of the pressure setting. They should be silent in

operation and give a seal as tight as practicable when closed. The materials of construction and method of assembly should allow for cleaning and disinfection.

5.78 Pressure stabilisers should be installed in a visible location so that their operation can be readily observed.

5.79 Cross-talk attenuators may be necessary where noise intrusion between adjacent spaces can arise and where confidentiality is required. In these cases, the pressure stabiliser and cross-talk attenuator should be mounted in a short length of ductwork within the ceiling void.

5.80 Pressure stabilisers may need to be fitted with a stand-off baffle on their discharge side to prevent a sight line in situations where a laser will be used. Baffles may also be required to preserve privacy or prevent discharge air causing draughts or disturbing the air distribution pattern in the adjoining room. They are also useful in low-level locations to prevent the airflow path being obstructed by portable equipment.

6. Automatic controls

6.1 Various options for control of single and multi-zone air-conditioning systems are given in CIBSE Guide B.

General requirements

6.2 The basic requirements for an automatic control system are as follows:

- facilities to start, set-back and stop the plant;
- facilities to control the volumetric air-flow;
- facilities to control the system or room pressure;
- temperature control and indication;
- humidity control and indication;
- devices to monitor and indicate the plant's operating state;
- alarms to indicate plant failure, low air-flow, and filter state.

The control functions actually provided will depend on the purpose of the ventilation system.

6.3 There will also be a need to determine the control strategy in the event of a fire either within the zone being served or within an adjoining zone.

6.4 The designer should consider whether it is necessary for the supply and extract fans to be interlocked, either so that the supply fan will not operate unless air-flow is established within the extract system, or vice-versa depending on the required pressures within the rooms being served.

6.5 The sequence switching of units in order to prevent transient reverse airflows will be particularly important in laboratory and pharmacy areas that also contain fume cupboards, safety cabinets and other LEV systems.

6.6 Alarms should be provided to show 'filter fault' and 'low air-flow'. The "filter fault" alarm should be initiated by a predetermined increase of pressure differentials across the filter. The 'low air-flow' alarm should be initiated when the supply air quantity falls to 80% of the design value.

Objectives of control system

6.7 The primary objective of ventilation plant control system is to maintain the space served within the required environmental control limits, at the appropriate times, regardless of external conditions or internal loads and with the minimum energy consumption.

6.8 Often, it is not possible to predict accurately building load variation at the design stage, and thus optimum set points cannot be assessed. Information provided by monitoring the operation of the plant via a Building and Energy Management

System (BEMS) will enable optimum set points to be established and energy consumption reduced. Control of most systems will be via a BEMS. This will enable the operating conditions and control tolerances to be set and monitored. The BEMS may also be set to log the actual energy consumed by the system together with that recovered by the energy-recovery device. This will provide a useful check on overall operating efficiency and provide evidence that energy targets are being achieved.

6.9 BEMS incorporating self-adaptive control algorithms that automatically adjust the set-point to the suit the usage and load are preferred. The provision of movement sensors within the controlled space in order to determine the actual occupancy will facilitate this process.

6.10 The failure of specialised ventilation systems can have grave consequences for the delivery of healthcare. Control systems should therefore be simple, robust and reliable.

6.11 Computer-software-driven control systems are becoming the norm in building services. However, it should be remembered that healthcare ventilation systems need to be available to operate outside of normal working periods when software support is not available. Should the software fail, it will be left to site staff, who may have little knowledge of the control algorithms to restart the ventilation system. It is therefore essential to ensure that a simple means of re-starting critical systems in the event of a software failure is provided (see also Paragraphs 4.62 - 4.63)

Location of controls

6.12 Whether within the plant, duct or room, sensors should be located to provide accurate measurement of the condition of the air being monitored.

6.13 Sensors and control items such as control valves should be located close to the element being sensed or plant item being controlled, in order to minimise time lags within the system which may create over-shoot of conditions beyond the design envelope and result in additional energy consumption.

6.14 There are practical advantages in locating all control valves for an air-handling unit in a bank (at a convenient height) at one end of the unit. (This will not normally result in an undue additional control lag.)

6.15 Some applications require intermittent mechanical ventilation, frequently at a high air-change rate, (for example, in bathrooms and treatment rooms.) Local controls to facilitate this mode of operation should be placed in a prominent position to encourage economical use.

6.16 Local controls that enable the user to select more than one mode of operation should be clearly labelled to identify the particular mode selected. Where the system allows different room pressures to be selected then a direct-reading pressure gauge should be fitted within the eye line of the users to provide an independent confirmation of the resultant mode of operation. A clear

description of the selectable modes of operation should be mounted adjacent to the control switch.

Fire aspects

6.17 A fire control panel should be mounted at the entrance of the area that the ventilation serves. The panel should have restricted access for the fire officer and include independent on/off controls and indication of the supply and extract systems.

6.18 In certain critical care departments it is preferable to maintain the supply ventilation in case of a fire within the area. For example, in an operating department, while undergoing surgery, the patient cannot always be easily moved without significant risk. In the event of a fire in a staff or support area of the department, or adjoining zone, the continued supply of air to a theatre will maintain it at a positive pressure and protect the patient and staff from the effects of smoke. This will allow time for the patient to be stabilised so that he/she can be safely evacuated if necessary. A similar situation occurs for patients in ITU and other critical care units. In all of these cases the ventilation to the critical area should continue to operate unless the AHU starts to draw in smoke. For these departments, a notice should be affixed to the fire control panel drawing attention for the need to liaise with departmental staff before switching off fan units.

6.19 All supply AHUs should have a smoke sensor mounted in the main supply duct immediately downstream of the AHU. In the event of a fire in the AHU or smoke being drawn into the system from an outside source, it should cause the supply air fire damper to close and shut down the AHU.

Time switching

6.20 Facilities to start, set-back and stop the plant should be provided in the plantroom. Remote start and set-back control and indication, if required, should be provided at a manned staff location, for example, at the reception or staff base or, in theatres, within the Surgeon's Panel.

6.21 Many ventilation systems may be completely shut down when the area served is not in active use. Alternatively, where there is a need to maintain a background condition, the ventilation output can be reduced by "setting back" the system. This will significantly reduce energy consumption and extend the life of filters and other system components.

Start-up control

6.22 The plant's start control should contain a control logic that will start the plant in the sequence set out in the following algorithms, Figures 2 - 5

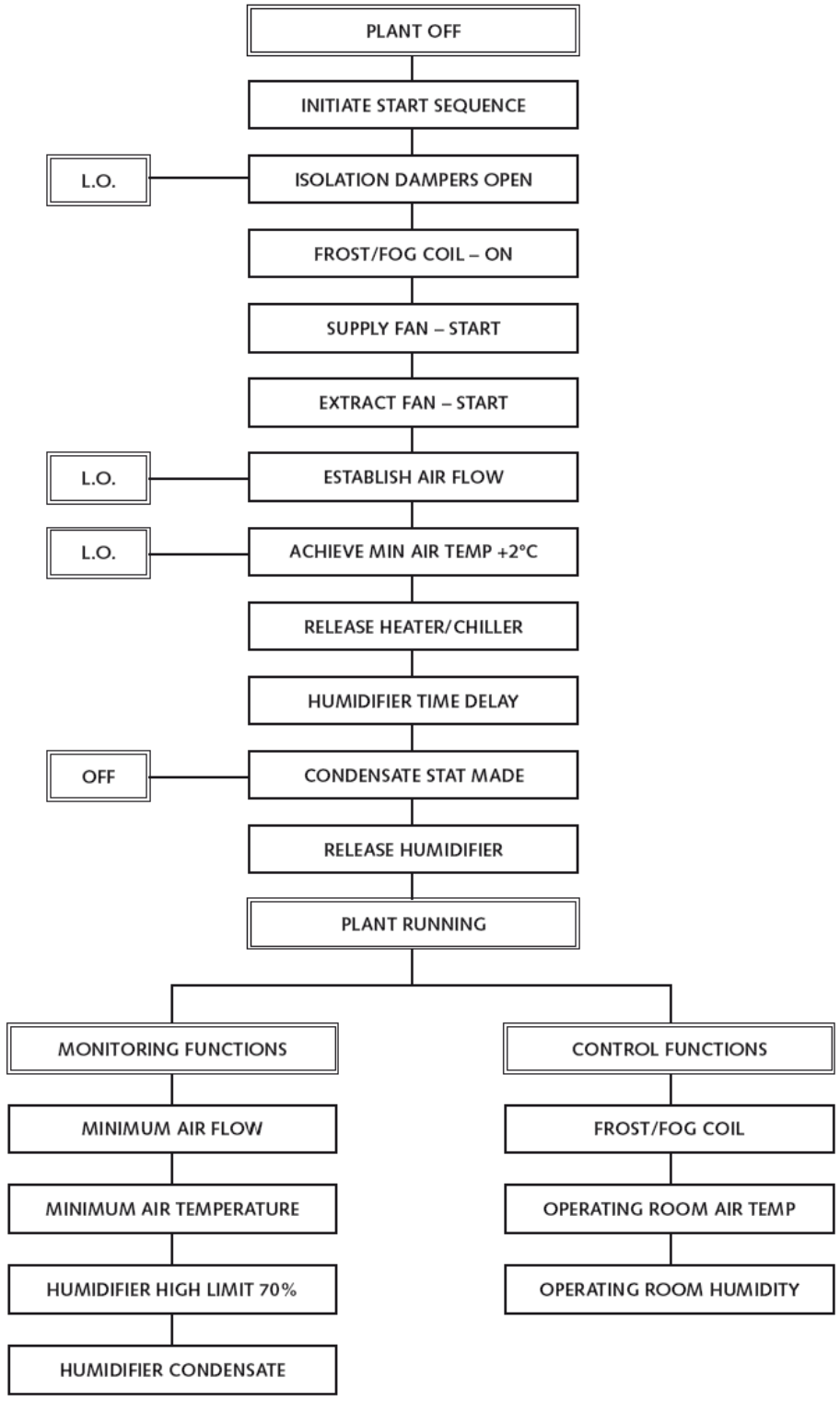


Figure 2: Typical plant control algorithm – normal start-up sequence

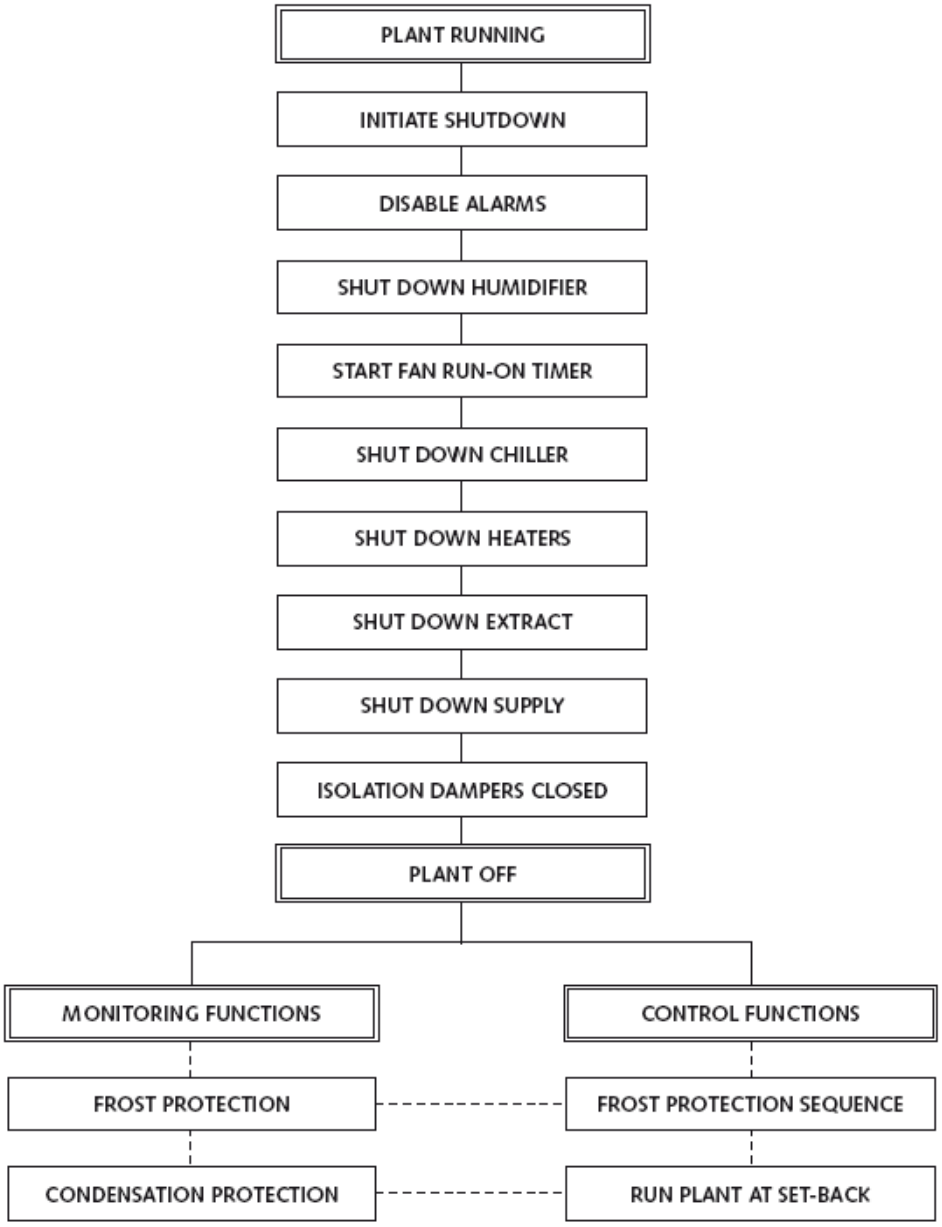


Figure 3: Plant control algorithm – normal shutdown sequence

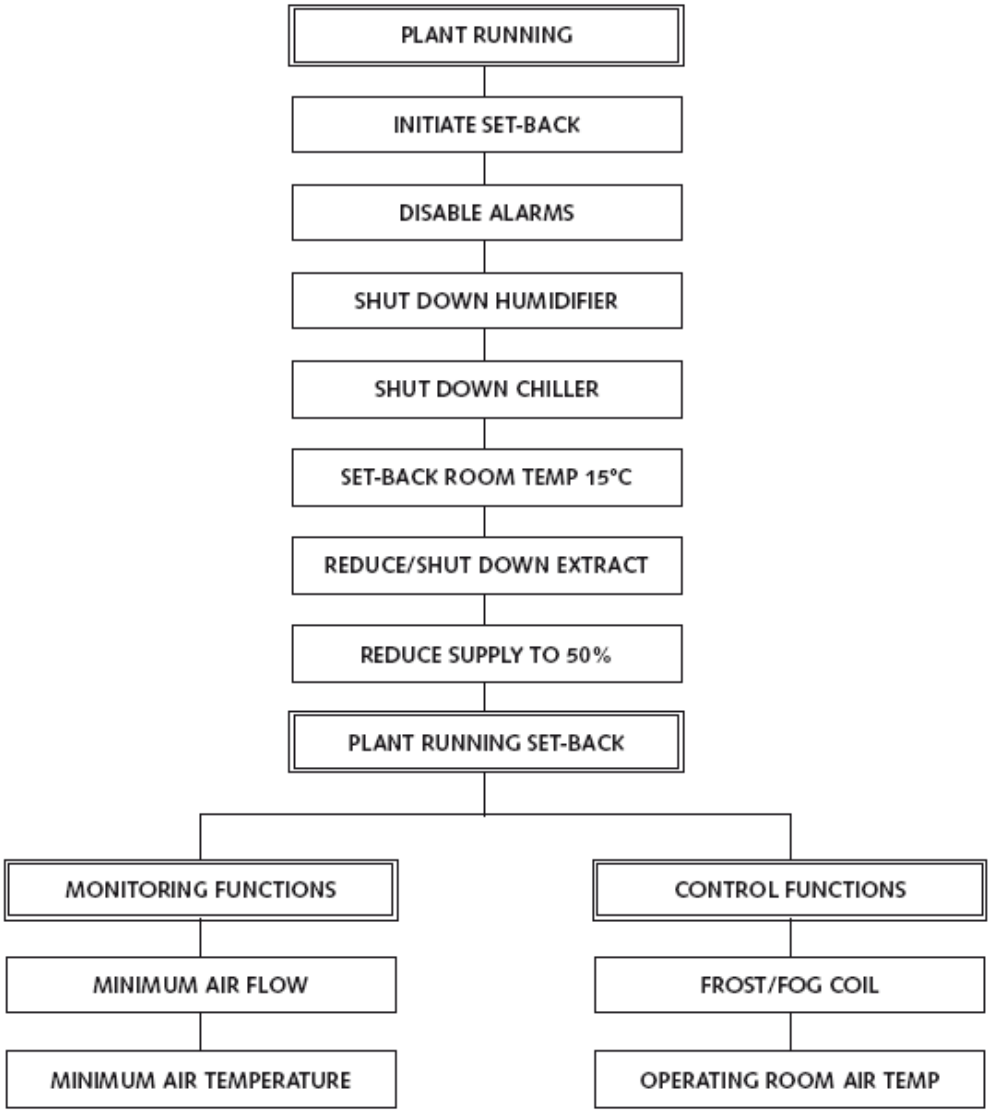


Figure 4: Plant control algorithm – set back sequence

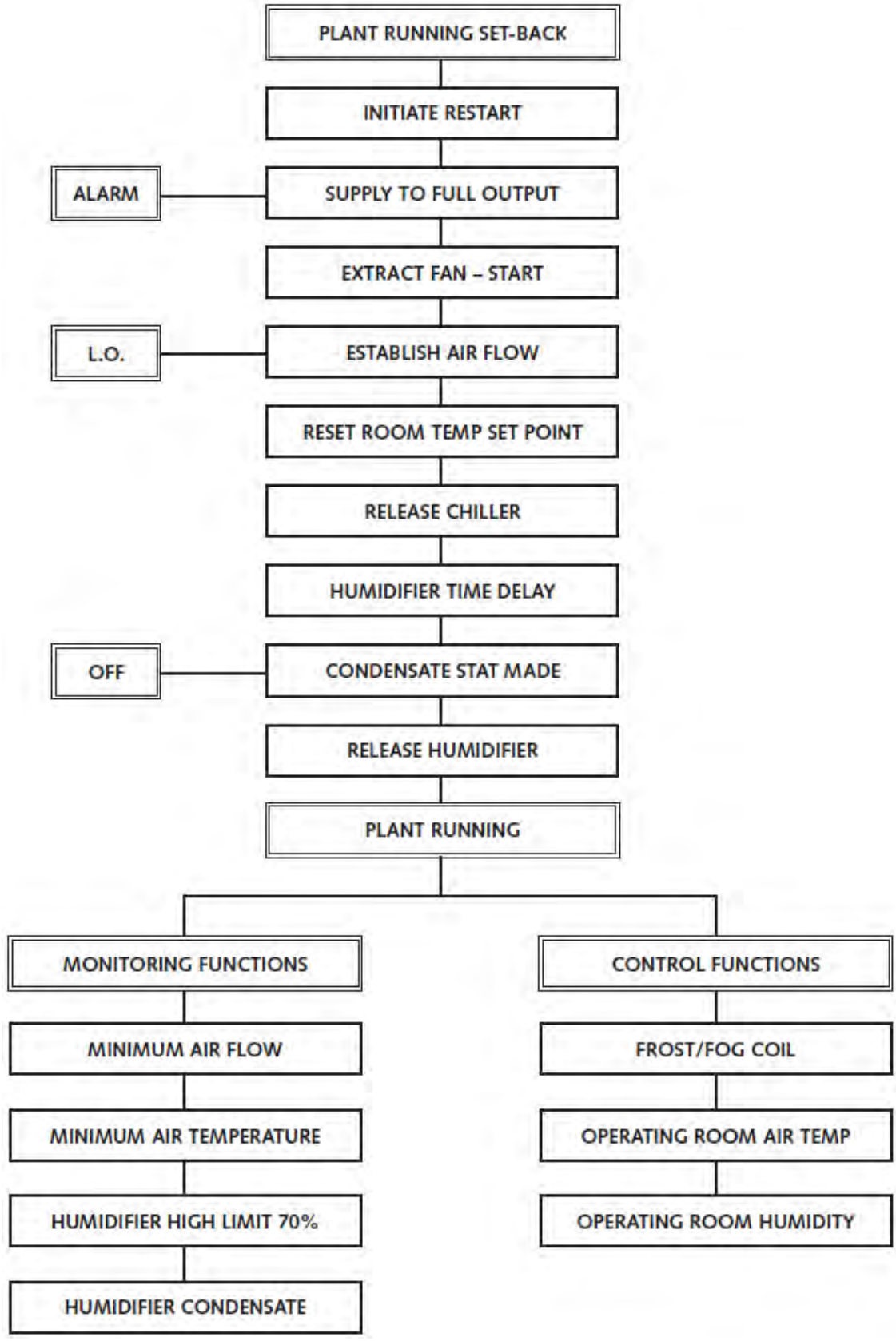


Figure 5: Plant control algorithm – restart from set-back

Set-back control

6.23 Where variable speed controls are installed, the setback facility for each plant should depress the control temperature to around 15°C; exclude any humidification and cooling from the system; and reduce the supply and extract air volumes to around 50%. The extract fan can also be turned off as long as the desired direction of air movement from clean to less clean will be maintained (See also Figures 2 - 5).

Use control

6.24 The installation of movement detectors allows for “use control” of ventilation systems. A simple control logic that reduces the system to a “set-back” condition if there has been no movement detected in the space for, say, 30 minutes and that switches the system “off” if no movement is detected for one hour is recommended for many applications, including operating suites.

6.25 A variation on this can be provided by linking ventilation controls to lighting. For example, in an operating theatre, the system may be off outside of working hours, could run at set-back when the general lighting was switched on and increase to full speed when the operating lamp is switched on. As with movement detection, a 30-minute run-on should be provided at each stage when the lights are turned off.

6.26 Either of the above control strategies may be refined by linking to the BEMS to provide a control logic related to normal working hours and associated ‘real-time’ movement within the zone being controlled. This should result in significant energy savings.

Environmental control

Temperature control methods and application

General

6.27 All control valves must fail safe, that is, close in the event of power or air-flow failure, with the exception of the fog/frost battery control valve, which should open upon power or airflow failure.

6.28 Control valves should be located in an accessible position. Isolation valves should be provided to enable the control valve to be removed for service without the need to drain-down the system.

6.29 Care should be taken to ensure that the installation of control valves and their associated pipework do not obstruct access to the AHU inspection doors and hatches.

Room temperature control

6.30 The limits for room temperature set point are generally between 16°C and 25°C depending on the particular application, and in some specialised instances (for

example, operating departments) are adjustable within a predetermined range by the user.

6.31 The selection of temperature set point for each room or zone may be by a control facility in the room / zone, or remotely at the control panel or BEMS. Where the control device is mounted within the room / zone and adjustable by the user, it should be marked either 'raise' and 'lower' or '+' and '-'. It should control within a specified temperature range to suit the user requirement with a control tolerance of ±1K. All other control set-points should be selectable either on the control panel or at the BEMS interface.

6.32 Where local control is provided, an indication of temperature will be required locally, or at a staff base (if appropriate), using an analogue or digital indicator. The indicator should be large enough to be read from the normal working position (for example, at the operating table in a theatre). This may be mounted in a supervisory or, 'surgeon's' control panel, with the signal repeated on the main system control panel or BEMS. It is important that this indicator displays the actual measured temperature and not the selected temperature.

6.33 Where the supply and extraction systems are designed for ventilation only and there is a wet heating system to provide background heating, care must be taken to avoid one system trying to heat the space while the other system is trying to cool the area.

Frost battery control

6.34 Steam-supplied frost batteries must be operated as on/off devices with their sensor mounted upstream of the battery. This will give 'open loop' control. A set point of +1°C is recommended.

6.35 Low pressure hot water (LPHW)-supplied frost batteries should be controlled using the proportional mode. Their sensor should be located downstream of the battery to give 'closed loop' control. A set point of between 2°C and 5°C is recommended.

6.36 If the temperature downstream of the frost battery, as sensed by a serpentine thermostat, falls below the required set point over any part of the coil, the plant must automatically shut down in order to prevent damage to the other batteries. The serpentine thermostat must not be in direct contact with the coil.

Off-plant control

6.37 The control logic must prevent the chiller and pre-heater being on at the same time.

Humidity control methods and application

6.38 In order to prevent excessive condensation when starting up from a total plant shut-down, a time delay should be incorporated into the control system such that the humidifier does not start until 30 minutes after the ventilation plant starts up.

6.39 Irrespective of the method of control, a high-limit humidistat should be installed to ensure that when the humidifier operates, the condition of the air in the duct does not exceed 70% saturated, particularly during plant start-up.

6.40 With certain types of steam humidifiers, it may be necessary to install a thermostat in the condensate line from the humidifier's steam supply, to ensure that the steam at the control valve is as dry as possible before it is injected into the air supply.

6.41 The humidifier and cooling-coil control must be interlocked so that they cannot be on at the same time.

6.42 The humidifier control system should ensure that it is switched off with the fan. It is preferable to design the control system so that the humidifier is isolated for an adequate time before the fan is turned off so as to purge humid air from the system.

6.43 All control valves must fail safe (that is, close in the event of power failure) and the humidifier must be interlocked with the low airflow switch.

Multi-zone control methods and application.

6.44 Close control of all air-conditioning parameters may be difficult to achieve with multi-zone systems, since each zone will in theory require a re-heater and humidifier to give total control of humidity if that is what is required. In reality such close control is rarely required in practice. It is therefore usual with multi-zone systems to provide control of zonal temperature only, with humidity control where fitted being based on average conditions within all zones, or minimum conditions within one zone.

6.45 Where there is a requirement for close control of air-conditioning parameters in a number of zones (e.g. an operating department) separate plants should be provided for each zone in order to avoid the need for expensive over-cooling and reheating of individual zones.

6.46 Most multi-zone systems within healthcare premises are controlled based on off-coil control within the central plant, with trimmer heater batteries on individual zones.

Alarms and indication

6.47 Supply and extract systems should include indicator lamps on the control panels to confirm the operational status of each system. Where the usage is on a regular daily pattern, time control with a user-operated timed manual over-ride should be provided.

6.48 Where a system is provided for a particular space, the indicator should be in, or immediately adjacent to, that space and local controls should be provided with labels clearly defining their function (eg. isolation suites.)

6.49 The 'plant failure' and 'low air-flow' alarms should be initiated by a paddle switch or other device located in the main air supply duct. This should operate when

the air quantity fails to reach or falls to around 80% of the design value and will give indication of fan failure, damper closed, access door left open, or any other eventuality that could cause a reduction of air quantity. Monitoring the current drawn by the fan motor is not a substitute for a sensing device that is directly affected by the air-flow.

6.50 The 'filter fault alarm' should be initiated by a predetermined increase of pressure differential across the filters, thereby indicating a dirty filter.

6.51 Direct-reading gauges or manometers should be installed across filters to give maintenance staff an indication of their condition.

6.52 Visual indication should be provided at a manned staff location (for example, the reception or staff base) and on the main control panel and BEMS to show 'plant failure' and 'low air flow'.

BEMS

6.53 Control of most systems will be via a Building Energy Management System (BEMS). This will enable the operating conditions and control tolerances to be set and monitored. The BEMS may also be set to log the actual energy consumed by the system and recovered by the energy recovery system. This will provide a useful check on the overall operating efficiency and provide evidence that energy targets are being achieved.

7. Specialised ventilation systems

7.1 This section contains design information for a range of healthcare ventilation applications.

7.2 The following departments will require a degree of specialised ventilation.

- the Operating department;
  - treatment rooms;
  - endoscopy, day case and minimum invasive suites;
  - cardiology and operative imaging suites;
  - conventional operating theatres;
  - Ultra-clean ventilation (UCV) operating theatres;
  - barn theatres;
  - recovery and ancillary areas.
- Obstetrics;
  - maternity theatres;
  - birthing rooms;
  - LDRP Rooms;
  - SCBU.
- critical areas and high-dependency units of any type;
- Isolation facilities;
  - infectious diseases units;
  - bone marrow and other transplant units;
  - chemotherapy and oncology units.
- Sterile Supply and Decontamination Units;
  - wash rooms;
  - inspection and packing rooms;
  - sterile pack stores.
- the Pharmacy departments;
  - aseptic suites;
  - extemporaneous preparation areas;
  - radio pharmacies.
- the Pathology department;
  - laboratories;
  - cat 3 and 4 rooms.

- the Mortuary and Post mortem suite;
  - mortuaries;
  - post-mortem rooms;
  - specimen stores.
- Hydrotherapy units;
- Burns units;
  - burns theatres;
  - treatment rooms;
  - isolation rooms;
  - tissue banks.
- Emerging specialties;
  - gene therapy units;
  - stem-cell laboratories.
- Infrastructure;
  - plant rooms housing combustion equipment;
  - welding facilities;
  - wood working workshops;
  - electric vehicle charging areas.

7.3 Design information for many of these applications is given in Appendix 1 Table A1, Appendix 2 and in the following Chapters within this section.

7.4 It is not possible within this existing document to give definitive guidance for every healthcare specific ventilation application. Additional detailed guidance may be issued in due course in the form of supplements.

General information

7.5 The section on operating theatres is the most extensive and contains much information that is common to other applications. Each theatre suite should have its own dedicated air-handling unit and extract fan. Where no specific guidance is given the principles set out below should be followed:

- the foregoing sections of the document contain general information on healthcare-specific aspects of ventilation system design and specification;
- a set of standard solutions for the design of general operating theatre suites to conform to past and new standards is given in new standard layouts Nos 1, 3, 5 and 7 and those for UCV theatres in new standard layouts Nos 2, 4, 6 and 8 within Appendix 3;
- the CIBSE Guides A & B contain basic information on ventilation design that can be applied to most applications;

- where a British or European standard exists that is specific to the application (for example, a clean room) it should be used as the basis of the design requirement;
- air should always move from clean to less-clean areas. A hierarchy of room cleanliness is given in Table A2;
- differential pressure will prevent contamination between areas when doors are closed. Information on air leakage through closed doors and hatches for a range of differential pressures is given in Table A3;
- the flow of air will prevent contamination between areas when doors are open. Information on air leakage through open doors and hatches for a range of differential pressures is given in Table A4;
- if anaesthetic gases are used, 15 air changes per hour will be required;
- a methodology for calculating a design solution for a non-standard suite of operating rooms is given in Appendix 4. This may be adapted as necessary to suit other less complex applications where air is required to cascade from clean to less clean areas.

7.6 The supply of air to a room has four main functions:

- to dilute airborne contamination;
- to control air movement within such that the transfer of airborne contaminants from less clean to cleaner areas is minimized;
- to control the temperature and if necessary the humidity of the space;
- to assist the removal of and dilute waste gases where used.

7.7 Because of the complexities of controlling air-movement patterns, much design effort will be required for this aspect. It is important that the design makes the best possible use of the air available, as excessive supply airflows for the control of air movement should not be used. The amount of air supplied will be determined by the number of doors and desired air-change rate.

7.8 There are four routes whereby airborne contaminants may appear in a room:-

- through the supply air;
- shed directly by the room occupants;
- arising as a result of the work activities;
- transferred from adjacent spaces.

7.9 Particles entering with the supply air can be controlled by the selection of suitable filter grades.

7.10 Particles shed directly by the room occupants can be controlled by:

- restricting access to essential persons only;
- the choice of the occupants' clothing;

- the room's air-change rate.

7.11 Particles arising as a result of the work activity can be controlled by:

- enclosing, semi-enclosing or otherwise controlling the work-based source;
- the room air-change rate.

7.12 The transfer of particles from adjacent spaces can be controlled by:

- differential pressure;
- air-flow paths.

7.13 Air change rates are given in Table A1. These figures have been found to give sufficient dilution of airborne contaminants, provided the mixing of room air is reasonably uniform.

7.14 A downward-displacement turbulent air distribution is generally preferred. The supply and extract diffusers should be positioned to ensure that all parts of the room are actively ventilated and that where necessary the staff will be in a clean air-flow path. (See Section 5 for additional guidance on supply terminals).

7.15 Horizontal-flow room-air distribution with or without a Coanda effect can be a source of draughts and difficult to set up correctly. Its use should be confined to non-critical areas.

Air movement control

7.16 The design of the system should seek to minimise the movement of contaminated air from less clean to cleaner areas. Transfer grilles enable air to pass in either direction between rooms of equal class and pressure. Pressure stabilisers operate in one direction only; they allow excess air to be directed to the area desired and assist in maintaining room pressure differentials. When closed they prevent significant reverse air-flow.

7.17 The relative locations of supply and extract terminals and their design air-volume rates will determine the basic airflow between adjacent spaces. Transfer grilles and pressure stabilisers will permit and control the flow of air between spaces ensuring a flow from the clean to less clean areas. Failure to provide such devices will lead to uncontrolled air flows when personnel move between rooms. They may also result in doors being held partially open by air pressure

Temperature and humidity control

7.18 To achieve the required room conditions, supply flow rates are calculated conventionally, taking account of all heat and moisture gains and losses, and of maximum permissible temperature differences between the room and supply air. In most applications the base heating load will be provided by a heating system. In critical systems the room or suite being considered will be within the heated building envelope so the ventilation will be sized to suit the casual gains or losses.

7.19 Temperature differences of up to 10K for winter heating and 7K for summer cooling must not be exceeded.

7.20 It is acceptable for the humidity to swing uncontrolled between 35% and 70% saturation.

Removal and dilution of waste anaesthetic gases

7.21 Anaesthetic gases are subject to occupational exposure limits. Waste anaesthetic gas must be contained and removed by a suitable gas-scavenging system. Some leakage from the anaesthetic equipment and the patient's breathing circuit will occur with all systems, particularly during connection and disconnection; and from the interface with the patient. The air movement scheme should ensure that this leakage is diluted and removed from the room. Anaesthetic agents are heavier than air so placing the supply terminal at high level with an extract at low level, adjacent to the anaesthetic gas terminal units will ensure that staff are in a clean air-flow path.

7.22 In LDRP and delivery rooms the use of anaesthetic gas is controlled on demand by the patient. This may result in significant leakage which, in order to reduce staff exposure, will need to be controlled by establishing a clean airflow path. A supply at high level at the foot-end of the bed with extract at low level at the head-end will provide such a path.

Fire aspects

7.23 When considering the overall airflow movement, careful thought needs to be given to the operation of the ventilation system, to limit smoke spread in the event of a fire.

Door protection

7.24 Air should flow from the cleaner to the less clean areas as shown in Table A2. There are several factors that affect the likelihood of a reverse air- flow through doorways:

- when a person passes through a doorway, both the passage of the person and the movement of the door flap cause a transfer of air between the areas separated by the door;
- when a door is left open there is a transfer of air between the two areas separated by the doorway. This is caused by air turbulence, but is greatly increased by any temperature differential between the areas (a 1.4m wide doorway may allow the transfer of 0.19 m^3/s of air in each direction when there is no temperature difference, but when the temperature differential increases to say 2K, the volume transferred may increase to 0.24 m^3/s).

7.25 Two methods of door protection are used in order to reduce the likelihood of contamination of clean area by a reverse air-flow from a less clean area:

- closed door protection – a pressure differential is created across a closed door so that any air leakage is from the clean to the less clean area.

Table A3 gives details of closed door leakage rates for a range of differential pressures;

- open door protection – the pressure differential drops (See Table A5) and is effectively replaced by a flow of air through the doorway from the clean to the less clean area. The flow of air needs to be sufficiently large to ensure that significant reverse airflow cannot occur and will be related to the relative cleanliness of the areas being considered. Table A4 gives air-flow rates for open door protection related to door / opening size and classification of the adjoining areas.

7.26 Pressure stabilisers enable the room differential pressure to be set when the doors are shut, thus providing closed-door protection. When a door is opened the stabilisers will close, forcing air to be directed through the doorway thus providing open-door protection.

7.27 The recommended air-flow rates to achieve this are given in Table A3. Provided that the dilution criteria in Table A1 are met, the occasional small back-flows created (when two doors are opened simultaneously; or when there is a high temperature difference across an open door) will have little effect on the overall air cleanliness of the affected room.

7.28 In applications where it is critical to maintain a specific airflow and /or pressure regime (for example isolation rooms) all windows in the zone should be locked shut or sealed. Trickle vents, if fitted, will also need to be sealed.

Systems design

7.29 The design of the ventilation system for an area depends on the overall configuration of the department. Where the department is served by more than one AHU, the control of the units may need to be interlocked so that reverse air-flow patterns do not occur.

7.30 Dual-duct high velocity systems have advantages, but are noisy, costly and may give rise to unacceptable values of humidity. Single-duct, low velocity/pressure systems are preferred.

7.31 Extract grilles should be sited and balanced to promote air movement in the desired direction.

7.0 (a) Operating department ventilation systems

7.32 The information given in this section relates to general operating suites. It will be applicable to other types of theatre suite such as maternity, burns, cardiac, etc. The standard values given may need to be adjusted to reflect non-standard room sizes, pressure regimes and air change rates.

7.33 A method of obtaining a design solution for non-standard theatres is given in Appendix 4.

7.34 Additional information for Ultra-clean ventilation (UCV) theatres is given in Section 7.0 (b).

General

7.35 The supply of air to an operating room has four main functions:

- to dilute airborne contamination;
- to control air movement within the suite such that the transfer of airborne contaminants from less clean to cleaner areas is minimized;
- to control the temperature and if necessary the humidity of the space;
- to assist the removal of, and dilute, waste anaesthetic gases.

7.36 Because of the complexities of controlling air-movement patterns, much design effort will be required for this aspect. It is important that the design makes the best possible use of the air available, as excessive supply airflows for the control of air movement should not be used. The amount of air supplied to the operating room will be determined by the number of doors and desired air-change rate.

7.37 The detailed considerations upon which the supply air-flow rate is based are as follows.

Dilution of airborne bacterial contaminants

7.38 There are four routes that airborne contaminants may appear in an operating room:

- through the supply air;
- shed by operating staff;
- produced by the surgical activities;
- transferred from adjacent spaces.

7.39 Supply flow rates for the main rooms of the operating suite are given in Appendix 3. For the other areas where room sizes and activities vary from site to site, air-change rates are given in Table A1. These figures have been found to give sufficient dilution of airborne bacterial contaminants, provided the mixing of room air is reasonably uniform.

7.40 A downward-displacement air distribution is preferred; it may be either turbulent or laminar flow. For turbulent flow the supply-air diffusers should be positioned either in the centre of each quadrant of the ceiling or along a line between the centres of each quadrant. This should ensure that all parts of the room are actively ventilated and that there will be adequate air movement at the operating table. Laminar flow would be provided by a perforated plenum terminal centred above the operating table. (See Section 5 for additional guidance on supply terminals).

7.41 Suspended articulated equipment is usually fitted in theatres. These require significant structural steelwork in the ceiling void to cater for the loads imposed by the resulting bending moments. It is important to ensure that the void is

deep enough to accommodate both the steelwork and the ventilation ducts. The location of the steelwork must not prevent a suitable layout of the ventilation ductwork and correct positioning of the supply air terminals. It needs to be recognised that the correct ventilation of an operating theatre plays a significant part in controlling healthcare acquired infections and is not subordinate to the desire to make equipment easy to move.

7.42 Horizontal flow distribution with or without a Coanda effect can be difficult to set up correctly and are unlikely to be as effective in Theatre applications. It should not be used in new installations. However space constraints may force its retention or replacement when refurbishing existing installations. Where fitted, the supply grilles will require a means of directional adjustment.

7.43 For general operating theatres, the air supply would be filtered in the AHU. Terminal HEPA filters are not generally required.

Control of air movement within the suite

7.44 The design of the system should seek to minimise the movement of contaminated air from less clean to cleaner areas. Transfer grilles enable air to pass in either direction between rooms of equal class and pressure. In older designs suitably dimensioned door undercuts were often used in lieu of transfer grilles. Pressure stabilisers operate in one direction only; they allow excess air to be directed to the area desired and assist in maintaining room-pressure differentials.

7.45 The relative locations of supply and extract terminals and their design air-volume rates will determine the basic air-flow between adjacent spaces. Transfer grilles and pressure stabilisers will permit and control the flow of air between spaces ensuring a flow from the clean to less-clean areas of the suite. Failure to provide such devices will lead to uncontrolled airflows when personnel move between rooms and doors being held partially open by air pressure.

Temperature and humidity control

7.46 Supply flow rates to achieve the required room conditions, are calculated conventionally, taking account of all heat and moisture gains and losses, and of maximum permissible temperature differences between the room and supply air. In most applications the room being considered will be within the heated building envelope.

7.47 Temperature differences of up to 10K for winter heating and 7K for summer cooling must not be exceeded.

7.48 It is acceptable for the humidity to swing uncontrolled between 35% and 60% saturation.

Removal and dilution of waste anaesthetic gases

7.49 Anaesthetic gases are subject to occupational exposure limits. The air-movement scheme should ensure that staff are in a clean air-flow path. (See Paragraph 7.21).

7.50 Air extracted from operating suites should not be re-circulated, as it may contain malodorous contaminants. However an energy recovery system should be fitted in the extract in order to reduce the plant energy consumption. (See Paragraphs 4.142 - 4.147).

Fire aspects

7.51 When considering the overall air-flow movement, careful thought needs to be given to the operation of the ventilation system, to limit smoke spread in the event of a fire. However, this is a highly staffed department with a low fire risk/load status and these factors need to be recognised when developing the fire strategy. It is considered satisfactory to treat the complete operating department as a single fire compartment providing there are at least two exits from it. Over-compartmentalisation can lead to difficulties in establishing clean air-flow paths and room-air dilution rates. This will lead to an increased risk of healthcare-associated infections. Staff areas within the department should be treated as a sub-compartment. (See Paragraph 6.18).

Door protection

7.52 Air should flow from the cleaner to the less clean areas as shown in Table A2. The factors that affect the likelihood of a reverse airflow through doorways are discussed in Paragraphs 7.24 - 7.26.

7.53 It is not possible to design an air-movement scheme, within the restraints of the amount of air available that will protect the operating room when two doors are simultaneously opened. The design process that has been used considers that each door is opened in turn and ensures that the direction and rate of air-flow through any open doorway is sufficient to prevent any serious back-flow of air to a cleaner area.

7.54 Provided that the air-change rates in Table A1 are met, dilution will be sufficient to ensure that the occasional small back-flows created (when two doors are opened simultaneously; or when there is a high temperature difference across an open door) will have little effect on the overall air cleanliness of the affected room.

7.55 The following general points should be taken into consideration during the design of operating suites:

- Number of exits – the fewer the number of rooms (and therefore doorways) leading from the operating room the better, as traffic is reduced and less complicated air-movement control schemes are required.
- Scrub and hand-wash facilities – these may be a part of the operating room, often in a bay. The bay would count as part of the operating room volume

and should have a low-level active or passive extract to remove the moisture-laden air. Should a separate room be required for the scrub area, a door between the scrub-up room and the operating room is an inconvenience to scrubbed staff, and could be replaced by an opening. This opening should be larger than a normal single doorway, but the scrub would not, in these circumstances, be considered part of the operating room volume.

- If an alcohol scrub regime is employed, individual theatre scrubs may not be required and would be replaced by a common departmental pre-/post-operation scrub position in the corridor. This would require local extract to prevent a build-up of moisture.
- Preparation 'Sterile Pack Store' (SPS) – if it is intended to 'lay-up' instruments in the operating room, the preparation room is then used simply as a sterile pack store. The nominal room pressure can therefore be the same as that of the operating room and the airflow between the two rooms in either direction. Air supplied to the preparation room may be directed into the operating room either through a door mounted transfer grille or if no door is fitted, through the opening. Alternatively, stock ready-use sterile items can be located in a bay within the theatre. In this case, a portion of the total theatre supply air should be provided in the bay to ensure it is actively ventilated.
- Preparation room 'lay-up' – when the preparation room is used as an instrument 'lay-up' room, it should be regarded as being of greater cleanliness than the operating room, and the design should minimise the transfer of air from the operating room to the preparation room. Air supplied to the room may be directed to the operating room through a pressure stabiliser taking care not to compromise the airflow pattern in the operating room. The air may also be directed into a corridor;
- Service corridor – if materials to be disposed of are placed in impervious material for transportation, it is not necessary to have a separate corridor for this purpose. However, a service corridor has many operational advantages it terms of the flow of materials through the theatre suite. It also permits routine service and maintenance access without compromising the use of adjacent theatre suites.

Standard air-movement control schemes

7.56 In the previous versions of this guidance standard air movement control schemes were given that provided a range of design solutions to typical operating suite layouts. These were satisfactory design solutions for 'standard' sized rooms within the suite but were never intended to be universal for any sized room or suite. Guidance on operating suites contained in HBN 26 (2004) has increased the recommended size of operating room from approximately 35m^2 to 55m^2. Associated room sizes and air change rates have also increased. This means that the original standard solutions are no longer appropriate for new-build installations.

7.57 Because of the resulting increase in the volume of air supplied to the theatre, provision needs to be made either to actively remove it or allow it to escape

passively through pressure stabilisers. The increase in room size has also made the number and position of air-supply terminals critical to the effective ventilation of the room.

7.58 Four new standard solutions have been developed to reflect the current guidance on theatre suite layout and room sizes given in HBN 26 (2004) as well as the general increase in air-change rates.

7.59 The most commonly used original standard solutions have been revised and updated. They have been retained in this guidance, as they will remain applicable to older theatre suites that are being refurbished to their original performance standards. They will also be applicable in existing departments where space constrains do not permit the upgrading of suites to the latest standard of performance or where a pre-built "shell" is being fitted out.

7.60 It is important to recognise that in any situation where a "non-standard" room size or theatre suite layout is being considered, the designer must return to first principles when developing a solution. Examples of non-standard configurations would be:

- cardiac theatres that typically have an operating room half as big again as normal, a perfusion laboratory and no anaesthetic room;
- operating departments served by a central instrument lay-up preparation area rather than individual prep rooms;
- balanced-flow theatres for infectious cases.

Appendix 4 contains a methodology for assisting the designer to arrive at a suitable solution.

7.61 The new and revised standard design solutions are as follows:

No 1 – Typical Conventional theatre – room sizes as HBN 26;

No 2 – Typical UCV theatre – room sizes as HBN 26;

No 3 – HBN 26 illustrated Conventional theatre;

No 4 – HBN 26 illustrated theatre with UCV terminal fitted;

No 5 – Pre-2006 Conventional theatre, single corridor (former SHTM 2025; 1b);

No 6 – Pre-2006 UCV theatre, single corridor (former SHTM 2025; 1a);

No 7 – Pre-2006 Conventional theatre, two corridor (former SHTM 2025; 5b);

No 8 – Pre-2006 UCV theatre, two corridor (former SHTM 2025; 5a).

7.62 Details of these standard solutions are given in Appendix 3. They contain diagrams that show the relationship of rooms and the various doors and transfer devices between them, **but should not be regarded as architectural layouts.**

The schemes have been developed using the calculation procedure described in Appendix 4. Important features of the solutions are:

- Zone trimmer heaters – a trimmer heater battery is advocated when calculations indicate that the temperature differential between rooms may be greater than 2K. Generally this will only be the case in the preparation room when designated as a lay-up.
- The preparation room (sterile pack store)/operating room interface – these rooms are deemed to be of equal cleanliness, and thus a transfer grille is required between these rooms or the door can be replaced with an opening wider than a standard door.
- Preparation (lay-up)/disposal room interface – pressure relief dampers are recommended here to provide an air path when doors are closed, while preventing back-flow when a door is opened elsewhere.
- Operating room/anaesthetic room interface – pressure stabilisers, or in some cases, carefully sized transfer grilles are recommended here, and between the anaesthetic room and corridor, and between the operating room and corridor.
- Operating room/scrub room interface – an opening is provided between these rooms. The flow of air through the opening provides protection, and gives bacterial dilution within the scrub room; the air is then exhausted to the corridor via a pressure stabiliser.

7.63 No mechanical supply or extract ventilation is provided in the scrub room, and thus when a door is opened elsewhere in the suite, the stabiliser will close, allowing the air to be re-directed to help protect the doorway. If the scrub is a bay within the theatre then a suitably positioned pressure stabiliser and / or active extract should be provided to ensure air movement and prevent a local build-up of moisture.

7.64 Any other scheme may be used and the standard solutions applied, if the following conditions are met:

- room relationships in air network terms are as shown in the plans;
- door-gap measurements approximate to those given in Scottish Health Technical Memorandum 58: ‘Internal doorsets’, (but see also Table A3 and Note 3);
- casual heat gains are accounted for;
- a trimmer battery is installed in the air supply system to the preparation room;
- leakage through the structure is kept to a minimum.

Note 3: It should be noted that many doors are now fitted with cold smoke seals as standard. These will significantly reduce the door leakage rate when new and undamaged. It is therefore recommended that provision for the design door leakage is factored into the sizing of the appropriate transfer grille or pressure stabiliser. Failure to do this will result in air gap whistles and doors being held partially open by air pressure.

7.65 It is recommended that every effort should be made to adopt one of the schemes described above.

Air terminals and air distribution within rooms

7.66 The selection and sighting of air diffusers will be critical in establishing an efficient pattern of mixing. To this end the diffusers selected must be fit for purpose. Ceiling mounted circular 'air master' style, square 'four-way blow' or similar diffuser designs that provide a downward displacement, turbulent airflow are the preferred option. (See Paragraph 5.68).

7.67 Plenum-type 'laminar'-flow-style diffusers with a footprint that encompasses the operating site are acceptable but may be prone to buoyancy effects as a result of temperature difference. Manufacturers' type-test data should be consulted to ensure that the terminal will achieve the required performance envelope. Note that these are not true laminar-flow systems in the strict sense of the word but produce a downward-displacement parallel-flow style of air distribution.

7.68 The diffuser equipment chosen should not cause 'dumping' and it should provide a velocity 1 metre above floor level at the operating position of between 0.2 m/s and 0.3 m/s.

7.69 In the operating room, the supply air terminals must be at high level, and should all be adjustable for rate of flow as well as being easily cleaned and silent in operation.

7.70 In order to ensure that all parts of the operating room are actively ventilated, there should be an air-out path on each face or in each corner of the theatre. This may be provided by a pressure stabiliser, transfer grille, active or passive extract terminal. A minimum of three, but preferably four, air-out paths - approximately equally spaced - should be provided.

Automatic control

7.71 The automatic control of ventilation in operating suites needs to be simple and robust. Over-reliance on complex room pressure and flow relationships linked to automatic fan speed control is unnecessary and in the long term have been shown to be unreliable. Complex software algorithms that can only be accessed and interpreted by off-site specialists should not be used. Whichever control strategy is chosen it is important that on-site staff have the facility to override the control system and keep the ventilation operating at least until the surgical procedure is complete. (See also Paragraph 6.11)

7.72 Theatre air-conditioning control sensors should be actively ventilated. They would typically be located in a sampling extract duct mounted in the surgeon's

panel, positioned at normal working height (1.8m above finished floor level) and be accessible for cleaning and the removal of fluff and lint.

7.73 Wall-mounted passive-temperature and humidity sensors are not recommended.

7.74 Controls should be provided to enable operating department ventilation plants to be closed down when the operating suites are unoccupied. (See also Paragraphs 6.24 - 6.26)

7.75 When in the 'off' mode, the control system should ensure that the ventilation plant is automatically reinstated if the space temperature falls below 15°C.

7.76 The theatre control panel should include plant status indication; clearly-readable temperature and humidity indicating gauges; and means of adjusting the set point for temperature. Theatre ventilation plant status indication should be located at the staff control base.

7.77 Where it is considered necessary to fit a humidifier, it should be selected to humidify to 40% saturation at 20°C during the design winter outside conditions. The cooling coil should be able to remove sufficient moisture so that 60% saturation at 20°C is not exceeded during the design summer outside conditions.

7.78 Each operating suite should be served by an independent supply and extract plant.

Ventilation of operating department ancillary areas

General

7.79 There are advantages in providing mechanical ventilation to all areas of the department. Maintaining operating suite airflow patterns is simpler and grilles and diffusers can be sited to eliminate condensation on windows. Where radiators or embedded wall or ceiling panels are installed they should be confined to the corridors and staff-only areas of the department.

Ventilation requirements

7.80 Table A2 gives guidance on the operating department areas in descending order of cleanliness, and this should be considered in the overall design of the department ventilation systems. The specified flow rates of air through doors given in Table A4 for the operating suite are not necessary for other areas of the department. However, the air-flow directions must be maintained from the clean to the less clean areas.

7.81 All windows in the department should be double-glazed and hermetically-sealed in order to ensure that the desired airflow pattern is maintained under all external environmental conditions and to avoid infestation. Trickle vents if fitted will need to be sealed.

Systems design

7.82 The design of the ventilation system for the ancillary rooms depends on the overall configuration of the department. The plant for the ancillary rooms may need to be interlocked to the theatre suite plants so that reverse air-flow patterns do not occur.

7.83 Extract grilles should be sited and balanced to promote air movement along the clean and access corridors towards the reception/transfer areas. This should not affect the air distribution in the operating suite(s).

Reception

7.84 The aim in these areas is to provide comfortable conditions having regard to the movement control requirements of the department as a whole. The number of air changes will depend on the particular design.

Sterile pack bulk store

7.85 The store needs to be maintained at a positive pressure in order to preserve the cleanliness of the outside of the packs; 6 air changes are recommended.

Recovery

7.86 The air-change rate in the recovery room will be rather higher than that needed merely to provide clean, comfortable conditions, as it is necessary to control the level of anaesthetic gas pollution; 15 air changes are recommended, with a balanced air flow.

7.87 The supply air terminals should be ceiling mounted above the foot-end of the recovery bed positions. Extract should be at low (bed height or below) level behind the bed head positions or in the corners. This will establish a clean airflow path so that staff do not inhale anaesthetic gases exhaled by recovering patients.

7.0 (b) Ultra-clean ventilation systems

General requirements

7.88 The design philosophy of a conventionally ventilated operating suite is based on the need to dilute contaminants and control both the condition and movement of air in an operating suite. Ultra-clean ventilation (UCV) is a means of significantly increasing the dilution effect by providing a large volume of clean filtered air to the zone in which an operation is performed and sterile items are exposed. Air is discharged above the operating zone and while not truly laminar, its downward displacement purges the clean zone of contaminants and particles generated by the activities within it. The airflow in and around the clean zone also serves to prevent particles originating outside the zone from entering it. The resulting reduction in contaminants has been shown to reduce significantly post-operative sepsis following certain orthopaedic procedures.

7.89 The number of bacteria that are present in the air at the wound site and exposed surgical items is dependent on the operating team, their procedural discipline, choice of clothing and the type of UCV system. Ultra-Clean air is defined as that containing not more than 10 CFU/m^3.

7.90 UCV systems are very successful in reducing contaminants at the wound site so it is often considered that there is no need for complex air movement control schemes in the rest of the suite. However, when designing the ventilation scheme, it should be noted that the users may switch the UCV terminal to "set-back" when non-orthopaedic surgery is taking place. This is because the high airflow rates can cause increased moisture evaporation of exposed tissue that may be detrimental to the surgical outcome. In recognition of this, the ventilation scheme should be capable of providing operating conditions to at least a "conventional" theatre standard throughout the suite with the UCV in set-back mode. It should also be remembered that suitable levels of ventilation will always be required in the peripheral rooms.

7.91 UCV systems can be designed and built from first principles or a range of bespoke modular units of varying shapes and sizes are available with each manufacturer having a slightly different approach to UCV design. Some systems are fitted with partial or full walls to delineate the clean zone and direct a laminar or exponential downflow of air within it. Other designs utilise slotted linear supply terminals to produce an air curtain around the clean zone together with laminar-flow diffusers to provide a downward-displacement supply within it. **Notwithstanding any variation in the design philosophy, all UCV systems will be required to achieve completely the performance standard set out in the "Validation" section of this document**. (Section 8)

7.92 As with conventional theatres, each UCV operating suite should have its own dedicated air handling unit (AHU) to the standard set out in Section 4 of this document. To ensure operational flexibility and permit routine maintenance, air handling units should not be shared between suites.

7.93 In retrofit installations, site conditions may preclude individual AHUs for each suite. In these circumstances an AHU may be shared between not more than two operating suites providing each suite has its own control of temperature. An accessible airflow measurement test point should be provided in the supply branch duct to each theatre so that the primary air volume to each UCV canopy can be determined. In addition the branch supply and extract should be capable of being physically isolated and the main air-flow rate reduced so that either suite can be taken out of use without detriment to operating conditions in the other.

7.94 An inherent feature of a UCV system is its large airflow so it is essential to re-circulate the air supplied to the operating theatre and/or to recover its energy in order to optimise operating costs.

7.95 The primary fresh-air volume supplied to a UCV suite will be the same as in a conventional suite and it should be dispersed to the rooms in the suite in the same manner. This is an important aspect of the design and requests by UCV suppliers for increased primary air-supply volumes should be resisted.

7.96 Laying-up in the clean zone is preferable for infection control reasons. Where a Sterile Pack Store (SPS) Preparation room is provided a transfer grille will be required in the preparation room / theatre door.

7.97 If the Preparation room is intended to be used for laying-up instruments, a pressure stabiliser will be required between the prep room and theatre. It should be fitted with a stand-off baffle to prevent air transfer interfering with the ultra-clean airflow distribution.

7.98 Separate scrub-up or disposal facilities are not necessary for air cleanliness although operational policy may prefer such a provision. A separate anaesthetic room should, however, be provided.

7.99 There is no aerobiological reason why two or more UCV systems should not be installed in a common area as long as adequate spacing is provided. These are known as “barn theatres” and require special design considerations and operational discipline. The relative positions of the UCV units, temperature control range and location of doors and openings to other areas will all significantly affect the airflow at the operating positions.

Types of UCV system

Remote plant systems

7.100 In a remote plant system, all the air-conditioning equipment is located outside of the operating room, except for the unidirectional air-flow terminal, terminal filter, air diffuser and the return-air grilles (see Figure 6).

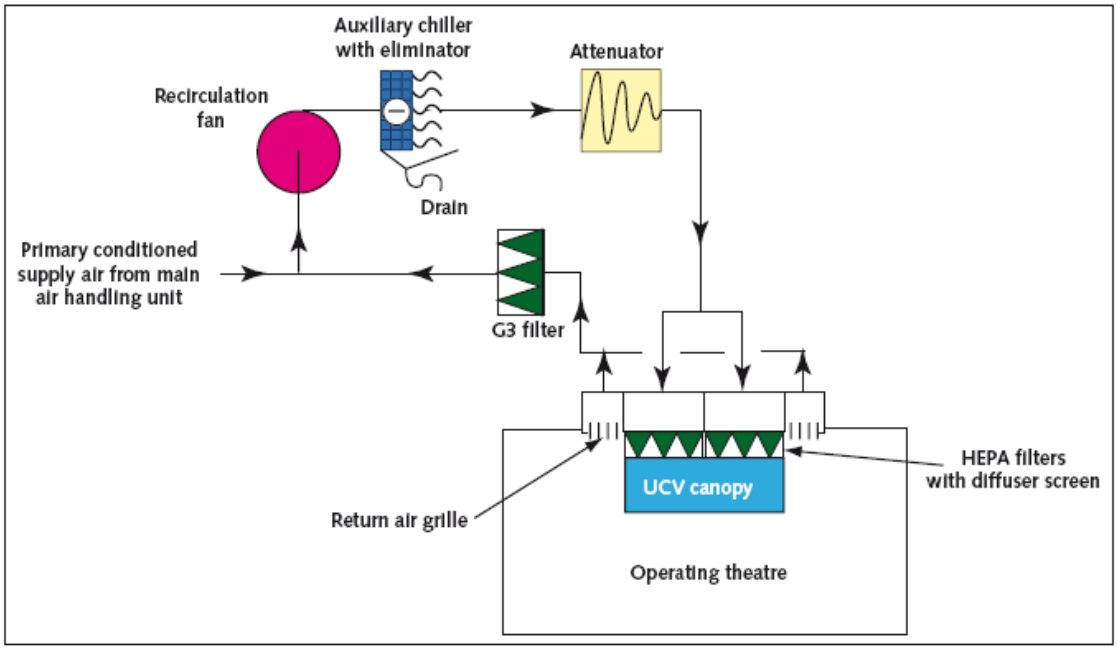


Figure 6: UCV theatre with remote air recirculation

7.101 This arrangement is the preferred option for new installations as it has the following advantages:

- the recirculation fans are out of the theatre thus reducing noise. Multiple recirculation fans can be replaced by a single fan unit with its drive out of the air stream;
- casual heat gains from recirculation fan(s), canopy lights, equipment and people within the theatre can be removed by a chiller battery in the return air stream. This will prevent heat build-up in the theatre;
- the return-air filters can be changed without needing access to the theatre making routine maintenance more feasible;
- the opportunity exists to locate the HEPA filter in the primary supply duct rather than the theatre terminal. This will reduce the number of filters required and allow them to be changed without entering the theatre.

Modular systems

7.102 Modular systems are frequently used in retrofit applications. Vertical or horizontal units are available.

7.103 Vertical-flow modular units comprise a ceiling-mounted air-terminal module containing return-air filters, return-air fans, final filter and air diffuser. Primary air is supplied by a remote air-conditioning unit at the volume and to the standard required for a conventional operating suite. (see Figure 7)

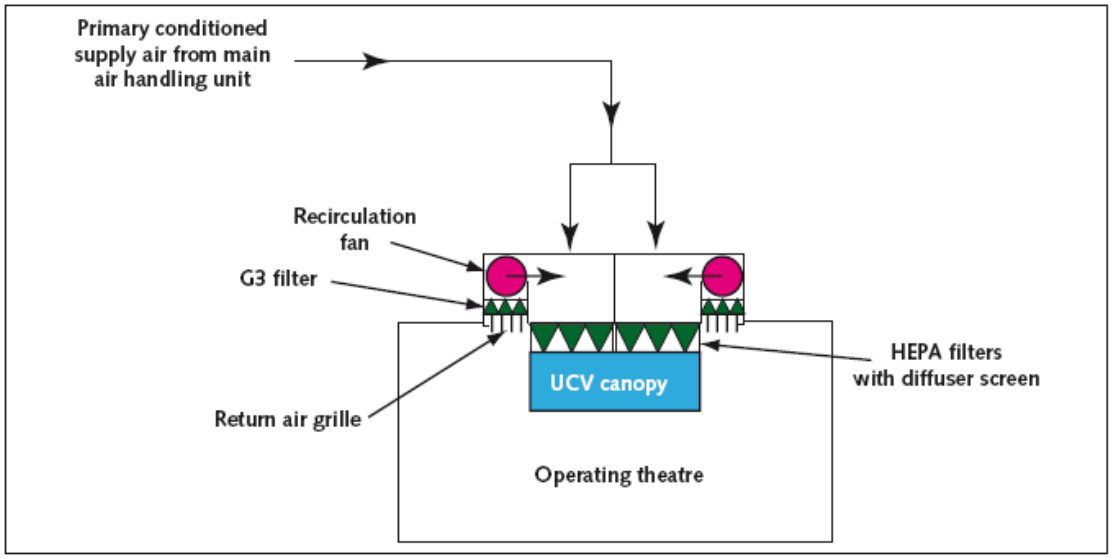


Figure 7: UCV theatre with modular system

7.104 Horizontal or cross-flow modular units comprise a wall-mounted air-terminal module standing vertically to produce a horizontal flow of air and containing final filter/diffuser, return-air filters and fans. The module may incorporate a cooling unit or be supplied with 'fresh air' from a separate primary cooling system.

Vertical flow UCV systems

7.105 Vertical-flow systems have a superior performance and are more effective at reducing infection risks. Air-curtain or partial-wall systems are acceptable, but are known to be more susceptible to problems arising from performance

deterioration, poor operating-team discipline and high occupancy rates than is the case with full-wall systems. A full-wall is considered to be any wall terminating not more than one metre above the finished floor level.

7.106 Because of the large volume of air being moved in a relatively small space, the siting of the return-air grilles can cause short-circuiting of the air discharged through the UCV terminal. If the return-air grilles are positioned at high level, partial walls should be provided to control short-circuiting. The partial-walls shall be not less than 1m from the operating room walls and terminate at least 2m above floor level. The clearance should be increased proportionally for larger terminals (that is, 1.15m for 3.2m x 3.2m units and 1.25m for 3.5m x 3.5m units). In all cases, the sidewalls should terminate at 2m above floor level.

7.107 Siting the return-air grilles around the periphery of the theatre at low level will eliminate short-circuiting, remove the need for partial walls and give an improved airflow path. In any event there should be an air-out path on each face or in each corner of the theatre. These may be provided by combination of pressure stabilisers and passive or active low level extract grilles. Failure to provide air-out paths on all faces of the theatre may result in the surplus air causing entrainment into the clean zone.

7.108 Vertical systems should have a clean zone large enough to encompass the operating site and all of the instrument trays likely to be needed for the surgical procedures to be undertaken. Ophthalmic and minor hand surgery would typically require a 1·4m circular or rectangular terminal. For major orthopaedic procedures a minimum size of 2·8m x 2·8m will be required. This is the area projected on the floor under the supply air terminal within the partial walls, full walls or air curtain. Any air outside this zone cannot be guaranteed to be ultra-clean although given the dilution factor the level of microbiological contamination will be much lower than the general level in a conventional operating room. The use of lines or a coloured area on the floor delineating the extent of the clean zone will assist staff and is therefore essential.

7.109 When upgrading an existing conventional theatre to an ultra-clean standard the only solution may be the installation of a modular system. In these units, the heat gains from the return-air fans and terminal lights may warrant the inclusion of supplementary cooling within the module although modern luminaries contribute substantially less unwanted heat. However issues of cooling coil drainage, condensate removal and maintenance access within the space constraints of the module may make this option impracticable. The additional cooling load should then be catered for by conditioning the primary air to compensate.

7.110 If an existing AHU is to be retained, it may require modification to ensure that it achieves the minimum standards set out in Section 4 of this document. The fan may need re-rating to accommodate the change in system resistance. The cooling coil may also need to be upgraded to cater for the increased load resulting from the return air fans and terminal lights. Failure to make adequate provision for this may make the theatre unusable during prolonged warm spells.

7.111 A factor affecting the air-flow pattern is the supply or room air temperature difference. When the supply-air temperature is significantly above room temperature, buoyancy effects will reduce the volume of air reaching the operating zone. If it is anticipated at design stage that this will be a regular occurrence, then a system incorporating full-walls should be used. Demountable extensions that convert a partial-wall to a full-wall unit are available.

7.112 Convection up-currents from the surgical team and operating lamp tend to counter the movement of clean air towards the operating site, hence the air velocity reaching the operating level is critical. The minimum velocity given below has been selected to take account of these factors and is greater than the theoretical minimum value.

7.113 For all vertical UCV systems the design discharge velocities will be as follows:

Air velocity 2 metres above floor level:

- partial-wall system = 0.38 m/s average;
- full-wall system = 0.30 m/s average.

Air velocity 1 metre above floor level:

- all systems = 0·2 m/s minimum within the operating zone.

The validation Paragraphs 8.75 – 8.86, gives details of the method of measurement.

7.114 Variable-speed recirculation fans with differential pressure control may be the most suitable solution for maintaining consistent performance and energy saving.

Horizontal UCV systems

7.115 Horizontal UCV air-flow systems have been shown to be less effective than vertical systems and are not the preferred solution. There may be occasions, however, where architectural, engineering, economic or workload considerations prevent the installation of a vertical-flow system and only a horizontal-flow system can be installed.

7.116 Horizontal- or cross-flow modular units comprise a wall-mounted air terminal standing vertically to produce a horizontal flow of air across the operating field. The terminal module contains the final filters, air diffuser, return-air grilles, filters and fans. The module may incorporate a full air-conditioning unit or be supplied with 'fresh-air' from a separate primary air-conditioning system. In the latter case the return-air fan power may warrant the inclusion of a supplementary cooling coil within the module.

7.117 The system should have sidewall panels at least 2·4m apart. The panels may fold to facilitate cleaning of the theatre. The minimum height of the terminal should be 2·1m and a deflector at the top of the filter/diffuser will be acceptable

as an alternative to a full roof. These dimensions reflect currently available equipment and may impose operational constraints in addition to a lower level of performance common to these systems.

7.118 In the horizontal flow systems, personnel working between the filter and surgical wound will disperse bacteria that are more likely to contaminate exposed surgical instruments and enter the wound. This may be minimised by the use of improved clothing and operating procedure to reduce dispersion of bacteria. The use of lines on the floor delineating the extent of the clean zone and hatching or colour coding the 'no-entry' zone between the air diffuser and patient will serve to prompt staff and are therefore essential.

7.119 The air discharge velocity as measured 1m from the diffuser face should have a mean value of 0·4 m/s. The validation Section 8 gives details of the method of measurement.

Filters

7.120 The main plant primary and secondary filters should be to the standards and in the location set out in Section 4.

7.121 Terminal filters should be provided within the airflow terminal or in the air supply to it. High efficiency particulate air (HEPA) filters grade H10 as specified in BS EN 1822 will be required as a minimum. There is no aerobiological benefit in fitting filters of a higher grade than this, although for practical reasons most UCV manufacturer recommend the fitting of H12-grade filters.

7.122 In some modular UCV units, the terminal filter is used as a pressure equaliser to balance airflow and filters of a higher grade with a greater pressure drop may be recommended by their manufacturer. The increased resistance may affect the velocity of air reaching the operating level and there will be penalties in terms of installed fan power and higher noise levels.

7.123 The final filters should be installed in a leak-proof housing in a manner that allows the terminal unit, filters and their seals to be validated. A challenge test will be carried out during commissioning to prove the effectiveness of the complete installation.

7.124 Where UCV units are constructed in sections, a means of measuring the pressure drop across the terminal filters in each section should be provided. The pressure test-points should be located outside of the partial wall, capped to prevent air leakage and accessible within the theatre without the need to open the unit inspection panels. Alternatively direct-reading pressure gauges should be fitted.

7.125 The UCV system will require a return-air filter to capture the relatively coarse particles that would otherwise significantly reduce the life of the final filter. This should be at least a G3 grade to BS EN 779. In remote recirculation systems there may be advantages in fitting a higher grade return air filter, as it will reduce the load on the terminal HEPA filters and extend their life.

Noise level

7.126 If sound-attenuating material is used to line any portion of the inside of the UCV unit it should be non-particle-shedding and fire-resistant. (Further guidance can be found in SHTM Firecode suite of documents).

7.127 The maximum noise level in an operating room fitted with a UCV terminal of any type shall not exceed 50 NR. The validation section gives details of the method of measurement.

Lighting and operating lights

7.128 CIBSE lighting guide LG2 and BS EN 12464-1 give detailed information of lighting requirements. Operating luminaires should comply with the photometric requirements detailed in relevant sections of BS EN 60601.

7.129 The position of the UCV light fittings and style of partial walls, where fitted, should neither adversely disturb the airflow nor result in significant spatial variations in illuminance levels.

7.130 In vertical units, specialised task lighting should be provided by toroidal, cruciform or small multiple dome-shaped luminaires as they have good aerodynamic properties. The ideal luminaire will have a minimal effect on the airflow regardless of where it is positioned. Large-diameter saucer-shaped luminaires should not be used in vertical-flow systems as they will occlude the airflow in the critical central zone. It is important to consider the suitability of existing luminaires when retrofitting UCV systems.

7.131 In vertical UCV installations a minimum of 2·75m from floor to underside of the diffuser is required to allow for supporting mechanisms and lamp articulation. When upgrading existing systems this dimension may not be achievable. However, when parked, the lowest point of the central light stem, luminaire and articulation arms should never be less than 2m above floor level.

7.132 The traditional means of light support is a central column that passes through the UCV terminal and is rigidly fixed to the building structure. The position of the support therefore prevents air being supplied at the centre of the terminal. Separate supports displaced from the centre of the clean zone would lead to improved airflow. This approach was advocated in the 1994 version of HTM 2025 but at the time of writing no UK manufacturer has chosen to adopt this solution.

7.133 In horizontal units the size or shape of the specialised task luminaire has little effect on the air-flow pattern.

Controls and instrumentation

7.134 The functions of the supply AHU and extract ventilation should be continuously monitored by a BEMS control unit. The controls and instrumentation for the main plant are set out in Section 6.

7.135 UCV systems will additionally require:

- a set-back facility that can reduce the air supplied through the UCV terminal to a volume that equates to not less than 25 air changes per hour of the operating room gross volume whilst still leaving the supply AHU operating at full speed;
- a facility to turn the entire system, supply AHU and UCV terminal, off. (an emergency stop is not required);
- a read-out sufficiently large to be clearly visible from the operating table that shows the temperature of the air being supplied by the UCV terminal;
- a read-out sufficiently large to be clearly visible from the operating table that shows the relative humidity of the air being supplied by the UCV terminal;
- a red indicator light that will illuminate when either the supply AHU or the UCV terminal fails, either or both are switched off or are at set-back;
- an amber indicator light that will illuminate when the UCV terminal is at set-back and the supply AHU is running;
- a green indicator light that will illuminate when both the supply AHU and UCV terminal are operating at full speed;
- a blue indicator light that will illuminate when the UCV terminal air flow, as detected by a differential pressure sensor, falls below 80% of the design flow rate.

AHU	UVC terminal	Indicator light	Comment
Off or Fault	Off or Fault	Red	Ventilation not operating at a suitable level to commence surgical procedures
Off or Fault	On (set-back)		
Off or Fault	On (full speed)		
On (set-back)	Off or Fault		
On (full speed)	Off or Fault		
On (set-back)	On (set-back)		
On (full speed)	On (set-back)	Amber	Ventilation provided to at least conventional theatre standard
On (full speed)	On (full speed)	Green	Full UCV standard conditions
-	-	Blue	HEPA-filter resistance causing low air flow

Table 7: Indicator light logic table

7.136 The switching devices and indicators should be incorporated in the surgeon's panel and their functions clearly labelled. In retrofit installations an auxiliary panel for the UCV may be the most practical option. If fitted it should be mounted adjacent to the surgeon's panel and their control functions interlocked as necessary.

7.137 When a system is designed to have partial walls with full-wall extensions, a volume control facility may be incorporated to allow the system to be run with reduced velocity when the demountable full-walls are in place. It would be the responsibility of the user to ensure correct operation of the system. To assist the user an explanatory notice should be included on the theatre control panel.

7.138 A direct-reading gauge should be fitted in the theatre to show a representative pressure drop across the final filters. If the UCV control box is located out of the theatre and has a means of manually adjusting the return air-fan speed then it should also be fitted with a direct-reading differential pressure gauge. The means of adjusting the return-air fan speed should be lockable to prevent casual adjustment. The direct-reading gauges should be fitted with a means of indicating the correct operating pressure range.

7.139 The UCV-unit manufacturer's control box should be located in an accessible position preferably in the operating department adjacent to the operating theatre that it serves. A service corridor, if provided, is an ideal location. The control box should be clearly labelled with the identity of the operating theatre that it serves.

7.0 (c) Extract systems

7.140 Extracts may be provided for a variety of reasons including:

- simple odour control (for example in a WC or mortuary);
- to receive and remove moisture-laden air (for example, in a kitchen);
- as part of a combined supply/extract balanced system (for example, in an operating suite);
- to capture a hazardous substance at source (for example a safety cabinet).

7.141 Devices that use an inflow of air to control exposure of staff to hazardous substances are classified as Local Exhaust Ventilation (LEV) systems under the COSHH Regulations.

7.142 An LEV system may comprise a self-contained unit incorporating its own carbon filter such as a simple bench-top fume cupboard. Alternatively it may be a complete "ventilation system" comprising a make-up air supply, multiple-exhaust-protected work stations, branch and central extract ductwork, duplex extract fans and a high-level discharge terminal. It may also incorporate a special filtration system appropriate to the hazardous substance being controlled. Such systems could be required for workshops containing woodworking machinery or large centralised pathology laboratories housing multiple safety cabinets, dissection benches, fume cupboards and specimen stores.

7.143 It is important to recognise at the design stage whether an extract is being provided for comfort or as an LEV system. Typical systems in healthcare include:

- microbiological safety cabinets and Category 3 containment rooms;
- fume cupboards;
- welding-fume extracts;
- woodworking machinery duct collectors;
- battery-charging bay extracts;

- powered plaster and bone saws;
- pharmaceutical preparation cabinets and tablet machines;
- dissection benches, cut-up tables and some specimen stores;
- medium- and high-risk infectious disease isolation facilities;
- decontamination facilities;
- dental furnaces, grinders and polishers.

7.144 General design information and guidance for LEV systems is produced by the Health and Safety Executive (HSE) as HS(G)37. Information on the design and installation of microbiological safety cabinets is given in BS5726 and that for fume cupboards is given in BS EN 14175. Their recommendations should be closely followed.

7.145 LEV systems are statutory items that will be subject to an independent inspection every 14 months.

Hood extract systems

Special requirements

7.146 Extract canopies will be required over steam-and-heat-emitting appliances, for example sterilisers, catering and washing equipment; and for the extraction of toxic fumes over benches used for mixing, sifting and blending procedures.

7.147 Perimeter-drain gulleys and corrosion-proof grease eliminators should be provided on kitchen hoods.

Typical arrangements

7.148 The air-flow rate must be sufficient to ensure an adequate capture velocity in the vicinity of the process; typical values are as follows:

- evaporation of steam and like vapours 0.25 m/s to 0.5 m/s;
- chemical and solvent releases 1.0 m/s;
- vapour of gases 5 m/s to 6 m/s;
- light dusts 7 m/s to 10.0 m/s.

Excessive velocities will be wasteful of power and generate noise.

7.149 The lowest edge of the canopy should be 2m above finished floor level, with a minimum of 300mm overhang beyond the edge of the equipment on all sides.

7.150 A compact arrangement of equipment (but with access for maintenance) will minimise the canopy area, and hence reduce the air volume necessary to achieve the optimum capture velocity.

7.151 Hoods required for the control of heat gain and vapours may be connected to the general extract system when it is convenient to do so, but where non-corrosive ductwork materials are necessary, a separate discharge is preferred.

7.152 Lighting and internal divider plates are often required to be built into the perimeter of large canopies. However, built-in shelving systems are not recommended, as they interfere with the air-flow, and constitute a maintenance problem.

Control of hood extracts

7.153 Provided that it does not interfere with the operation of the department when not in use, the ventilation system for the hood extract and any associated supply can be shut down. To this end, local control should be provided.

Bench extract systems

Special requirements

7.154 Bench extract ventilation is required in departments such as pathology and mortuary, where activities involve the release of malodorous or toxic fumes that should not be inhaled. Where hazardous substances are being controlled, the system should be designated an LEV.

Typical arrangements

7.155 Each ventilated position will usually be accommodated in a continuous run of benching, which should not be more than 650mm from front to rear and which should be provided with a continuous upstand at the rear. Each position should have a 1200mm x 150mm linear extract grille mounted on a purpose-designed plenum box (incorporating guide vanes as necessary), with its face flush with the upstand. The bottom of the grille should be as close as practicable to the level of the working surface (usually 75mm above, to allow for cleaning). The minimum velocity across any part of the grille should be 1 m/s. The grille should be readily demountable to allow for cleaning.

Control of bench extract systems

7.156 Provided that it does not interfere with the operation of the department when not in use, the ventilation system for the bench extract and any associated make-up supply can be shut down. However, a run-on timer with a minimum setting of 30 minutes must be provided. To this end, local or automatic-use control should be provided.

7.157 Processes that produce hazardous vapours, fumes, dusts or noxious vapours should be enclosed or semi-enclosed in a suitable cabinet or exhaust protected workstation.

Safety cabinet and fume-cupboard extract systems

7.158 Safety cabinets and fume cupboards are devices that use an inflow of air to control exposure of staff to hazardous substances. The units, their exhaust

systems, filters, fans and discharge terminals are all classified as Local Exhaust Ventilation (LEV) systems under the COSHH Regulations. The make-up air system to a room that contains an LEV system should also be considered as an essential part of the system and be included in the LEV classification. Information on the design and installation of microbiological safety cabinets is given in BS5726 and that for fume cupboards is given in BS EN 14175. Their recommendations should be closely followed.

7.159 The Advisory Committee on Dangerous Pathogens (ACDP) publishes 'The Management, Design and Operation of Microbiological Containment Laboratories' covering the general environment in which they are used and operational considerations.

Special requirements

7.160 The supply-air system should not distort the unidirectional and stable air pattern required for fume cupboards and microbiological safety cabinets. In general, supply-air ceiling diffusers should not discharge directly towards fume cupboards or safety cabinets, unless the terminal velocity is such that the air-flow pattern of the cabinet is unaffected. The design should ensure that high air-change rates, and/or the opening and closing of doors do not have any adverse effect on the performance of safety cabinets or fume cupboards. A damped door-closure mechanism may help.

7.161 In order to safeguard the user, all safety cabinets and fume cupboards must be fitted with a clear indication that they are operating correctly. Direct-reading gauges or falling-ball indicators are preferred (in addition to electronic pressure indicators). The system should be set to alarm audibly if the face velocity falls below the minimum safe operating level.

Arrangements for safety cabinet installations

7.162 The manufacture and installation of microbiological safety cabinets must be in accordance with the relevant national standards and guidance issued by the Advisory Committee on Dangerous Pathogens (ACDP).

7.163 A Class 1 microbiological safety cabinet must be specified for routine work involving Group 3 pathogens. It should be housed in a Category 3 containment room. Specific design information on containment rooms is issued by ACDP in conjunction with the Health and Safety Commission.

7.164 Siting and installation of microbiological safety cabinets are of particular importance because:

- the protection afforded to the operator by the cabinet depends on a specific and stable unidirectional air flow through the open front;
- the protection to the environment by the cabinet depends on the high efficiency particulate air (HEPA) filters. The exhaust air should never be considered as totally free from microbiological hazard.

7.165 Microbiological safety cabinet is HEPA filtered prior to being discharged to outside. The extract ductwork should as far as practicable be kept under negative pressure while inside the building.

7.166 Current standards permit the installation of microbiological safety cabinets with integral fans, provided that the extract ductwork can be kept short (that is, less than 2m); such an installation however, is likely to be noisy and is not recommended for use in new buildings.

7.167 The discharge from the cabinet should be fitted with a back-draft damper. In multiple installations where several cabinets discharge into a common extract and discharge duct, it must be possible to isolate each cabinet from the system when not in use.

7.168 Roof-level discharge, wherever practicable, is preferred since it removes much of the uncertainty over air re-entering the building through ventilation inlets and/or windows. In such an installation, the extract fan should be situated separately from the cabinet and close to the discharge outlet, to maintain the duct within the building under negative pressure. The discharge point on a flat roof should be through a 3m high terminal. This is required to safeguard staff who may need to access the roof periodically for maintenance. This requirement will also be applicable to fume-cupboard discharges.

7.169 Where this is impracticable, discharge into the room via a double HEPA filter has been accepted. The preferred method, however, is to discharge 3m above the roofline in line with the similar standard for fume cupboard designs.

Arrangements for fume cupboard installations

7.170 The manufacture and installation of fume cupboards must be in accordance with the relevant national standards and associated guidance.

7.171 The primary factors that contribute to the effective performance of fume cupboards include:

- an adequate volume of supply air;
- an effective exhaust system to promote the safe dispersal of waste products to atmosphere.

7.172 The air velocities through sash openings must be sufficient to prevent hazardous materials from entering the laboratory while avoiding excess flow rates that interfere with the investigation process. Average face velocities should be between 0.5 and 1.0 m/s, with a minimum at any point within 20% of the average, the upper end of the range being applicable to the containment of materials of high toxicity. The design velocity must be maintained irrespective of whether the sash opening is varied, or whether doors or windows are open or closed. Variable Air Volume (VAV) cupboards are available which offer a reduction in energy use.

7.173 The possibility of a fire or explosion that may not be contained by a fume cupboard must always be considered. A fume cupboard should not, therefore,

be sited in a position where exit to an escape route will necessitate passing directly in front of it.

7.174 Fume-cupboard fans should be installed as near as possible to the termination of the duct, thus maintaining the maximum amount of ductwork at negative pressure.

7.175 Where there are adjacent buildings with opening windows, or where downdraughts occur, it may be necessary to increase the height of discharge ducts in order to achieve adequate dispersal. In complex locations, airflow modelling or wind tunnel tests may be required to determine the optimum height of the stack (see also Paragraph 7.167).

7.176 Fume-cupboards for certain processes must have separate extract systems. However, where appropriate, individual fume-cupboard exhaust systems may discharge via non-returning dampers into a single collection duct rather than having a large number of separate stacks. The collection duct should have a large cross-sectional area to minimise its effect on the individual exhaust systems; be open to atmosphere upstream of the first connection; and be designed to discharge a total air volume at least equal to the combined individual extract systems.

7.177 Individual fume-cupboard extract systems, discharging either directly to atmosphere or into a collection duct, do not require duplex fans. However, a collection duct designed to provide dispersal of effluent from a number of individual extracts, should have duplex fans with automatic changeover.

7.178 Some fumes are particularly corrosive, so the choice of material for the ductwork, and type of extract fan fitted should reflect the nature of the fume being conveyed.

Control of extract systems

7.179 It is desirable to provide local control of safety cabinets in order to maximise the life of the HEPA filter, and to permit the sealing of the cabinet and room for fumigation if spillage occurs.

7.180 To cope with the risk of an accident or spillage outside safety cabinets, a ‘panic button’ should be provided to switch off the supply to that area; and discharge all extracted air to atmosphere.

7.181 In pathology departments, it will be necessary to have one or more microbiological safety cabinets and one or more fume cupboards available for use at all times, including weekends, therefore, local overriding controls for all these items and any associated ventilation plant will be necessary.

7.0(d) Plantroom ventilation

General requirements

7.182 Plant rooms are required to be ventilated in order to maintain acceptable temperatures for satisfactory operation of the plant and controls, and for

maintenance activities. In the case of plant rooms housing combustion equipment, a secondary function of the ventilation is to provide make-up air for the combustion process.

7.183 The air required for these purposes should be introduced into the space through inlets positioned to minimise the discomfort to occupants; they should be unlikely to be blocked, closed deliberately (except in the case of fire shutters if required), or rendered inoperative by prevailing winds.

7.184 Plantroom ventilation air should not be used for any other purposes, such as make-up air for extract; and where the plantroom contains combustion equipment, the appliance pressure must not fall below the outside air pressure.

7.185 Specialised healthcare air handling equipment must not be located in a fire compartment that houses combustion equipment.

7.186 Statutory regulations for plantroom ventilation are contained in the Scottish Building Regulations, and further guidance is given in CIBSE Guides A & B.

Assessment of ventilation levels

7.187 Ventilation requirements must take into account all heat sources within a plantroom, and where there are large glazing areas, solar gains. The ventilation rate should limit the maximum temperature within the plantroom to 32°C.

7.188 As the level of equipment operating during mid-season and summer is often lower than the winter condition, and the cooling effect of the outside air is reduced, it is necessary to calculate the minimum volume for each season of operation, and the inlet and outlet grilles or fan sizes should be chosen to cater for the largest seasonal air volume.

7.189 Replacement air should not be drawn through pipe trenches or fuel service ducts. Where metal ducts penetrate walls and floors, effective sealing should be provided to confine the ventilation to the boiler room and to meet fire protection requirements. Penetration of fire barrier walls by ventilation ducts should be avoided if possible.

7.190 Fire dampers in plant room ventilation ducts should be electrically interlocked with the boiler plant.

7.191 Care must be taken to prevent any noise generated in the boiler room emerging from natural or mechanical ventilation openings to the detriment of the surrounding environment. Particular care is necessary with mechanical flue draughts and fan-diluted flue systems.

7.192 Information on required air volumes in contained in the CIBSE Guide A & B.

7.193 Where combustion plant is installed, the high-level (outlet) openings should be sized to cater for the total ventilating air quantity; and the low-level (supply) openings sized to cater for the total combined ventilating and combustion air quantity.

Choice of ventilation system

7.194 Ventilation air may be introduced and exhausted by either natural or mechanical means or a combination of both. However, natural systems are preferred where possible.

7.195 Generally, small installations at or above ground level should have their combustion and ventilation air provided by natural means, employing both high- and low-level openings.

7.196 Basement, internal and large installations at or above ground level will usually require a combination of natural and mechanical ventilation. If the airflow rate is difficult, both supply and extract may require mechanical means.

7.197 Whether natural or mechanical, the system should be designed to avoid both horizontal and vertical temperature gradients. Both inlet and outlet openings should be placed on opposite or adjacent sites of the building to reduce the effect of wind forces.

7.198 Where mechanical air supply is employed, electrical interlocks with the boiler plant should be provided to prevent damage in the event of failure of the supply fan(s) once the air volume is established.

7.199 The necessary free opening areas for a naturally ventilated plantroom may be calculated using either the method in A4 of the CIBSE Guide A or the table in section B13 of CIBSE Guide B.

7.200 A combined natural and mechanical ventilation system should allow for natural extract at high level, to take advantage of convective forces in the room, with mechanical supply at low level. The high level natural ventilators should be sized to cope with the total quantity of ventilation air, as above.

7.201 To prevent leakage of flue gases and to ensure that the flue draught is not impeded at any time, the air pressure in the boiler room must not exceed the prevailing outside pressure. Therefore, the fan duty should exceed the calculated total combined combustion and ventilation air quantity by at least 25%. Fan-powered inlets should be arranged to flow outside air into the space at a point where cross-ventilation will ensure pick-up of heat without causing discomfort to occupiers.

7.202 Where it is impractical to provide sufficient natural ventilation to remove the heat emitted by the plant, both mechanical supply and extract will be required.

7.203 The high-level extract should be sized to cater for the total ventilating air quantity and the low-level supply should exceed the total combined combustion and ventilating air quantity by at least 25%, as above.

7.0(e) Ventilation of hydrotherapy suites

General requirements

7.204 In a hydrotherapy suite heat recovery should be via heat pump.

7.205 The quantity of supply air should be calculated as 25 litres/sec/m^2 wetted surface, with the wetted surface taken as 110% of the pool water surface area.

7.206 A re-circulation plant is recommended, with a minimum of 20% fresh air.

7.207 As far as practicable, re-circulated pool air should be provided to the ancillary changing and recover accommodation, with the only extract from the toilets, laundry/utility room and pool hall.

7.208 Supply air to the pool hall should be introduced at high level and directed towards the perimeter to mitigate condensation, with extract air taken from directly over the pool. Dampers should not be located over the pool water.

Control of hydrotherapy pool installations

7.209 The supply and extract fans should be interlocked so that the supply fan does not operate until flow is established within the extract system.

7.210 Time-clock control should be provided, with a local override switch to extend the normal operating period as required.

7.211 Night setback temperature (in the range of 21°C -25°C) and high humidity control (in the range of 60-75% sat) should be provided to override the time clock in order to prevent condensation. The exact set points should be ascertained post-installation.

7.212 A remote indication panel should be provided in the pool hall, giving a visual display of the pool water and pool air temperature.

8. Validation of specialised ventilation systems

Definitions

Commissioning - Commissioning is the process of advancing a system from physical completion to an operating condition. It will normally be carried out by specialist commissioning contractors working in conjunction with equipment suppliers. Commissioning will normally be the responsibility of the main or mechanical services contractor.

Validation - A process of proving that the system is fit for purpose and achieves the operating performance originally specified. It will normally be a condition of contract that "*The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life.*"

Note: Commissioning is often sub divided into sections e.g. air handling unit, automatic controls, airside balance, building fabric and fittings. Each section may be commissioned by its specialist installer and they are often accepted in isolation. Validation differs from commissioning in that its purpose is to look at the complete installation from air intake to extract discharge and assess its fitness for purpose as a whole. This involves examining the fabric of the building being served by the system and inspecting the ventilation equipment fitted as well as measuring the actual ventilation performance.

It is unlikely that 'in house' staff will possess the knowledge or equipment necessary to validate critical ventilation systems such as those serving operating suites, pharmacy clean rooms and local exhaust ventilation systems. Validation of these systems should therefore be carried out by a suitably qualified independent Authorised Person appointed by the NHS Board.

It is anticipated that training in the validation of specialised healthcare ventilation systems for independent Authorised Persons will become available during the life of this SHTM.

Commissioning general

8.1 Commissioning is an essential process for ventilation systems. It is therefore important that adequate provision for the process be made at the design stage of the project. Procedures for commissioning air-handling systems are given in CIBSE Commissioning Codes and BSRIA Application Guide Set COMPAK 1.

8.2 The duct-sizing procedure should take into account the requirements of system balancing, and the position and number of regulating dampers included in the design should be sufficient for this purpose.

Location of dampers and test holes

8.3 Balancing/commissioning dampers will be required in each branch of the distribution ductwork.

8.4 Test holes for the measurement of air-flow will be required at carefully selected points in main and all branch ducts. The number and spacing of holes are given in the BSRIA Application Guide Set COMPAK 1. Their positions must be identified at the design stage.

8.5 The test positions need to be accessible for commissioning to take place. They may also be required for subsequent annual verification of the system performance, so they should not be covered by permanent lagging.

8.6 The measurement point should be in a straight length of duct as far away as possible from any upstream bends, dampers or other elements that could cause disturbance to the airflow. The actual location should be:

- at least 1.5 duct diameters upstream of sources of turbulence such as dampers and bends;
- if this is not possible, 10 diameters downstream of dampers, bends or tees, and 5 diameters downstream of eccentric reducers;
- where there is enough space round the duct to insert the pitot tube and take readings;
- where the duct has a constant cross-sectional area.

8.7 Test holes for measuring total airflow from a fan should be located either 4 diameters upstream or 10 diameters downstream of the fan. Provision should also be made for measuring the speed of rotation.

Information to be provided

8.8 It is essential that the designer should pass on his intentions fully to the commissioning engineer by indicating which parts of the system are high, medium and low pressure, and by providing:

- relevant parts of the specification;
- schematic drawings indicating performance data as indicated in Table 8;
- equipment schedules;
- controller and regulator schedule;
- fan performance curves;
- wiring diagrams for electrical equipment, including interlock details.

Items in system	Information to be provided
Fans	Fan total pressure Volume flow rate at high and low speed Maximum motor current
Plant items	Type and identification numbers from equipment schedules Fluid and air volume flow rates Fluid and air side pressure losses Dry bulb temperatures Wet bulb temperatures Humidity
Dampers, including motorised and fire dampers	Identification numbers from equipment schedules Location Identification number Volume flow rate
Main and branch ducts	Dimensions Volume flow rates and velocities Identification numbers from equipment schedules
Terminal	Location Identification number Grille or diffuser factor Volume flow rate and neck velocity Operating static pressure
Test holes and access panels	Location Identification number
Controllers	Set points

Table 8: Information to be provided on schematic drawings

Notes: For Table 8

1. Fan total pressure is the difference between the total pressure (static pressure + velocity pressure) at the fan outlet and the total pressure at the fan inlet.

2. Where volume flow rates are variable, maximum and minimum values should be provided.

Commissioning personnel

8.9 As one individual is unlikely to possess all of the required commissioning skills, a commissioning team is therefore usually needed. The objective of commissioning is to ensure that the necessary performance and safety requirements are met.

8.10 During the commissioning process a great deal of information will be generated which will form an invaluable future source of reference about the plant. It is essential to ensure that it is collected together in the form of a commissioning manual and handed over to the client on completion of the contract together with the 'as fitted' drawings. This information should be both in hard copy and electronic format.

8.11 In order to be successful the commissioning process must start before achieving practical completion as many parts of the system will become progressively less accessible. The correct installation of those parts will need to be witnessed and leak-rate tests carried out as construction proceeds. Failure to establish responsibility for commissioning early enough will delay the completion of the project or lead to unsatisfactory plant performance.

Commissioning brief

8.12 The commissioning team will require a detailed brief from the system designer. This should include:

- a 'user' brief comprising a description of the installation and its intended mode of operation;
- the precise design requirements with regard to the scheme of air movement, room static pressures, supply and extract air-flow rates and acceptable tolerances;
- full details of the design conditions both inside and out, for winter and summer together with the control strategy;
- equipment manufacturer's type test data, commissioning, operation and maintenance recommendations;
- drawings showing the layout of the system, positions of air-flow measurement test points, dampers, regulating devices and filters within the duct runs, together with sizes of ducts and terminal fittings. It will save time if these drawings are annotated with the design volumes and static pressures required at each branch and outlet point;
- wiring diagrams for all electrical equipment associated with the air handling systems including motor control circuit details and any interlocking and safety devices such as emergency-stop buttons adjacent to the item of plant.

8.13 The CIBSE Commissioning Code, Series 'A' – "Air Distribution", provides full guidance on the information that will be required by the commissioning team.

8.14 The designer should include in the contract document instructions on verifying the accuracy of test instruments that should be supported by reference to relevant calibration certificates.

8.15 The system, on completion, should be operated by the contractor as a whole and subject to performance tests in accordance with the contract requirements. For critical systems, these may include independent validation of the system performance on behalf of the client.

8.16 Prior to dynamic commissioning, it is essential that builders' work in the area served by the system is complete, all rubbish and dust is removed, concealed plumbing (IPS-type) panels are in position and ceiling tiles are in place and clipped. Floors should be mopped and visible dust removed from all other surfaces.

8.17 Once the system is shown to meet the design intent the handover documentation should be completed. In the event of performance not being acceptable, the matter should be dealt with in accordance with the contract arrangements.

Pre-commissioning checks

8.18 The pre-commissioning checks consist of visual inspection, manual operation of equipment, static measurements and functional tests of individual components. They should be carried out prior to setting the system to work and undertaking the dynamic commissioning process set out in Paragraph 8.29 onwards of this guidance.

Standard of installation

8.19 During the installation of the system the following must be witnessed:

- that the plant and installations have been provided and installed in accordance with the design specification and drawings;
- that only approved sealants have been used in the installation;
- that all components function correctly;
- that the satisfactory sealing of access doors and viewing ports have been carried out;
- that air pressure tests and air-leakage tests on ventilation ducting have been carried out in accordance with the methods set out in the HVCA's DW/143: Ductwork Leakage Testing. It is usual to carry out these tests, a section at a time, as the ductwork is installed and before its insulation is applied. The results must be recorded in the commissioning manual;
- that gaps around doors and hatches are as specified in the design;
- that the correct operation of pressure stabilisers, control dampers, isolating and non-return dampers have been checked and installed in the correct orientation for air-flow;
- that test holes have been provided in their specified locations and are sealed with suitable grommets;
- that control dampers are secured and their quadrants fitted correctly;
- that any interlocks are operative and in accordance with specification;
- that the electric circuits are completed, tested and energised;
- that electric motors have been checked for correct direction of rotation both at full speed and set-back;
- that cooling and heating media are available at correct temperatures and pressures and in specified quantities;
- that the air-conditioning plant components and controls function correctly;
- that the air-conditioning plant interlocks and safety controls function correctly;

- that the plant is physically complete, insulation is applied and all ducts and pipework are identified as specified;
- that the building housing the ventilation plant is generally in a fit condition for commissioning and performance tests to commence, that is, windows, doors, partitions etc are completed, surfaces sealed and their final finish applied;
- that the areas containing the ventilation plant and those being served by it are clean;
- that access to all parts of the system is safe and satisfactory.

Cleanliness of installation

8.20 During installation it must be established that ductwork is being installed to the 'advanced level' as defined in the HVCA (2005) 'TR/19 – Guide to good practice: internal cleanliness of ventilation systems'. This specifically includes ensuring that ductwork sections arrive on site and are stored with their open ends sealed and that open ends remain sealed during installation to prevent the ingress of builders' dust.

8.21 Should any doubt exist whether the guidance has been observed, the ducts must be cleaned internally to restore them to this standard before being taken into use.

8.22 "Builders work" ducts of brick or concrete must be surface sealed to prevent the release of dust before being taken into use.

8.23 The area around the supply air intake must be free of vegetation, waste, rubbish, builders' debris or any other possible source of contamination.

Certification of equipment

8.24 The following test certificates should be assembled by the commissioning team and be available for inspection at any time during the contract period. They will form part of the handover information and should be placed in the commissioning manual:

- type-test performance certificates for fans;
- pressure-test certificates for:
  - heater-batteries;
  - cooling coils;
  - humidifiers (if appropriate);
- type-test certificates for attenuators;
- type-test certificates for primary and secondary filters;
- individual test certificates for high efficiency particulate air (HEPA) filters.

Equipment tests

8.25 Prior to setting the system to work, the checks in Paragraphs 8.26 - 8.28 should be witnessed, and proving tests should be carried out as detailed.

Filters

8.26 The quality of filter housing and in particular, the seals is a critical factor in maintaining the efficacy of the filtration system by ensuring that air does not bypass the filter panels. Therefore, the following checks should be made:

- filter seals should be fitted and in good condition;
- filters should be installed correctly with respect to air flow;
- bag filters should be installed so that the bags are vertical and their pockets free;
- HEPA filters should be installed in a sealed housing and their seals tested to DIN 1946 if specified;
- all filters should be checked to ensure they are free of visible damage;
- the differential pressure indicators should be checked for accuracy and that they are marked with the initial and final filter resistance.

Drainage arrangements

8.27 The drain should conform in all respects to the “Design considerations” of this SHTM. In addition the following must be proved:

- that the drain tray is easily removable;
- that a clear trap is fitted and is easily removable;
- that the drain has a clear air gap of at least 15mm;
- that the pipework is supported so that the air break cannot be reduced;
- that the drain system from each drain tray is independent up to the air break;
- that the operation of the drainage system is proved by introducing water into the duct at the drain tray and observing that it completely drains out. This check is to be repeated both at normal speed and set back once the fans have been commissioned. At this time the clear trap can be marked to indicate the normal water level with the fan running.

Fire dampers

8.28 The following must be witnessed and proving tests should be carried out as detailed:

- the operation of all fire dampers;
- the access provided to enable the dampers’ to be visually inspected and / or re-set should be sufficient for the purpose;

- indication should be provided of the dampers' position (open/tripped);
- indication of the fire dampers' location should be provided both on the ductwork and at a visible point on the building fabric if the ductwork is concealed.

Dynamic commissioning

Air-handling and distribution system

8.29 The fan drive, direction of rotation, speed and current drawn should be set in accordance with their manufacturer's instructions.

8.30 After the installation has been checked to ensure that it is in a satisfactory and safe condition for start-up, it should be set to work and regulated to enable the plant to meet its design specification. The proportional balancing method described in the CIBSE Commissioning Code "A" must be followed. The air-flow rates must be set within the tolerances laid down in the design brief. This will normally be the design airflow rate +10% -0%.

8.31 When combined supply and extract systems are to be balanced and the area that they serve is to be at or above atmospheric pressure then the supply should be balanced first with the extract fan switched off, and then the extract balanced with the supply fan(s) on.

8.32 For combined systems where the area that they serve is to be below atmospheric pressure then the extract should be balanced first with the supply fan switched off and then the supply balanced with the extract fan on.

8.33 On completion of the balance all volume air-flows in supply and extract ducts and from grilles and diffusers must be measured and recorded. The true air change rate can them be calculated from the data obtained.

8.34 The main supply and extract duct volume control dampers must be locked and their position marked.

8.35 All grille and diffuser volume control registers must be locked to prevent alteration and their final position marked.

Room air distribution

8.36 The pressure-relief dampers and pressure stabilisers must be set to achieve the specified room static pressures and locked. The grille direction control vanes and diffuser cones must be set to give the specified air-movement pattern. Visualisation techniques may need to be employed in order to prove that the required air-flow pattern is being achieved. This may be a potential requirement when commissioning LEV systems or rooms that contain them.

Air-conditioning plant

8.37 The specified flow rate and/or pressure drops must be set for all heater batteries, cooling coils and humidifiers. The methods described in the CIBSE

Commissioning Codes “W” and “R” should be followed. On completion their regulating devices must be locked to prevent alteration.

Control system

8.38 The control system should not be commissioned until both the air distribution system and air-conditioning equipment have been commissioned.

8.39 Because of the specialised nature of control systems and the fact that each manufacturer’s system will contain its own specialist components and settings, the commissioning should be completed by the supplier and witnessed by a representative of the user.

8.40 The location of all control and monitoring sensors should be checked and their accuracy proved.

8.41 The control system’s ability to carry out its specified functions must be proved.

8.42 If the plant is provided with a “user’s” control panel in addition to the one located in the plantroom then the operation of both must be proved. This will typically apply to operating departments and laboratory systems.

Specific performance standards

Air movement

8.43 The performance of the system should be measured and compared with information provided by the designer.

Plant capacity and control

8.44 When setting to work and proving the design, both the manufacturer of the air-handling plant and the control specialist should attend site together and jointly commission the system.

8.45 If any doubt exists as to the capacity of the installed system, then its ability to achieve the specified inside design conditions with the plant operating at winter and summer outside design conditions must be proved. Artificial loads will be required in order to simulate the internal gains/losses and the outside design conditions.

8.46 On completion of the plant performance test, recording thermo-hygrographs should be placed in each room/area served by the plant and also the supply air duct upstream of the frost battery. The plant should be run for 24 hours with all doors closed. During this period the inside conditions must stay within the tolerances specified. The BEMS should be used to obtain the information required wherever possible. Periodic tests will be required during the defects liability period.

Noise levels - general

8.47 The commissioning noise level is the level measured with a sound-level meter in the unoccupied room and taking account of the external noise together with the noise generated by the ventilation system. When occupied and in use this commissioning level will constitute a continuous background noise that will allow the overall noise level to be achieved. The ventilation plant design noise level is that generated by the plant alone with no other noise source being considered. The levels suggested make recognised allowance for the ingress of environmental noise.

8.48 The noise levels apply at the maximum velocity for which the system is designed to operate. Acoustic commissioning tests should be carried out with all plant and machinery running normally and achieving the design conditions of airflow, temperature and humidity.

8.49 An industrial-grade sound-level meter to BS3489 or IEC 651 Type 2 will normally be sufficient to check the noise level.

8.50 The noise level readings are to be taken at typical normal listening position 1.5m above floor level and at least 1m from any surface and not on any line of symmetry. In critical rooms the noise should be measured at the centre of the room and at the centre of each quarter. The mean of the 5 readings should then be calculated.

8.51 In the event of a contractual deficiency, a Type 1 precision-grade sound-level meter should be used and the noise level determined by the procedure given in Scottish Health Technical Memorandum 08-01 (2011).

Filter challenge

General ventilation filters

8.52 In-situ performance tests will not normally be required for primary and secondary filters and their housings. However the filters should be visually inspected for grade, tears, orientation and fit within their housing. Filters should be clean and a replacement set available. Bag filters should be installed so that their bags are vertical and spaced so that air can move through them freely. Any filter found to be wet should be replaced and the cause investigated.

HEPA filters (for exhaust protective enclosures and laboratories)

8.53 Pathogenic material may be discharged through damaged or badly installed HEPA terminal filters. The complete installation must be tested using the method set out in BS EN: 14644 ‘Method of Testing for the Determination of Filter Installation Leaks’.

8.54 The challenge tests may be carried out using either of the following techniques:

- use Dispersed Oil Generator (DOP) to provide the challenge and a photometer to detect leaks;

- use a Discrete Particle Counter (DPC) to detect leaks. (In order to obtain a sufficient challenge it may be necessary to remove temporarily the supply AHU secondary filters).

8.55 In both cases the upstream challenge should be measured. A measurement of particle penetration through a representative section of the HEPA filter media is then taken and used as the reference background level. These two readings enable the range of the detecting instrument to be set.

8.56 A challenge aerosol of inert particles of the type produced by a DOP generator should be introduced into the air, upstream of the HEPA filter. The downstream face of the filter, its mounting seal and housing would then be scanned for leakage using a photometer. A leak should be deemed to have occurred if a steady and repeatable reading on the photometer at any point exceeds 0.01% of the upstream reading.

8.57 Alternatively a Discrete Particle Counter (DPC) may be used. For the Discrete Particle Counter method the filter face is sampled at several points to establish the smallest non-penetrating particle size. If particles at or above this size are detected when subsequent scans of the filter face, its seal and housing are made, then there is deemed to be a significant leak at, or near, the test position.

8.58 Should the HEPA filter fail this test it must be replaced. Should the filter mounting seal or housing fail this test it may be repaired and the test repeated.

Bacteriological sampling

General ventilation systems

8.59 Bacteriological sampling will not normally be required for either general or local exhaust ventilation (LEV) systems unless otherwise specified.

Conventional operating rooms

8.60 The level of airborne bacteria introduced by the supply air can be checked by closing all doors and leaving the operating room empty with the ventilation system running for 15 minutes. An active air sampler set to 1 cubic metre and mounted on the operating table should then be activated remotely. Aerobic cultures on non-selective media should not exceed 10 bacterial and/or fungal colony forming units per cubic metre (CFU/m^3).

8.61 The results should be examined to establish the broad category of organisms present. A high preponderance of fungal organisms may be an indication of inadequate filtration for the particular installation. Precise guidance is inappropriate and will depend on local circumstances.

8.62 It may be appropriate to carry out a check of airborne bacteria during a surgical operation. If required this should be carried out as soon as possible after handover. Unless there are unusually high numbers of personnel or extensive activity in the room, the number of airborne bacterial and/or fungal CFU

averaged over any five-minute period, would be unlikely to exceed 180 per cubic metre.

8.63 Information on the additional validation testing of UCV Operating suites is given in Section 8.0(a).

Ventilation system commissioning/validation report

8.64 Following commissioning and/or validation a full report detailing the findings should be produced. The system will only be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life.

8.65 The report shall conclude with a clear statement as to whether the ventilation system achieved or did not achieve the required standard. A copy of the report should be lodged with the following groups:

- the user department;
- infection control (where required);
- estates and facilities.

8.0(a) Validation of UCV operating suites

General

8.66 Commissioning of a UCV terminal will normally be carried out by its supplier. Commissioning of the air-handling unit, fire dampers, distribution ductwork and control systems may be undertaken by different teams. It is therefore important to recognise that the UCV terminal is only one element of the specialised ventilation system serving the operating suite and it cannot be accepted in isolation.

8.67 In order to ensure that the complete system operates correctly it will be necessary to validate the system as a whole from the air intake through to the extract discharge. It is unlikely that “in house” staff will possess the knowledge or equipment necessary to undertake this process. Validation of Ultra-Clean operating theatre ventilation systems should therefore be carried out by a suitably qualified independent Authorised Person appointed by the client.

8.68 It is anticipated that training in the validation of specialised healthcare ventilation systems for independent Authorised Persons will become available during the life of this SHTM.

8.69 The following regime of inspection and testing should be applied to the validation of new installations designed to provide Ultra-Clean conditions in an Operating suite. The test regime has been devised to ensure that the system as installed fully achieves the design requirement for these systems as set out in Section 7.0(b) of this document.

Basic requirement

8.70 The operating suite to be validated should be physically complete with final finishes applied. All ventilation systems serving it should be operating correctly and delivering the design air-flow rates.

8.71 In order to avoid pre-loading the UCV terminal's recirculation ducts and HEPA filters, the Operating suite should be free of any obvious dust and at least "builders clean" before the recirculation fans are set to work.

8.72 The validation procedure for a conventional theatre suite should have been satisfactorily completed to the standard set out in Section 8 prior to attempting to validate the UCV unit. In particular:

- the supply AHU will have achieved the minimum standard;
- the operation of all fire dampers will have been proved;
- the supply and extract air-flow rates as measured in ducts and at room terminals will achieve their design values +10%; -0%;
- room differential pressures will be correct.

Evidence of the satisfactory achievement of the foregoing standard should be available for inspection and independently measured as necessary *prior to validating the UCV unit.*

UCV unit validation procedure

8.73 Tests to validate the suitability and performance of an ultra-clean operating suite should be undertaken in the order that they appear below. Should an item fail to meet the required standard it should be rectified and successfully retested before passing on to the next test.

Summary of test regime

- Challenge tests to ensure that:
  - the UCV terminal unit is correctly assembled and sealed so that no air will bypass the filters;
  - the terminal filters are correctly sealed in their housings;
  - the terminal filters are of the same grade, of uniform quality and undamaged.
- Air velocity measurements to ensure that
  - a sufficient quantity of air is being delivered by the terminal;
  - the terminal quadrants are in balance;
  - the air flow has sufficient velocity to reach the working plane.
- An entrainment test to ensure that contaminants arising outside of the UCV terminal footprint are not drawn into it.

- Visualisation techniques to gain an understanding of the overall system performance.
- Noise measurement to ensure that working conditions are satisfactory.
- Control system checks to ensure that the system operates as specified.
- Biological monitoring to determine how effective the system is in use.

Test and measuring conditions

8.74 While validating the UCV terminal, the conditions in the Operating room shall be stable and within the given ranges.

temperature: – 19°C - 23°C dry bulb.

humidity: – 30 – 65% relative humidity.

Test and measuring equipment

8.75 Any test or measuring equipment used should have a certificate to prove that it has been validated within the previous 12 months at a calibration facility using traceable national standards.

8.76 In the case of a noise meter, its “matched sound source” should have a certificate to prove that it has been validated within the previous 12 months at a calibration facility using traceable national standards. The noise meter should be calibrated to the sound source on each occasion that it is used.

Test grid – vertical units

8.77 A test grid should be constructed on the floor within the ultra-clean terminal footprint as projected by the inside dimensions of the sidewalls or boundary air curtain. A suitably marked test sheet will provide a consistent standard of test grid.

8.78 The test grid should comprise test squares of 280mm each side.

8.79 The test grid should be aligned along the centre lines of the terminal footprint with its centre under the centre point of the terminal.

8.80 Any test square with 80% of its area within the UCV footprint should be used as a test position.

8.81 An inner zone should be designated that is not less than 36% of the total footprint. It should be made up of a number of test squares distributed symmetrically about the terminal footprint centre line. Regardless of the shape of the terminal footprint, the inner zone should comprise a minimum grid of 6 x 6 test squares.

8.82 Unless specified otherwise, a test position should be in the geometric centre of a test square.

8.83 Test position 1 should be the leftmost test square in the row nearest to the operating room wall that houses the surgeon's panel.

(For an example of a grid for a 2.8 x 2.8 metre terminal see Figure 8)

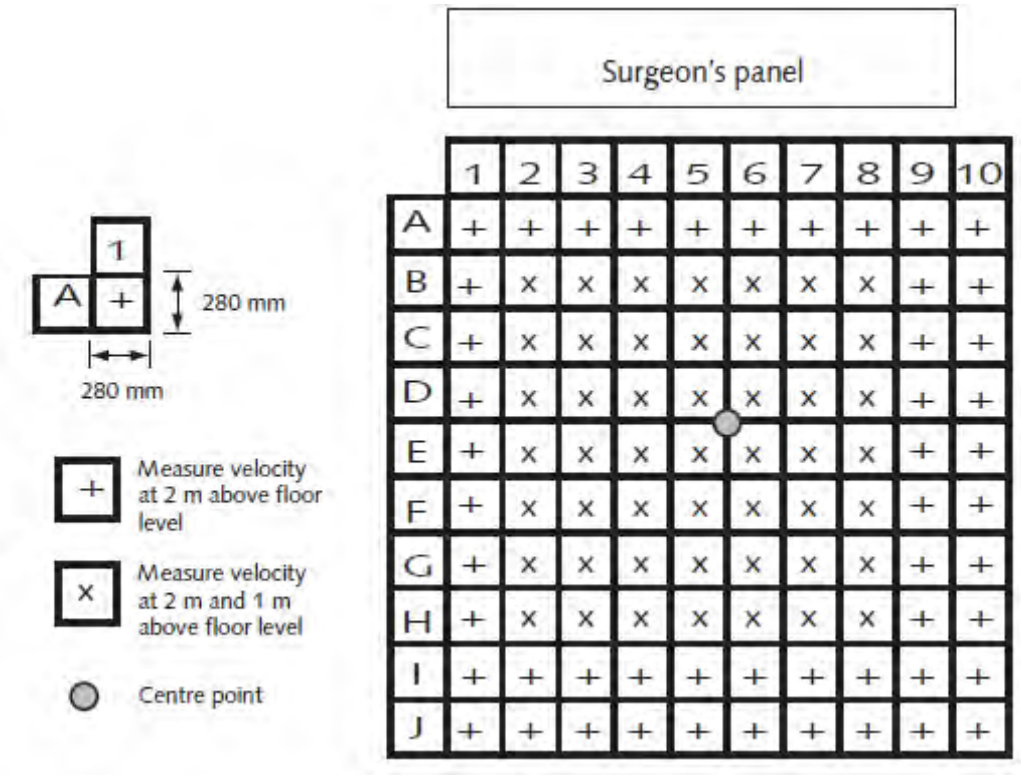


Figure 8: Example of a Test Grid for a 2.8m x 2.8m UCV Terminal

Test grid – horizontal units

8.84 A line of test positions should be marked on the floor 1m in front of the face of the UCV terminal.

8.85 A test position should be marked in the centre of the line. Additional test positions should be marked at 280mm spacing along the line either side of the centre position, up to the full-face width of the unit.

UCV terminal challenge tests (Vertical and horizontal systems)

8.86 The diffuser screen fitted below the face of the terminal HEPA filters should be lowered or removed while the challenge tests are being carried out.

8.87 The installed HEPA filters should be checked to ensure that their grade accords with the design specification and that their performance has been certified by the manufacturer.

8.88 The challenge tests may be carried out using either of the following techniques:

- use DOP to provide the challenge and a photometer to detect leaks;
- use a DPC to detect leaks. In order to obtain a sufficient challenge it may be necessary to remove temporarily the supply AHU secondary filters.

8.89 In both cases the upstream challenge should be measured. A measurement of particle penetration through a representative section of the HEPA filter media is then taken and used as the reference background level. These two readings enable the range of the detecting instrument to be set.

8.90 For the DOP test this should be set as the reference level and a leak will be declared significant if penetration greater than 0.01% of the range is detected. (See Paragraph 8.56 for details).

8.91 For the DPC method the filter face is scanned to establish the smallest non-penetrating particle size. If significant particles at or above this size are detected when subsequent scans are made then there is deemed to be a significant leak at, or near, the test position. (See Paragraph 8.57 for details)

UCV terminal unit clean zone leak test

8.92 This test will confirm that there is no unfiltered air bypassing the HEPA filter.

8.93 The joints and service penetration points under the UCV terminal within its side walls or boundary air curtain should be scanned to prove that there are no leaks.

8.94 A leak is defined as a significant rise above the background level.

Terminal HEPA filter seal leak test

8.95 The test will confirm that there is no unfiltered air bypassing the HEPA filter's seal.

8.96 Each HEPA filter's seal should be scanned to prove that there are no leaks.

8.97 A leak is defined as a significant rise above the background level.

Terminal HEPA filter media leak test

8.98 The test will confirm that the HEPA filters have not sustained damage while being installed.

8.99 The face of each HEPA filter should be scanned to prove that there are no leaks.

8.100 A leak is defined as a significant rise above the background level.

Vertical UCV terminal air velocity tests

Test set up

8.101 The terminal face diffuser screen should be in place for these tests.

8.102 Take spot readings to establish that the room is within the specified temperature and humidity test conditions.

8.103 Set out the test grid as described previously.

8.104 Swing the operating lamp arms and any other stem arms so that they align to present the least resistance to air flow, are perpendicular to the front edge of the test sheet and face the back edge. Any lamp and equipment heads should as far as practicable be outside of the UCV terminal footprint.

Test instrument

8.105 The measuring instrument should be a hot-wire anemometer with a digital read-out. The instrument resolution should be at least 0·01m/s, have a tolerance of ±0·015 m/s or 3% of that reading and be calibrated down to 0·15 m/s or lower. An alternative instrument may be used providing it is of no lesser specification.

Test method

8.106 The instrument should be mounted on a test stand and set to take a mean reading over a ten-second sample interval.

8.107 It is recommended that a printer be linked to the test instrument so that readings are recorded automatically. Alternatively they could be downloaded to a computer or data logger at the end of the test.

8.108 The test stand to be positioned on each test point in turn and the reading taken when the instrument has stabilised.

8.109 When taking a reading the test person should not stand within the same quadrant as the test instrument.

8.110 Readings are to be taken at the test positions with the instrument probe facing the wall housing the surgeon's panel, commencing at the first test position. Readings are taken working along the row from left to right and back, or for all text positions in one quadrant at a time.

8.111 When all test positions under one half of the terminal have been covered, readings of temperature and humidity are then taken at the specified height in the centre of the terminal. The read-outs on the surgeon's panel should be recorded at the same time.

8.112 Having completed one half of the test grid, the operating lamp arms and any other stem arms should be swung round through 180º and the test stand reversed so that the wall housing the surgeon's panel is behind the test person. Readings are recommenced starting at the right of the test row and working from right to left a quadrant at a time, as above.

UCV high-level discharge velocity test

8.113 Measurements of air velocity are to be taken at every test position 2m above floor level and the results averaged.

8.114 The average of the total readings taken is to be not less than:

0.38 m/s for a partial-wall system;

0.30 m/s for a full-wall system.

The average air velocity for each quadrant should not exceed ±6% of the measured average velocity for the terminal

UCV low-level air velocity test

8.115 Measurements of air velocity are to be taken at each of the inner zone test position 1m above floor level.

8.116 The measured velocity at every test position in the inner (operating) zone shall be not less than 0·2 m/s.

Horizontal UCV terminal air velocity test

Test set up

8.117 Set out the line of test positions as described previously.

8.118 Swing the operating lamp arms and any other stem arms so that they align to present the least resistance to air flow and are perpendicular to the line of test positions.

Test instrument

8.119 See that specified for vertical systems (Paragraph 8.105 refers).

Test method

8.120 The instrument should be mounted on a test stand and set to take a mean reading over a ten-second sample interval.

8.121 It is recommended that a printer be linked to the test instrument so that readings are recorded automatically. Alternatively, they could be downloaded to a computer or data-logger at the end of the test.

8.122 The test stand should be positioned on each test point in turn and the reading taken when the instrument has stabilised.

8.123 When taking readings the test person should stand well downstream of the instrument.

8.124 Readings are to be taken at the test positions with the instrument probe facing the UCV terminal, commencing at the first test position on the left and working along the row from left to right at the specified height.

8.125 The instrument should be reset to the next specified height and the test repeated and so on.

8.126 Readings of temperature and humidity should be taken at the specified height in the centre of the terminal. The read-outs on the surgeon's panel should be recorded at the same time.

UCV discharge velocity test

8.127 Measurements of air velocity are to be taken at all test positions at 1m, 1·5m and 2m above floor level.

8.128 The average of the total readings taken should be no less than 0·4 m/s.

UCV entrainment test (Vertical systems only)

Rationale for the entrainment test

8.129 The performance of UCV systems may be compromised by room air being drawn into the ultra-clean airflow, a phenomenon known as “entrainment.” Significant levels of entrainment could lead to microbial contamination of items left exposed on instrument trolleys laid out beneath the canopy.

8.130 UCV systems having permanently fitted full sidewalls do not need to be tested, as the sidewalls physically prevent entrainment.

Principle of the test

8.131 A source of particles is produced outside of the UCV terminal and is used to challenge the system. A detector is placed within the ultra-clean airflow and used to determine the percentage penetration of the test particles at predefined locations under the UCV terminal footprint. The source and detector are moved in tandem around the UCV canopy and pairs of readings taken, from which the percentage penetration at specified locations is calculated. The degree of penetration should be below specified maximum limits if entrainment is to be declared not significant.

8.132 The entrainment test may be carried out using either of the following techniques:

- use DOPs to provide the challenge source at the specified release position and a photometer to measure the entrainment; or
- duct non-HEPA-filtered air to the specified release position and use a DPC to measure the entrainment.

Test set-up

8.133 The terminal face diffuser screen should be in place for these tests.

8.134 The test should be performed without any equipment in place beneath or closely adjacent to the UCV terminal.

8.135 The theatre lights should be moved to a central position beneath the terminal and raised to 2m above floor level, so as not to interfere with the peripheral airflows.

8.136 Take spot readings at the centre of the canopy, one metre from floor level, to establish that the room is within the specified temperature and humidity test conditions.

8.137 Set out the test grid as described previously.

8.138 For either of the following entrainment tests, a measurement of particle penetration through a representative section of the HEPA filter media is to be taken and used as the reference background level.

Test equipment, challenge source, measuring instrument and detector head

8.139 The challenge and detector equipment should be chosen so that:

- the tracer particles are mainly within the size range 0.3 to 5 microns and thus capable of remaining airborne for a substantial time;
- the particles used should not be able to penetrate the terminal filters in sufficient numbers to cause a background count that is more than 0.1% of the challenge count;
- the choice of particle and detector will enable a minimum of a three-logarithm (1,000-fold) range of counts to be recorded between the highest (that is, source) and lowest (that is, background) readings expected. (A concentration of approximately 10^5 particles per cubic metre of source air has been shown to be adequate.)

Source – Dispersed Oil Particles (D.O.P.)

8.140 The DOP generator should be able to produce a cloud of test particles in the form of a visible smoke. The test smoke should be delivered via an aperture so that it flows vertically downward from the lowermost edge of the partial wall, on the outside of the UCV canopy.

8.141 The test smoke is to be delivered via an aperture.

Note 4: To prevent undue contamination of the theatre and filters with deposits of oil, DOP should only be released for the minimum amount of time necessary to complete the test.

Challenge source – natural particles

8.142 The source unit should be a fan/blower or other method that takes non-HEPA-filtered air and expels it via a delivery head at the specified release position to provide the particle challenge. The challenge air should be delivered vertically downwards from the lowermost edge of the partial wall, on the outside of the UCV canopy, parallel to the airflow coming from the diffusers. The challenge air velocity should be the same as the measured average velocity at 2m from the terminal under test.

Note 5: The use of DOP for testing is gradually being phased out and replaced by a natural challenge measured with a DPC. At the time of writing research is under way to define more precisely a challenge source unit for natural particles. It is anticipated that such a unit, together with a matching test methodology, will become available during the life of this Scottish Health Technical Memorandum.

The detector (defined in terms of range and resolution)

8.143 This may be a photometer or a DPC. It is recommended that a printer be linked to the test instrument so that readings are recorded automatically. The instrument should be capable of sampling a minimum a 28.3 litres of air per minute and in the case of the DPC, provide readings for particle size ranges from 0.3 microns to 5.0 microns and greater. The instrument should be compliant with the requirements of BS EN ISO 14644-1. An alternative instrument may be used providing it is of no lesser specification.

Test positions and orientation of source and detector

8.144 The test positions should be at the centre of each test square, as defined for the velocity test.

8.145 For rectangular UCV terminals, measurements of penetration are to be taken at the four corner test squares of the test grid and at intermediate positions along the line of test squares between the corners. The number of intermediate test positions will be as equally spaced as possible around the periphery with no fewer than 3 and no more than 5 complete test squares between test positions.

8.146 A further series of measurements are to be obtained around the periphery of the inner zone. Measurements of penetration are to be taken at the four corner test squares of the inner zone of the test grid and if necessary at intermediate positions along the line of test squares between the corners as equally spaced as possible, with no fewer than 3 and no more than 5 complete test squares between test positions.

8.147 A single measurement should be taken at the geometrical centre of the UCV terminal footprint. The centre measurement will be taken with the detector head mounted vertically upwards 1 metre above floor level.

8.148 The centre of the challenge particle source should be aligned with the centre of the designated test square, with its longer edge against the outer edge of the partial wall and delivering the challenge from the lower edge of the partial wall. The air containing challenge particles is directed vertically downwards from the lower edge of the partial wall, in a plane parallel to the adjacent partial wall. Where there is physical interference due to obstructions such as gas pendants, the source will be moved to the next available non-obstructed test-square location nearest to the stipulated sampling position. The detector should then also be moved to remain opposite the source.

8.149 In the case of non-rectangular terminals, an interpretation of the above strategy should be adopted that will yield a no less searching examination of the unit's ability to control entrainment.

Test method

8.150 The sampling head of the detector instrument is mounted on a test stand with its sampling orifice facing outwards horizontally from the centre of the UCV canopy, 1m above floor level. The sampling head should be orientated at right angles to the partial wall when sampling along the sides of the test grid but will be set to bisect the angle when measuring at the corner test positions (Figure 88 illustrates the challenge and detector orientations when evaluating a 2.8m x 2.8m UCV terminal).

8.151 The test will commence at the first test position, this being designated the leftmost corner of the test grid when facing the wall housing the surgeon's panel. The penetration will also be measured at the corresponding test point on the inner zone commencing at the corner nearest to the first test position. When these tests have been completed, the source and detector equipment should be moved to the next test positions, working around the test grid in a clockwise direction.

8.152 The test stand should be positioned on each test point in turn and a pair of readings (challenge, then penetration) taken when the instrument has stabilised. The detector should be set to take a reading over a 15 second sample interval.

8.153 When taking a reading the test person should stand within the UCV terminal footprint but not in the same quadrant as the detector head.

Analysis and interpretation

8.154 The following standard is to be achieved:

- penetration to be not greater than 10% of the challenge at each test position in the outer zone;
- penetration to be no greater than 1% of the challenge at each test position in the inner zone;
- penetration to be no greater than 0·1% of the challenge at the centre of the test grid.

If a result is close to, or above the given limits, then a further reading must be obtained using a longer time base (1 minute) and the penetration must not exceed the given limit.

Basis of the test

8.155 Whyte W, Shaw BH, Freeman MAR. An evaluation of a partial-walled laminar-flow operating room. *J Hyg Camb* 1974; 73: 61 – 75.

Whyte W, Lidwell OM, Lowbury EJL, Blowers R. Suggested bacteriological standards for air in ultraclean operating rooms. *J Hosp Infect* 1983; 4: 133 – 139.

UCV visualisation

8.156 The use of smoke to gain an understanding of the overall performance of the system may prove useful at this stage in the validation process but cannot be relied on to produce a contractually definitive measure of performance.

UCV noise level

8.157 An industrial-grade sound-level meter to BS EN 61672 Type 2 fitted with a muff should be used to check the noise level. The instrument should be calibrated using a matched sound source prior to each set of readings.

Vertical systems

8.158 The noise level readings should be taken at typical normal listening positions 1·5m above floor level and at least 1m from any surface and not on any line of symmetry. Measurements should be taken under the centre of each quadrant of the UCV terminal and the four readings averaged.

Horizontal systems

8.159 The noise level readings are to be taken at typical normal listening positions 1·5m above floor level on the test line. The width of the unit should be divided in two and a measurement taken in the centre of each half but avoiding any line of symmetry. The two readings should be averaged.

8.160 Measurements should also be taken in each room of the suite.

8.161 In the event of a contractual deficiency a Type 1 precision-grade sound-level meter complying with BS EN 61672 should be used. Readings should be taken at the positions specified above and in each case the logarithmic mean of the results should be calculated in order to determine the noise level. Further information can be found in SHTM 08-01 (2011).

8.162 For vertical or horizontal systems, the noise level shall not exceed:

- 50NR [55dB(A)] – for UCV operating rooms and spaces without doors that open directly on to it (for example the scrub);
- 40NR [45dB(A)] – for all other peripheral rooms of the suite.

UCV control system checks

Temperature

8.163 The readings of temperature taken under or in front of the UCV unit should be within ±1 K of each other and the read-out on the surgeon's panel.

Humidity

8.164 The readings of humidity taken under or in front of the UCV unit should be within ±5% of each other and the read-out on the surgeon's panel.

Direct-reading differential pressure gauges

8.165 The differential pressure across the terminal filter(s) should be measured to confirm the accuracy of the indicated reading of any gauge.

Control functions

8.166 The operation of all control functions provided on the surgeon's panel should be proved for conformity with the design specification.

8.167 If an auxiliary panel has been fitted then its interlocking with the main surgeon's panel control functions must be proved to conform to the design specification.

Panel indicator lights

8.168 The panel indicator lights should illuminate as appropriate when the control functions are selected or warning levels are reached

BEMS interface

8.169 The operation, monitoring and alarm functions must be proved to conform to those set out in the design specification.

UCV theatre microbiological tests

8.170 There is little value in performing microbiological sampling in a new theatre supplied with ultra-clean ventilation. The foregoing filter challenge tests, air velocity measurements and entrainment test should have proved that the system operates satisfactorily and achieves the contracted level of performance. The HEPA filters will remove bacteria-sized particles from the air supplied through the UCV terminal. Therefore there will be an insignificant number of bacterial and/or fungal CFUs present until the Theatre is actually used.

8.171 Once the theatre has been taken into use, microbial sampling during a surgical procedure should help to confirm the satisfactory performance of the system and discipline of the users. Before commencing bacteriological testing, the room and its ventilation system should have achieved a steady state condition: (see also Paragraph 8.74)

8.172 The installation should be tested during surgical procedure at intervals between the time of the first incision and final closure of the wound. On average, the air sampled within 300mm of the wound should not contain more than 10 CFU/m^3.

UCV validation report

8.173 Following validation a full report detailing the findings should be produced. The report shall conclude with a clear statement as to whether the UCV theatre suite achieved or did not achieve the standard set out above.

8.174 A copy of the report should be lodged with the following groups:

- operating department;
- infection control;
- estates and facilities.

Appendix 1: Recommended air-change rates

Application	Ventilation	ac/Hour	Pressure (Pascals)	Supply Filter	Noise (NR)	Temp (°C)	Comments For further information see Section 6
General ward	S / N	6	-	G4	30	18-28	
Communal ward toilet	E	10	-ve	-	40	-	
Single room	S / E / N	6	0 or –ve	G4	30	18-28	
Single room WC	E	3	-ve	-	40	-	
Clean utility	S	6	+ve	G4	40	18-28	
Dirty utility	E	6	-ve	-	40	-	
Ward Isolation room	-	-	-	-	-	-	See SHPN 4; Supplement 1
Infectious disease Iso room	E	10	-5	G4	30	18-28	Extract filtration may be required
Neutropenic patient ward	S	10	+10	H12	30	18-28	
Critical Care Areas	S	10	+10	F7	30	*18-25*	Isolation room may be –ve press
Birthing Room	S & E	15	-ve	G4	40	*18-25*	Provide clean air-flow path
SCBU	S	6	+ve	F7	30	*18-25*	Isolation room may be –ve press
Preparation room (Lay-up)	S	>25	35	F7*	40	*18-25*	*H12 if a lay-up for a UCV Theatre
Preparation room / bay sterile pack store	S	10	25	F7	40	*18-25*	*50NR if a bay in a UCV Theatre
Operating theatre	S	25	25	F7	40	*18-25*	
UCV Operating theatre	S	25*	25	H12	40	*18-25*	Fresh air rate; excludes re-circulation
Anaesthetic room	S & E	15	>10	F7	40	*18-25*	Provide clean air-flow path
Theatre Sluice/dirty utility	E	>20	-5	-	40	-	
Recovery room	S & E	15	0	F7	35	*18-25*	Provide clean air-flow path

Table A1

Application	Ventilation	ac/Hour	Pressure (Pascals)	Supply Filter	Noise (NR)	Temp (°C)	Comments For further information see Section 6
Recovery room	S & E	15	0	F7	35	*18-25*	Provide clean air-flow path
Cardiac catheterisation lab	S	15	+ve	F7	40	*18-22*	
Endoscopy room	S	15	+ve	F7	40	*18-25*	
Endoscopy cleaning	E	>10	-ve	-	40	-	
Day case theatre	S	15	+ve	F7	40	*18-25*	
Treatment room	S	10	+ve	F7	35	*18-25*	
Pharmacy aseptic suite	S	20	#	H14	-	*18-22*	# See EGGMP (Orange guide) a
Cat 3 or 4 containment room	#	>20	#	H14*	-	*18-22*	# See ACDP guide; *Filter in extract
Post mortem room	S & E	S = 10 E = 12	-ve	G4	35	*18–22*	Provide clean air-flow path
Specimen store	E	-	-ve	-	-	-	Fan accessible from outside of store

Table A1 continued

Notes: 18°C-22°C indicates the range over which the temperature may float

18°C-22°C indicates the range over which the temperature should be capable of being controlled

S = supply N = natural ventilation

E = extract [a] – European guidelines on good manufacturing practice published by the Medicines and Healthcare products Regulatory Authority (MHRA)

Appendix 2: Hierarchy of cleanliness

			Air-flow rate for bacterial contaminant dilution	
Class	**Room**	**Nominal pressure (Pa) a**	**Flow in or supply m^3/s**	**Flow out or extract m^3/s**
Sterile	Preparation room (a) lay-up (b) sterile pack store Operating room Scrub bay b	 35 25 25 25	See standard schemes in Appendix 3 for recommended design values	
Clean	Sterile pack bulk store Anaesthetic room c Scrub room	 +ve 14 c 14	6 ac/h The greater of 15 ac/hr or 0.15 -	- The greater of 15 ac/hr or 0.15 0.10
Transitional	Recovery room Clean corridor General access corridor Changing rooms Plaster room	3 0 0 3 3	15 ac/hr d e e 7 ac/hr 7 ac/hr	15 ac/hr d 7 ac/hr 7 ac/hr 7 ac/hr 7 ac/hr
Dirty	Service corridor Disposal room	0 -5 or 0	- -	f 0.41 or 0.10

Table A2

Notes (applicable to Table A2):

a. Nominal room pressures are given to facilitate setting up of pressure relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not critical, provided the desired airflow rates and movement are achieved.

b. An open or semi-open bay is considered to be part of the operating room; provided air movement is satisfactory, no specific extract is required. However if the layout means that air movement is poor, a local extract may be required to control local condensation on the building surfaces, which can result in mould growth.

c. For design purposes, anaesthetic should be assumed to be at 14Pa. When commissioning 10Pa is considered suitable.

d. 15 ac/hr are considered necessary for the control of anaesthetic gas pollution.

e. Supply airflow rate necessary to make up 7 ac/hr after taking into account secondary air from cleaner areas.

f. No dilution requirement. Temperature control requirements only.

Type	Pressure difference - Pa						
	5	10	15	20	25	30	40
Single door (CDB Size 2.4.3.2.6.)	.03	.05	.06	.06	.07	.07	.08
Double door (CDB)	.04	.08	.10	.11	.12	.13	.14
High permanent length of 3mm gap	.004	.008	.010	.011	.012	.012	.013

Table A3: Leakage flows in m^3/s through closed door gaps

Note: CDB = Component Data Base

It should be noted that many doors are now fitted with cold smoke seals as standard. These will significantly reduce the door leakage rate when new and undamaged. It is therefore recommended that provision for the design leakage is factored into the sizing of the appropriate transfer grille or pressure stabiliser. Failure to do this will result in air gap whistles and doors being held partially open by air pressure.

Factory-assembled door-sets with a steel frame and pre-hung leaves have become common. There is effectively no leakage across these doors when closed. Therefore, when this type of door assembly is fitted, the door leakage can be ignored and the design airflow into the room reduced accordingly. The design airflow would then become that required either (i) for open door protection, or (ii) to achieve the specified air-change rate - whichever is the greater.

Room class		Dirty	Transitional	Clean	Sterile
Sterile	Hatch	0.3	0.24	0.18	
	Single door	0.47	0.39	0.28	0 or 0.28 a
	Double door	0.95	0.75	0.57	0 or 0.57 a
Clean	Single door	0.39	0.28	0 or 0.28 a	
	Double door	0.75	0.57	0 or 0.57 a	
Transitional	Single door	0.28	0 or 0.28 a		
	Double door	0.57	0 or 0.57 a		
Dirty	Single door	0	Open single door = 0.80m x 2.01m high		
	Double door	0	Open double door = 1.80m x 2.01m high		

Table A4: Recommended air flow rates in m^3/s through a doorway between rooms of different cleanliness to control cross-contamination

Designer's Notes:

a. The degree of protection required at an open doorway between rooms is dependent upon the degree of difference in cleanliness between them.

b. Flow rate required between rooms within the same class tends to zero as class reduces.

c. If two rooms are of equal cleanliness, no flow is required (in practice there will be an interchange in either direction) and the design of the air movement will assume zero air-flow. In certain cases, however, interchange is not permitted and protection airflow of 0.28 is assumed in the design, for example, in the case of a preparation room used as a "lay up".

		Effect on other rooms	
Door open between	Resultant pressure in these rooms (Pa)	Room	Pressure (Pa)
Operating room and corridor or Scrub bay and corridor	0	Anaesthetic Preparation – lay up Disposal Preparation – sterile pack store	0 12 -6 5
Operating room and anaesthetic room (or other series room with double doors)	17	Preparation – lay up Disposal Preparation – sterile pack store	26 -9 22
Operating room and disposal room or Operating room and preparation room	25	No change	
Anaesthetic room and corridor (or other series room with double doors)	0	Preparation – lay-up Disposal Operating room Preparation – sterile pack store	30 -6 20 25
Preparation room – corridor Disposal room & corridor	0	No change	
Disposal room & outer corridor	0	No change	

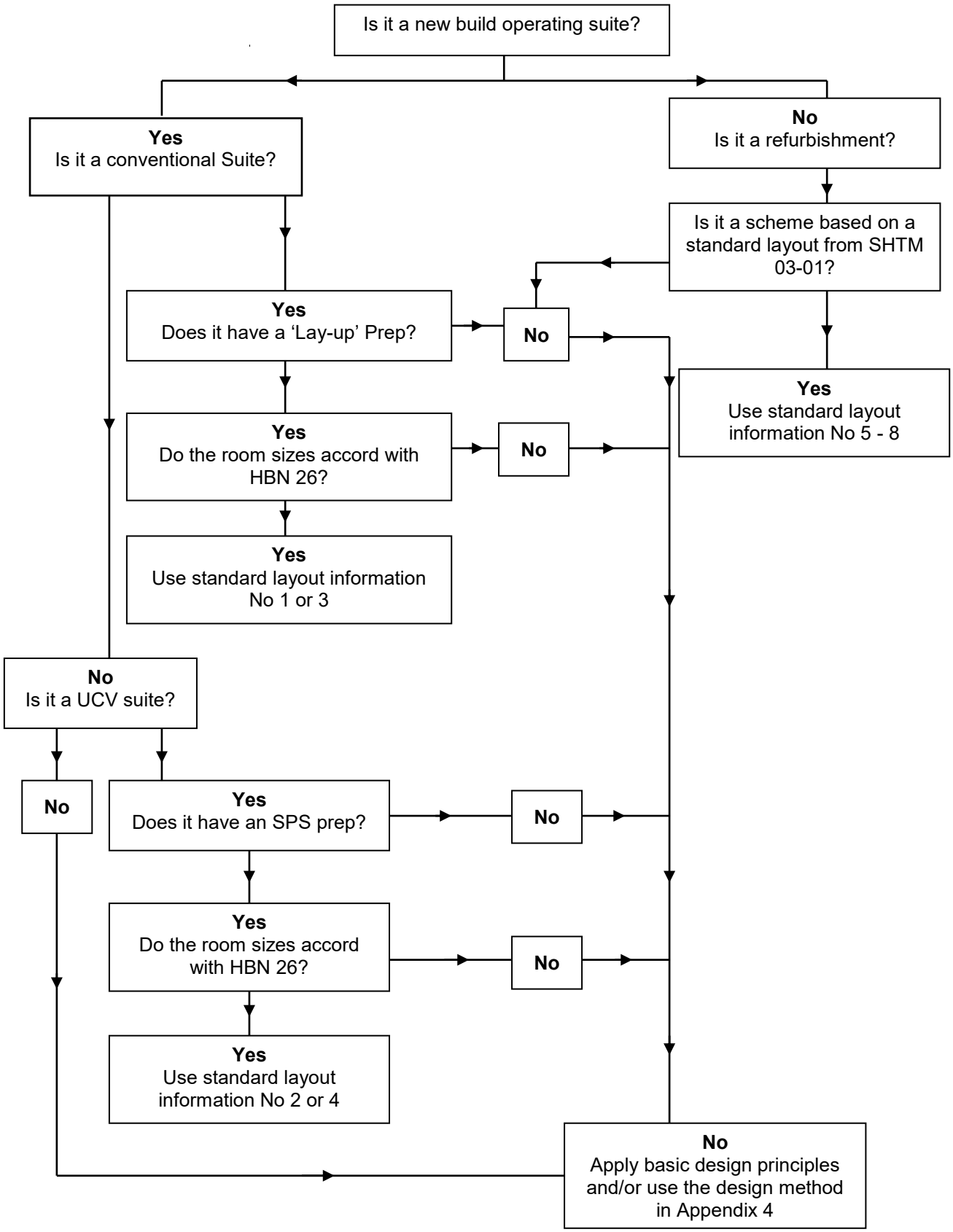
Table A5: Typical pressures in an operating suite when a given door is open

Notes: 1. The room differential pressure protects against reverse flows when the door is closed.

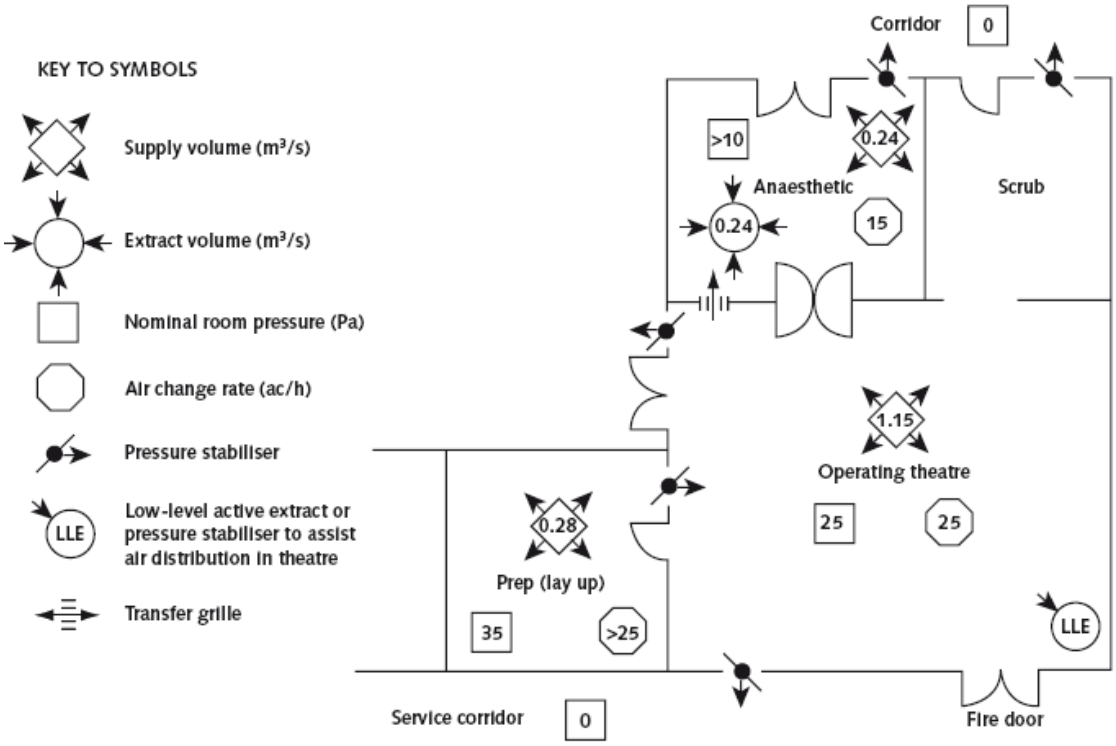
2. The flow of air through a doorway protects against reverse airflow when the door is open.

3. Pressure stabilisers control flow and ensure a known air-flow path between rooms when doors are closed and reduce back-flow between rooms when doors to other rooms are open.

Appendix 3: Operating suite design logic



New Standard Layout N° 1 - Suitable for a typical conventional theatre suite (Room sizes as specified in HBN 26)



Room	Size m³ Derived from HBN26	Air-Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	165	25	25	1.15
Anaesthetic	57	15	>10	0.24
Lay-Up-Prep	36	>25	35	0.28**
Scrub	*	-	25	-

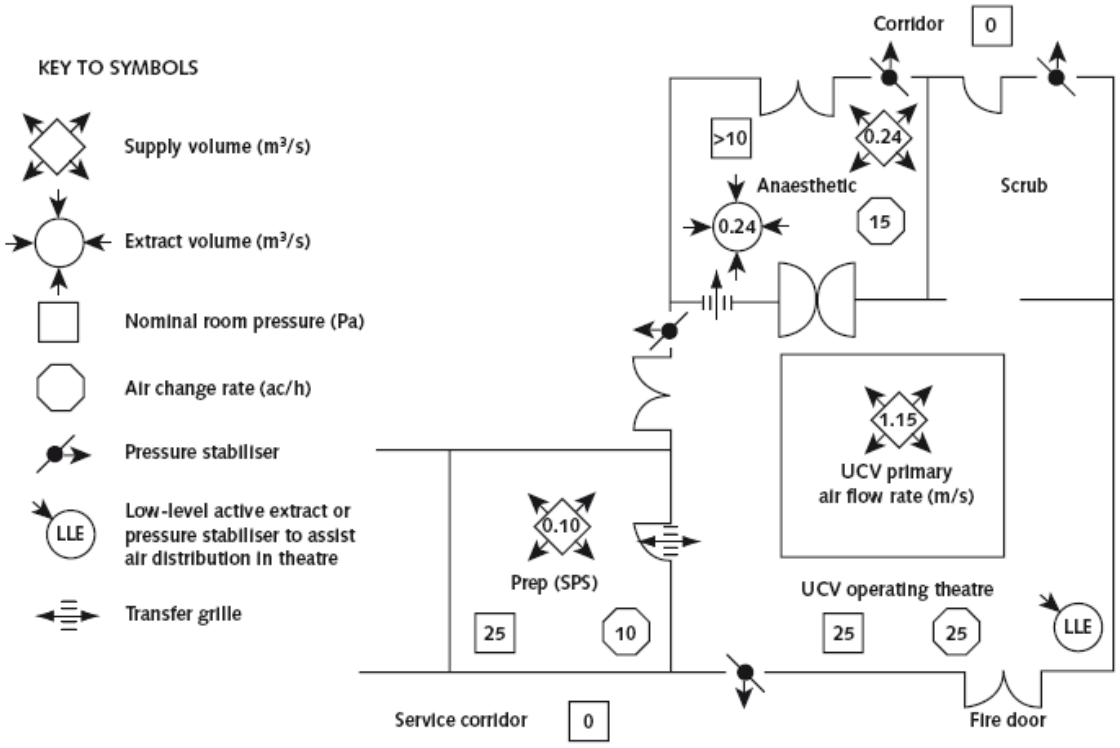
*This is a separate scrub and is not considered as being part of the theatre volume.

**Interchange is not permitted between the theatre and lay-up prep; therefore an airflow protection of 0.28 + 0.06 closed-door airflow is required as a minimum.

The volume of air to be extracted from the theatre should be determined by subtracting the airflow required for door protection at the exits from the total air entering the theatre space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre may be either passive and fitted with pressure stabilisers or active and connected to the extract system. They should be located at low level and positioned to promote the ventilation of all areas of the space.

New standard layout N° 2 - Suitable for a typical UCV theatre suite (Room sizes as specified in HBN 26)



Room	Size m³ Derived from HBN26	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	165	25	25	1.15**
Anaesthetic	57	15	>10	0.24
Sterile Prep	36	25	25	0.10
Scrub	*	-	25	-

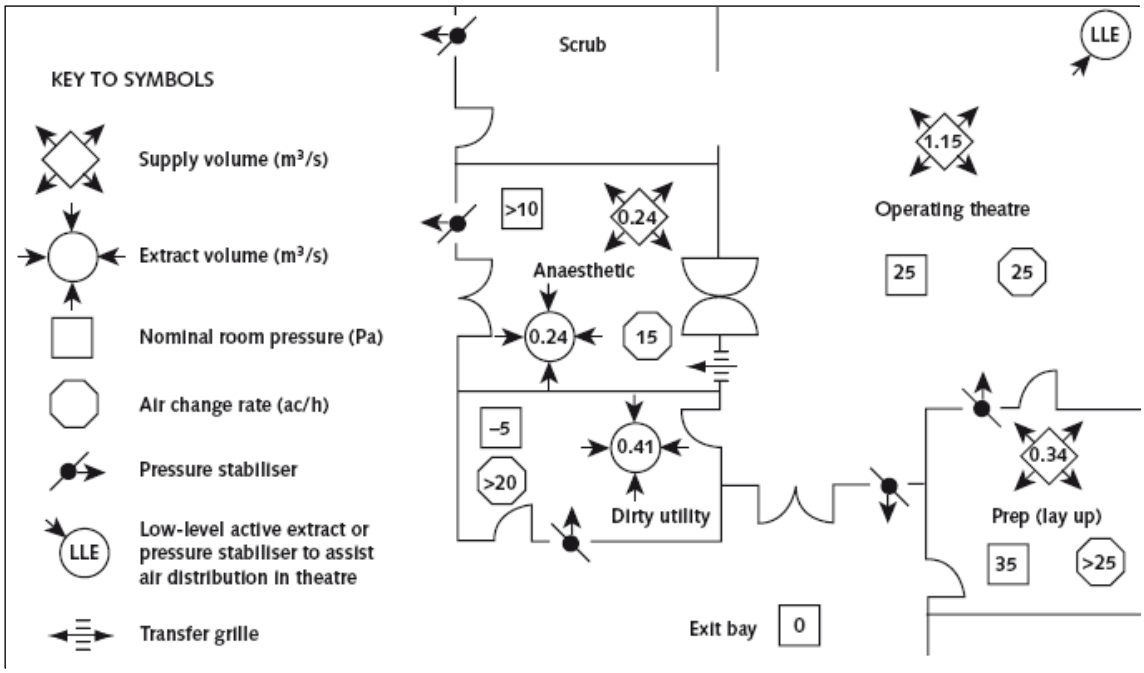
*Separate scrub and not considered as part of theatre volume

**Primary Fresh air Volume Only

The volume of air to be extracted from the theatre should be determined by subtracting the airflow required for door protection at the exits from the total air entering the theatre space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre may be either passive and fitted with pressure stabilizers or active and connected to the extract system. They should be located at low level and positioned to promote the ventilation of all areas of the space.

New standard layout N° 3 - Suitable for a typical Conventional theatre suite (Layout and room sizes are as illustrated in HBN 26)



Room	Size m³ Derived from HBN26	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	165	25	25	1.15
Anaesthetic	57	15	14	0.24
Lay-Up Prep	36	>25	35	0.34**
Scrub	*	-	25	-
Dirty Utility	36	-	-5	0.41

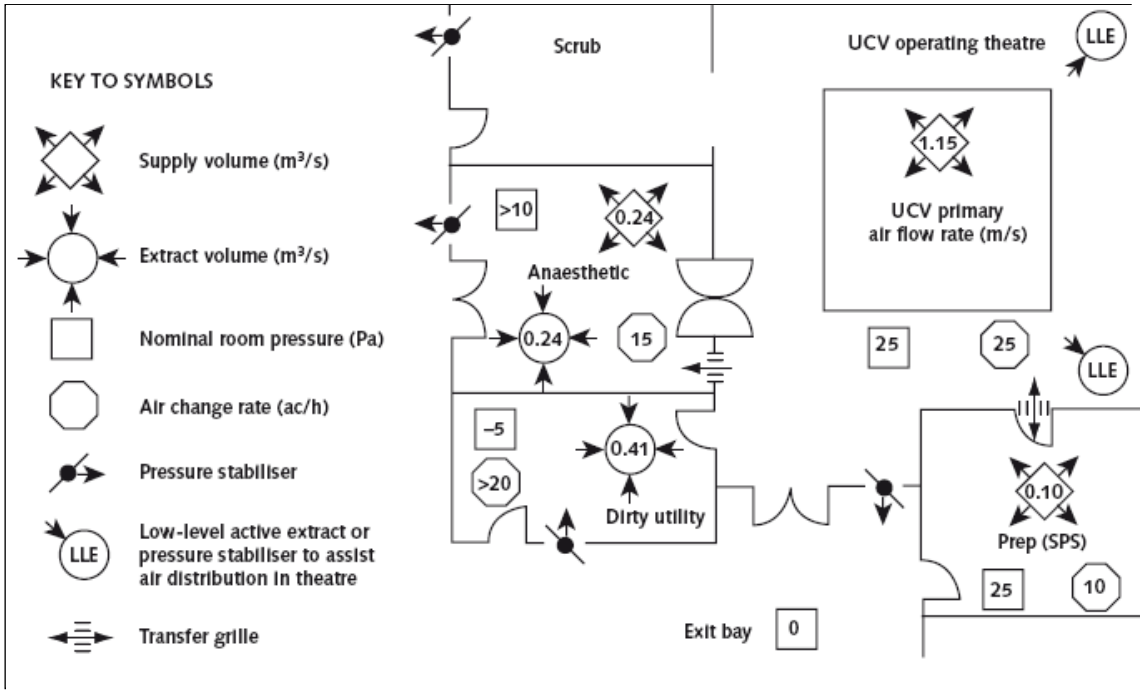
*Separate scrub not considered part of theatre volume.

**Interchange is not permitted between the theatre and lay up prep therefore as Table 4 an airflow protection of 0.28 + 0.06 closed door air flow is required as a minimum.

The volume of air to be extracted from the theatre should be determined by subtracting the airflow required for door protection at the exits from the total air entering the theatre space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre may be either passive and fitted with pressure stabilizers or active and connected to the extract system. They should be located at low level and positioned to promote the ventilation of all areas of the space.

New standard layout N° 4 - Suitable for a typical UCV theatre suite (Layout and room sizes are as illustrated in HBN 26)



Room	Size m³ Derived from HBN26	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	165	25	25	1.15**
Anaesthetic	57	15	>10	0.24
Sterile Pack Prep	36	10	25	0.10
Scrub	*	-	25	-
Dirty Utility	36	-	-5	0.41

* Separate scrub not considered part of theatre volume

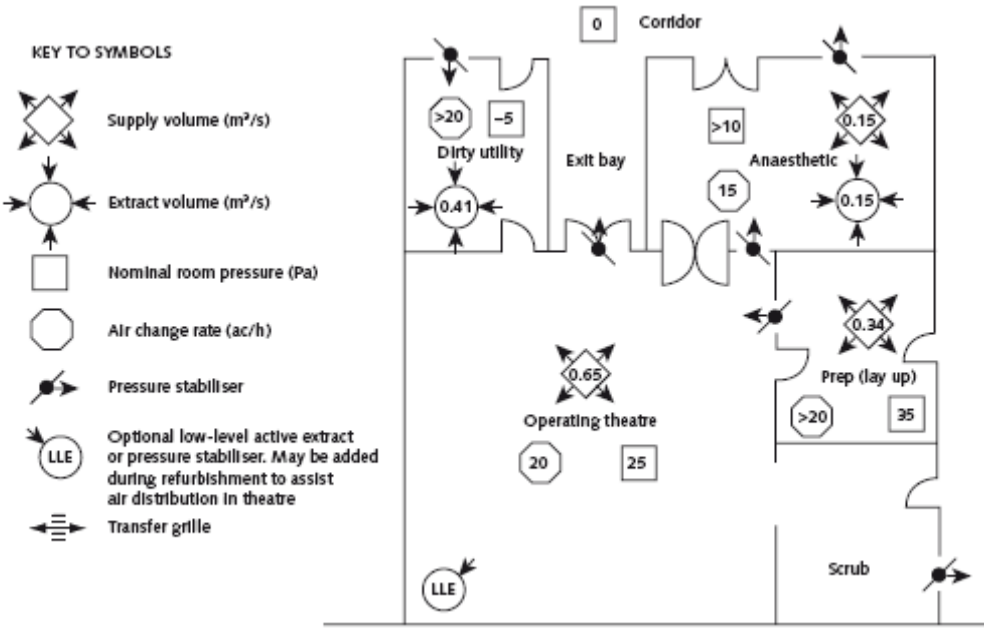
**Primary Fresh air Volume Only

The volume of air to be extracted from the theatre should be determined by subtracting the airflow required for door protection at the exits from the total air entering the theatre space. The balance should be equally divided between the passive or active extract locations.

The extracts within the theatre may be either passive and fitted with pressure stabilizers or active and connected to the extract system. They should be located at low level and positioned to promote the ventilation of all areas of the space.

New standard layout N° 5 - SHTM 2025 Existing standard plan '1b' typical layout for a conventional theatre suite

This layout and data is for historical purposes only. The information is to be used for the evaluating of existing systems or rebalancing following ventilation system cleaning.

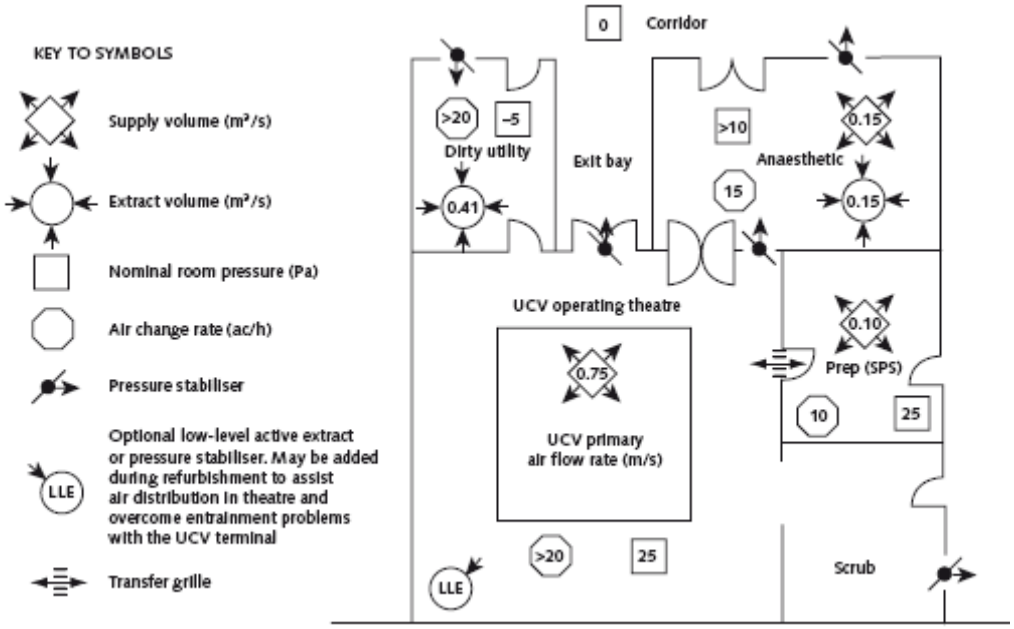


Room	Size m³	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	Existing Theatre Suite to Be measured on site	20	25	0.65
Anaesthetic		15	14	0.15
Lay-Up Prep		-	35	0.34
Scrub		-	25	Included within theatre
Disposal		-	-5	0.41

The disposal layout detailed will remain the same should a hatch be utilised instead of a door onto the outer corridor.

Standard layout No 6 - SHTM 2025 Existing standard Plan '1a' Typical layout for a UCV theatre suite

This layout and data is for historical purposes only. The information is to be used for the evaluating of existing systems or rebalancing following ventilation system cleaning.



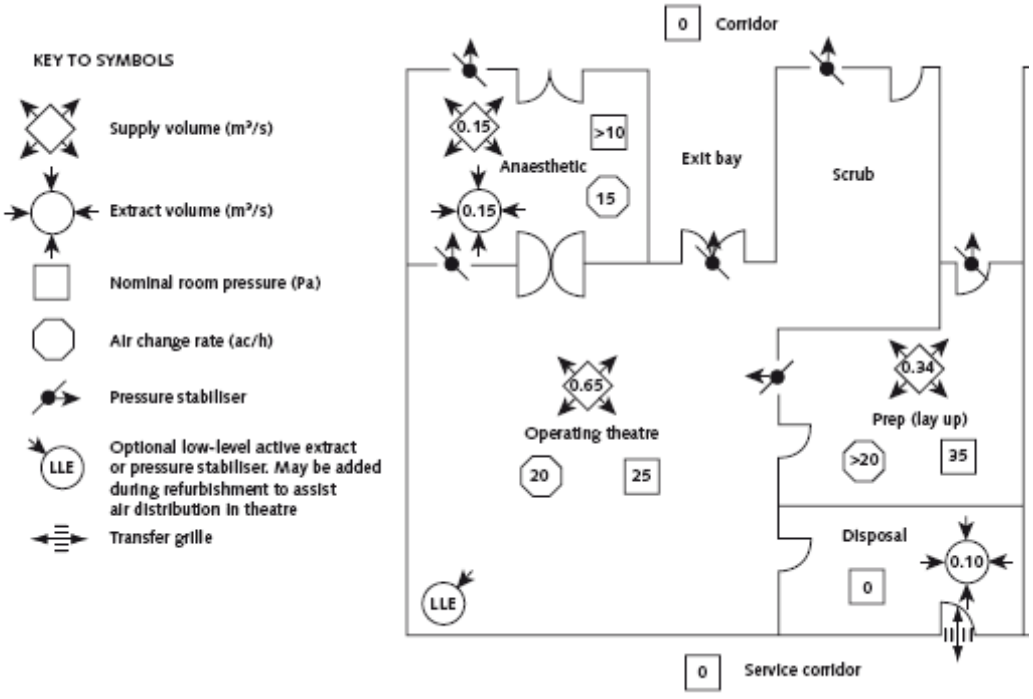
Room	Size m^3	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m^3/s
Theatre	Existing Theatre Suite to be measured on site	20	25	0.75*
Anaesthetic		15	>10	0.15
Sterile Pack Prep		10	25	0.1
Scrub		-	25	Included within theatre
Disposal		-	-5	0.41

*Primary fresh airflow volume

The disposal layout detailed will remain the same should a hatch be utilised instead of a door onto the outer corridor.

Standard layout N° 7 - SHTM 2025 Existing standard Plan '5b' Typical layout for a conventional theatre suite

This layout and data is for historical purposes only. The information is to be used for the evaluating of existing systems or rebalancing following ventilation system cleaning.

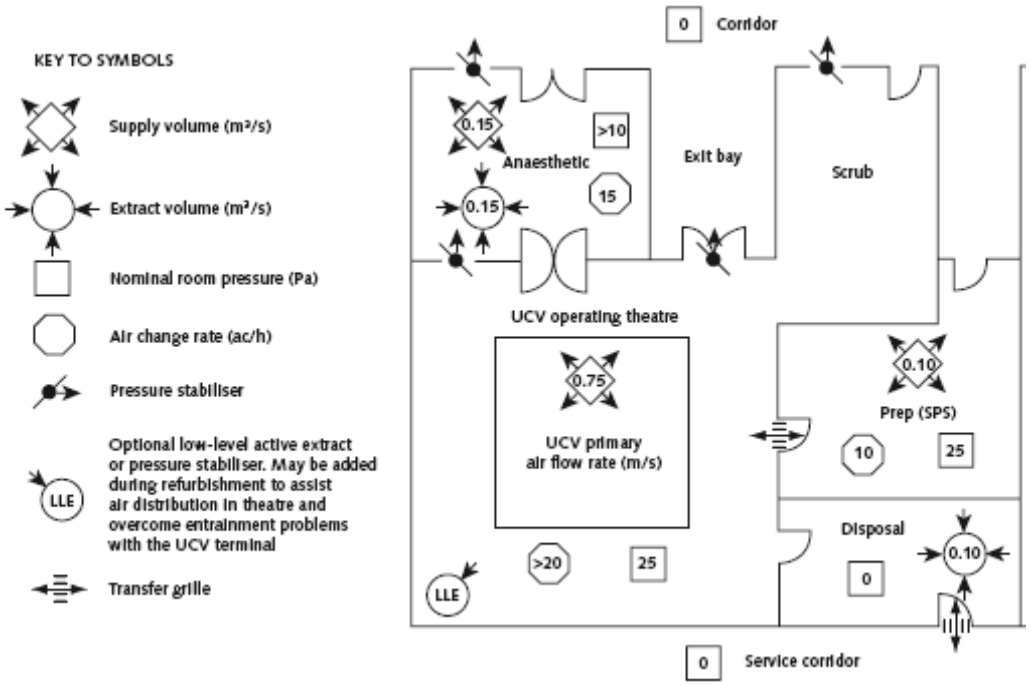


Room	Size m³	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	Existing Theatre Suite to be measured on site	20	25	0.65
Anaesthetic		15	>10	0.15
Lay-Up Prep		>20	35	0.34
Scrub		-	25	Included within theatre
Disposal		-	0	0.1

The disposal layout detailed will remain the same should a hatch be utilised instead of a door onto the outer corridor. Alternatively the disposal room could be omitted and replaced with a disposal hatch between the theatre and corridor.

Standard layout N° 8 - SHTM 2025 Existing standard Plan '5a' Typical layout for a UCV theatre suite

This layout and data is for historical purposes only. The information is to be used for the evaluating of existing systems or rebalancing following ventilation system cleaning.



Room	Size m³	Air Change Rate per hour	Nominal Pressure Pa	Flowrate m³/s
Theatre	Existing Theatre Suite to be measured on site	20	25	0.75*
Anaesthetic		15	>10	0.15
Sterile Prep		10	25	0.1
Scrub		-	25	Included within theatre
Disposal		-	0	0.1

*Primary fresh air-flow volume only

The disposal layout detailed will remain the same should a hatch be utilised instead of a door onto the outer corridor. Alternatively the disposal room could be omitted and replaced with a disposal hatch between the theatre and corridor.

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Appendix 4: Design of air-movement control schemes for operating theatres.

General

A4.1 Standard operating suite design solutions are given in Appendix 3. If these standard solutions cannot be used, the following procedure should be adopted, which will result in an acceptable design. Note that the method employed can equally be used to provide a design solution to a ventilated suite of rooms for any application.

A4.2 The method is concerned with the calculation of airflow rates to ensure that correct air movement occurs between rooms when any one door is open. Under most circumstances, the air quantities required for air-movement control will approximate to those for either temperature control or bacterial contaminant dilution. This flow rate is sufficient to control the effects of any slight reverse flows occurring when a door is opened.

A4.3 The progression through the design procedure is shown in the airflow design procedure chart (Figure A4/3) and is supported by worksheets WS1 to WS7 described in Paragraph A4.4. It is recommended that a plan of the suite and an airflow network be made (Figure A4/2) to collate all information. Flow rates, air-transfer devices etc should be entered as required. The remainder of this Appendix may be treated as reference data to assist in the various steps. The following symbols are used:

S_S – supply airflow rate for summer temperature control;

S_W – supply airflow rate for winter temperature control;

S_D – supply airflow rate for dilution of bacterial contaminants;

S_L – supply airflow rate for heat loss;

S_G – supply airflow rate for heat gain;

E_D – extract airflow rate for dilution of bacterial contaminants;

S_F – final supply airflow rates;

E_F – final extract flow rates;

S_{AMC} – air-supply flow rate for air-movement control;

E_{AMC} – air-extract flow for air-movement control;

L_{OUT} – leakage airflow rate outward;

L_{IN} – leakage airflow rate inward;

$\sum_{OUT}$ – total airflow rate outward;

$\sum_{IN}$ – total airflow rate inward.

A4.4 To simplify the procedure, standard worksheets (WS1 to WS7) have been devised. For each operating suite, a set is required comprising one each of WS1, WS3, WS5, WS6a, WS6b and WS7, one WS4 for each corridor and one WS2 to cover each peripheral room. WS2 has five versions:

- WS2a single flow;
- WS2b parallel/series multi-flow;
- WS2c parallel multi-flow or series multi-flow (unbalanced);
- WS2d series multi-flow (balanced); and
- WS2e bay (semi-open).

Peripheral room type

A4.5 The rooms in the operating suite other than the operating room and corridor are referred to as peripheral rooms. Peripheral rooms have been classified according to the flows in and out. These room classifications are defined below in Paragraphs A4.6 – A4.11.

Single flow

A4.6 This is a room with only one door and a net surplus of supply or extract air.

Parallel multi-flow

A4.7 This is a room with two or more doors through each of which the air-flows either outwards (high-pressure) or inwards (low-pressure) (for example the Prep (lay-up) in standard layout 5).

Parallel/series multi-flow

A4.8 This is a room having a net surplus of supply or extract and with two or more doors. One or more doors will be to an area of equal cleanliness and need not be protected; hence, the flow may vary between inwards and outwards, the remaining door being to an area of greater or lesser cleanliness (for example the Prep (SPS) in standard layout 6).

Series multi-flow (unbalanced)

A4.9 This is a room having a net surplus of supply or extract and with two or more doors. Air flows inwards through one or more doors and outwards through one or more doors.

Series multi-flow (balanced)

A4.10 This is a room as in Paragraph A4.9 above, but having either no mechanical ventilation or no net surplus of supply or extract. (for example an anaesthetic room).

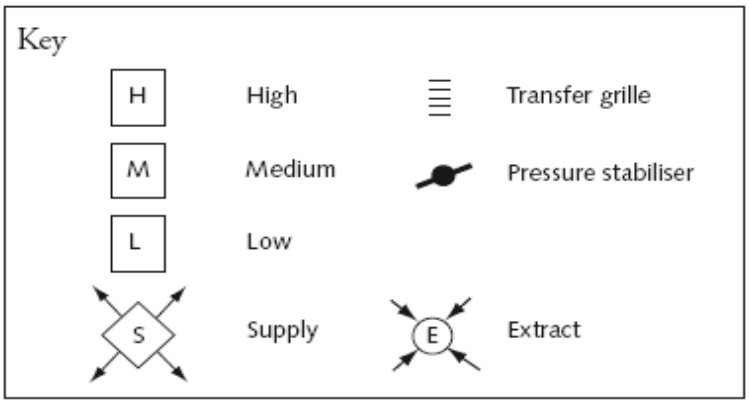
Bay

A4.11 A room that has a permanent opening to the operating room may be considered as a bay off the latter (for example a scrub). Two categories exist:

- open bay – the opening is larger than a normal single door opening. The bay may be considered as part of the main room;
- semi-open bay – the opening is no larger than a normal single door opening. In this case it is possible to protect the bay from the main room by provision of air supply or extract in the bay, or by passing air to or from another area.

Air-movement control in peripheral rooms

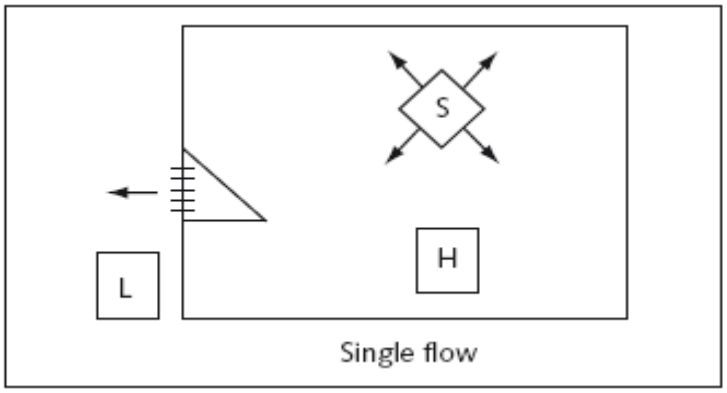
A4.12 For the design of air-movement control, two types of air-transfer device are considered. These are transfer grilles and pressure stabilisers. Each has a particular field of application within the design, as described in Paragraphs A4.34 – A4.43. Air movement is controlled in each of the different room types described in Paragraphs A4.13 – A4.31.



Note: This key applies to each diagram in A4.13 - A4.27.

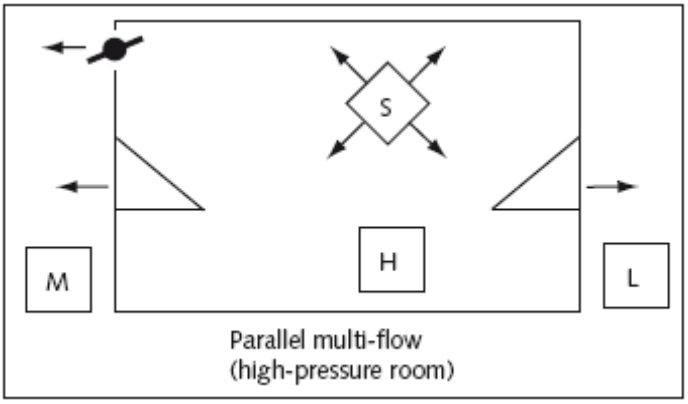
Single flow rooms

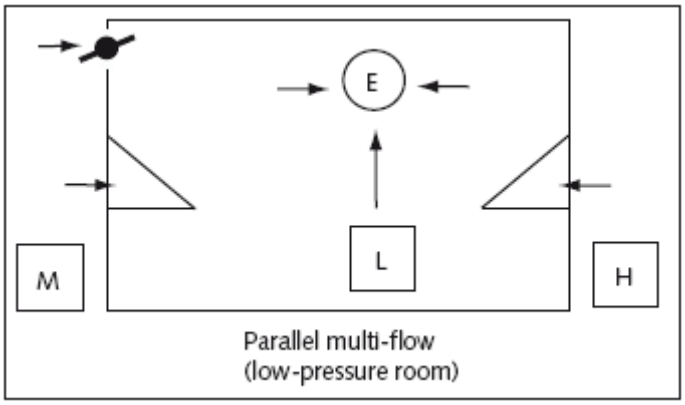
A4.13 An appropriately sized transfer grille should be located in or adjacent to the door of each single flow room to relieve the pressure differences across the door when closed.



Parallel multi-flow rooms

A4.14 The pressure difference across the closed doors must be relieved, but transfer grilles are not appropriate where two doors lead to areas of different pressures, because reverse flow could occur when the other door is open. For this reason, pressure stabilisers are used.



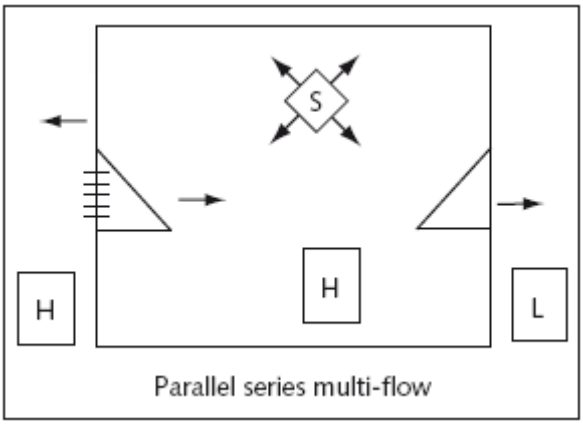


A4.15 These rooms will be either high-pressure or low-pressure with respect to the adjacent areas (see preparation lay-up room and disposal room, respectively, in standard layout 5). The pressure-relief damper is always situated between the room and area, which results in the smaller differential pressure to ensure best use of air.

A4.16 Just as reverse flow can occur if transfer grilles are used, it can similarly occur via door gaps when the other door is opened. It is not possible to avoid this, except by using air locks, but due to the low flow rates and short durations involved, this is not considered to be of importance.

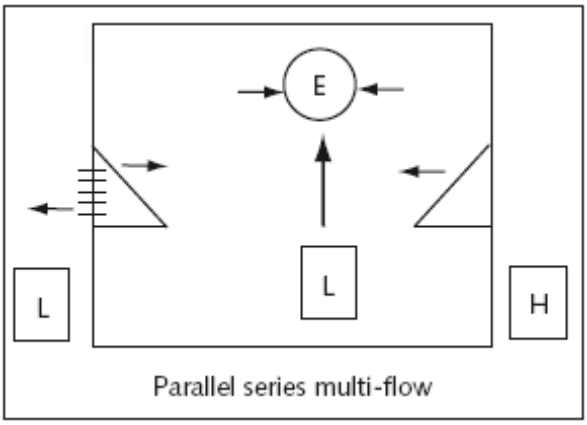
Parallel-series multi-flow rooms

A4.17 These rooms are similar to those in Paragraph A4.14 above, but because the room is of equal cleanliness to one of the adjacent rooms the nominal pressures will be equal and air may flow through the adjoining doorway in either direction. (for example the Prep (SPS) in standard layout 6).



Parallel series multi-flow

A4.18 Where the nominal room pressure equals that of the higher-pressure adjacent room, the best use of air is by supplying air required for bacterial dilution only and allowing this to exhaust via a transfer grille to the area of equal cleanliness. The doorway to the lower pressure area is protected by the combination of the supply air and the air that will flow inwards through the transfer grille from the area of equal cleanliness.

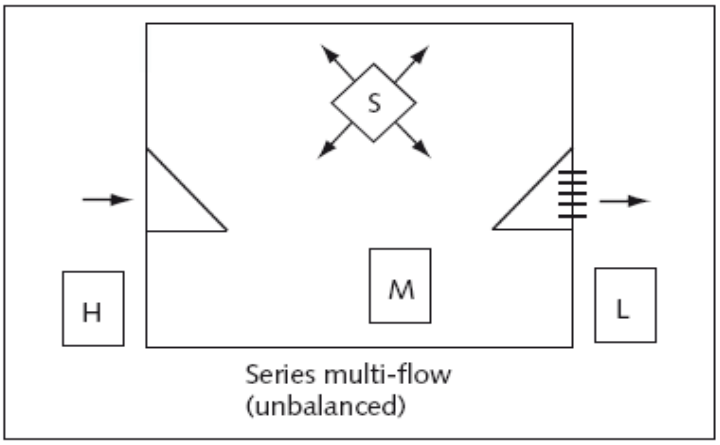


Parallel series multi-flow

A4.19 Conversely, where the nominal pressure equals that of the lower-pressure adjacent room, extract ventilation and a transfer grille to the lower pressure adjacent room should be provided. (for example, the disposal room in standard layout 8).

Series multi-flow (unbalanced)

A4.20 These rooms are somewhat similar to those in Paragraph A4.15 above, but because the pressure lies between that of the rooms on either side, the back-flow problem does not exist.



Series multi-flow (unbalanced)

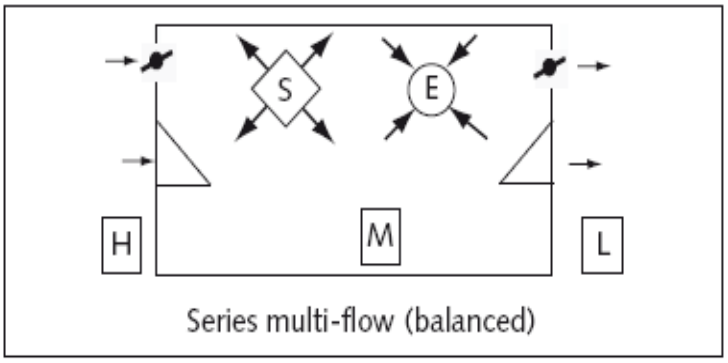
A4.21 Where the room has a net surplus of mechanical supply air, a transfer grille should be located in or adjacent to the door through which air flows outwards, and the mechanical supply flow rate to the room should be chosen to give protection when this door is open.

A4.22 Where the room has a net surplus of mechanical extract air, a transfer grille should be located adjacent to the door through which the air flows inwards, and the mechanical extract flow rate to the room should be chosen to give protection when this door is open.

A4.23 The grille must be sized for the protection requirement of the opposing door when open. When the room on the high-pressure side depressurises, there is a possibility of back-flow through gaps around the door, but this problem may be ignored.

Series multi-flow (balanced)

A4.24 In these rooms, a transfer device adjacent to each doorway is required in order to provide a flow path for the air required to protect the opposing door when opened.



Series multi-flow (balanced)

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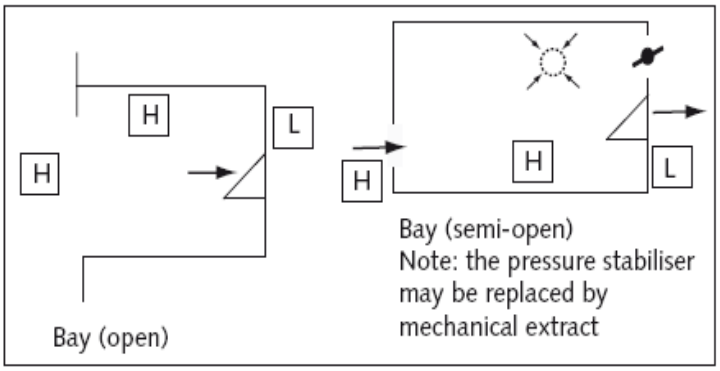
A4.25 These transfer devices will normally be pressure stabilisers, although transfer grilles may be used where a large amount of excess air is to be exhausted from the operating room when all doors are closed. (for example, anaesthetic rooms).

A4.26 The calculation procedure is to assume that pressure stabilisers are being used; then (if there is sufficient excess air) change to transfer grilles as described in Paragraph A4.50.

Bay

Open bay

A4.27 A bay of the open type (for example scrub-up) is considered to be part of the operating room. Provided air movement is satisfactory, no specific extract is required.



Semi-open bay

A4.28 In a bay of the semi-open type, protection of one area from the other is possible. (For example scrub-up).

A4.29 As stated previously, the need for protection between operating room and scrub-room is not very great. Better use of air can therefore be achieved in this case by installing a pressure stabiliser between the scrub-room and clean corridor. This will allow a flow of air through the scrub-room at all times, except when a door is opened elsewhere in the suite. The pressure stabiliser will then close and the air will be diverted to the other door. When it is considered necessary to protect the scrub-room at all times, either a transfer grille to the corridor or mechanical extract in the scrub-room should be provided.

Operating room

A4.30 Once the peripheral rooms have been considered, the operating room requirements may then be decided and the supply flow rate required for air-movement control calculated. This flow rate should be such that, with any one door open, the correct air movement directions are maintained. There will be one door in the suite that will require the largest supply flow rate to the operating room for protection when open. This is called the “key door” and is discussed separately in Paragraph A4.33. Use of this concept avoids repetitive

calculations for each door in turn. Having established the required supply flow rate, a relief route must be provided to the clean corridor for any excess air when the doors are closed. This would be via transfer grilles or pressure stabilisers through a series-flow room or via pressure stabilisers to the clean corridor directly.

Corridors

A4.31 All surplus air from the suite, except that lost through structure leakage and any passing to the outer corridor, will arrive in the patient/staff corridor. Should this air be insufficient to achieve the required air-change rate (see Appendices 1 and 2), some additional air supply should be provided. (The air balance should take account of structural leakage.)

Door opening

A4.32 Whereas the resulting pressures are dependent on ductwork layout, room relationships and characteristics of the fan, the generalisations shown in Appendix 2 can be used to estimate the change in room pressure when a door is opened.

A4.33 The “key door” will be the open double door which leaves the operating room at the highest pressure, and/or requires the largest air flow. This should be determined using the procedure in worksheet WS3.

Transfer grilles

A4.34 These may be used to limit the pressure differences across the closed door of a single-flow room or, in some instances, for protection of a series-flow or parallel-series-flow room. They allow airflow in both directions and may not be suitable for all applications.

A4.35 The free area of a grille is calculated from the following equation:

$$A = \frac{Q}{0.84\sqrt{\Delta P}}$$

where:

A is free area (m^2)

Q is flow rate (m^3/s)

P is pressure difference (Pa).

A4.36 The flow through a grille at a different pressure may be found from the following equation:

$$Q_2 = Q_1\sqrt{\frac{\Delta P_1}{\Delta P_2}}$$

where:

Q_1 and P_1 are original flow and differential pressure

Q_2 and P_2 are new flow and differential pressure.

A4.37 The transfer grille may be replaced by carefully proportioned door undercuts of the equivalent free area.

A4.38 The function of the transfer grille is to provide a means of airflow control by which the volume and pressure loss can be established. If a grille is used, it should have an easily removable core to facilitate cleaning.

Pressure-relief dampers

A4.39 The functions of a pressure-relief damper are now carried out by pressure stabilisers. Accordingly, all further mention of them has been removed from this document.

Pressure stabilisers

A4.40 Pressure stabilisers can be adjusted to hold the pressure constant over a wide range of flow rates. They are used where requirements exist for accurate room-pressure control or rapid shut-off on pressure fall.

A4.41 The installation of a grille or baffle in association with a stabiliser will alter the operating characteristics. It is recommended that a location be chosen to avoid the need for visual screening, for example, at high level. The location should be chosen to minimise the likelihood of damage.

A4.42 The stabilisers used should be virtually silent in operation, adjustable on site, maintenance-free and of a type that cannot be wrongly inserted. They should not be used in external walls or where the pressure difference is less than 5 Pa. The required size of a pressure stabiliser is dependent on the design pressure difference across it and flow rate through it. The manufacturer should provide data relating pressure difference to mean velocity (or flow rate per unit area). From this, the required area can be calculated and then rounded-up to the nearest size manufactured or nearest combination of smaller sizes.

A4.43 It is sometimes possible to arrange for a pressure stabiliser to perform two tasks. In an anaesthetic room, for example, the two pressure stabilisers may be made to pass the open door protection air, and also control the operating and anaesthetic room pressures with the door closed. To achieve this, the stabilisers are sized for the flow rate required with one of the doors open, but

the pressure setting is adjusted to be the value required with the doors closed. This is shown in Figure A4/1.

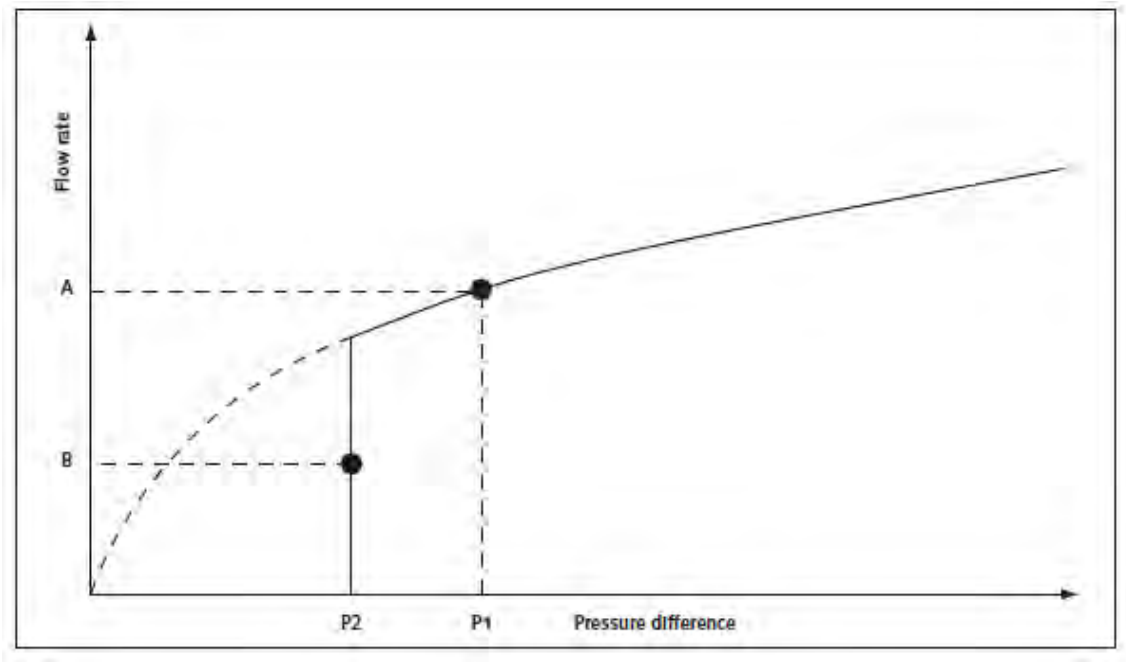


Figure A4/1

Door leakage flows

A4.44 For an air-movement control scheme to work satisfactorily, it is essential that the estimates of door-gap leakage made at the design stage are closely related to those which are achieved in practice. The calculation of gap-flows is complicated by the fact that such flows generally fall into the transition region between laminar and turbulent flow and hence do not follow the normal flow equations. The gaps assumed are 4mm along the bottom, 3mm at the top and sides, and 2mm between double leaves. Doors should not have wider gaps than these. Tighter gaps would result in lower flow-rate requirements and hence lower fan power, but care should be taken to ensure that all doors in the suite have similar gap dimensions. It may be possible to ignore the door leakage and so reduce the airflow requirement (see the notes in Appendix 3).

Room temperature estimation

A4.45 The air-flow rate required to prevent back-flow through an open door is dependent on the temperature difference across the door. The design figures shown in Appendix 3 are based on the temperature differences that will normally occur in practice, assuming heat gains and losses in accordance with Appendix 2.

A4.46 In accordance with the airflow design process, the temperature differences across the doors of all rooms classed as “sterile” is calculated. Worksheet WS6 is recommended for the calculations, using the following criteria:

- assume that the operating room is being controlled at 20°C and calculate the incoming air-supply temperature as shown on worksheet WS6;

- the calculation should be repeated for both summer and winter conditions, with an operation in progress;
- assume all doors are closed;
- use the room supply flow rates from WS1;
- use the inward air flows through air-transfer devices and closed door leakages from WS2a to WS2e;
- the formula used in worksheet WS6 is as follows:

$$T = \frac{(t_1Q_1 + t_2Q_2 + \cdots + t_nQ_n) + 0.828H}{(Q_1 + Q_2 + \cdots Q_n)}$$

where:

Q = flow rate from source (m^3/s)

t = the temperature of source (°C)

H = the room heat gain (kW).

A4.47 If the evaluated temperature differences between rooms do not exceed 2°C, the solution is satisfactory; otherwise proceed as follows:

- check the assumption on which the heat gains are based;
- take steps to reduce the heat gains;
- if the door is to a corridor, the flow through the open door will be larger than the value given in Appendix 2. Calculate on WS3, assuming it is the “key door” with door-flow unknown, and the supply as known;
- if the door leads to a room with mechanical supply, install a trimmer heater in the supply to the room controlled by either a differential thermostat or a thermostat slaved to the operating room thermostat to ensure that T is minimized.
- If the door leads to a room with no mechanical supply, increase the door protection flow as follows:

$$Q_{new} = Q_{old}\left[\frac{\Delta T + 1}{2}\right]$$

A4.48 These options should be considered in the above order, and the first three should be investigated thoroughly before proceeding to the latter two. The mechanical supply may need to be increased in order to achieve the desired air-change rates.

Relief of excess air from operating room when all doors are closed

A4.49 As the mechanical supply to the operating room is sized to provide an appropriate flow outward through any door that is opened, it follows that when all doors are closed, there will be more air supplied to the operating room than

can exit from it via leaks etc. This “excess” air can be relieved by either of the two methods described in Paragraphs A4.50 - 4.54.

By transfer devices via the anaesthetic room

A4.50 For door protection, the transfer devices in the anaesthetic room are typically designed to pass 0.47 m^3/s at a differential pressure of 14 Pa. When the doors are closed, the differential pressure will change to 11 Pa between theatre and anaesthetic room, and 14 Pa between anaesthetic room and corridor; the volume of air passed by the transfer devices will be modified as shown in the following formula:

$$Q = Q_1\left(\frac{\Delta P_1}{\Delta P_2}\right)^{1/2}$$

$$= 0.47\left(\frac{11}{14}\right)^{1/2}$$

$$= 0.42\ m^3/s$$

where:

Q = “excess” air to be vented with doors closed;

Q_1 = air-flow required for door protection through transfer device;

ΔP_1 = nominal differential pressure with door to operating room closed and door to corridor closed;

ΔP_2 = nominal differential pressure between either the anaesthetic room and corridor when the operating room door is open, or the anaesthetic room and operating room when the corridor is open. This differential pressure is used when selecting size of both devices.

A4.51 If the “excess” air is less than 0.42 m^3/s, a pressure stabiliser is required to ensure that the correct protection airflow is available to pass through the door.

A4.52 If the “excess” air is greater than 0.42 m^3/s, a transfer grille is acceptable because at all times the airflow will exceed the flow required for door protection.

By pressure stabilisers to the corridor

A4.53 If it is undesirable to pass operating room air through the anaesthetic room, it may be passed directly to a corridor via a separate pressure stabiliser.

A4.54 If there is sufficient “excess” air, the transfer grille solution at Paragraph A4.52 should be adopted, as it provides the simplest solution and, once set up, will require no further maintenance. With less excess air, it is recommended that the air be passed through the anaesthetic room via the pressure stabilisers as at Paragraph A4.51, thus keeping the number of pressure stabilisers to a minimum. Both these solutions increase the air-change rate in the anaesthetic

room, but care should be taken to avoid passing excessive amounts through that would cause discomfort to the occupants.

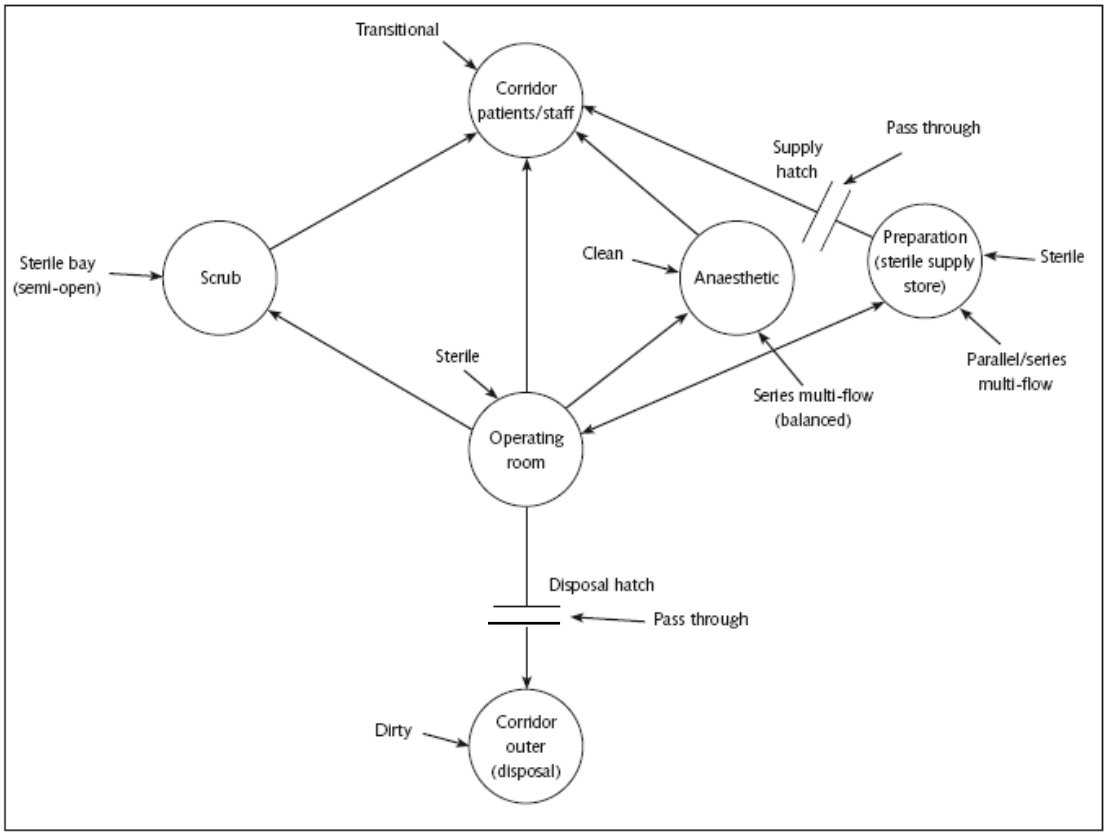
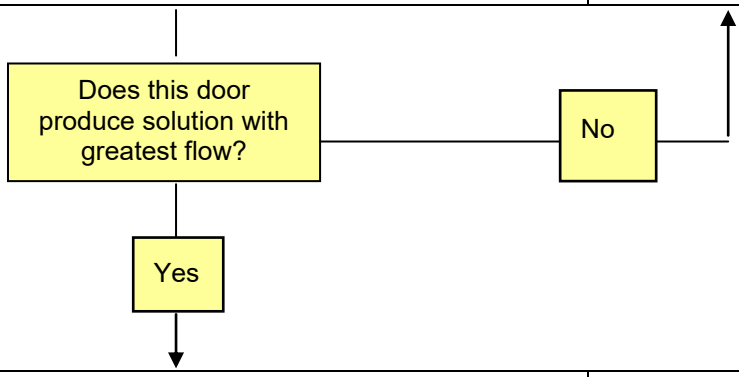
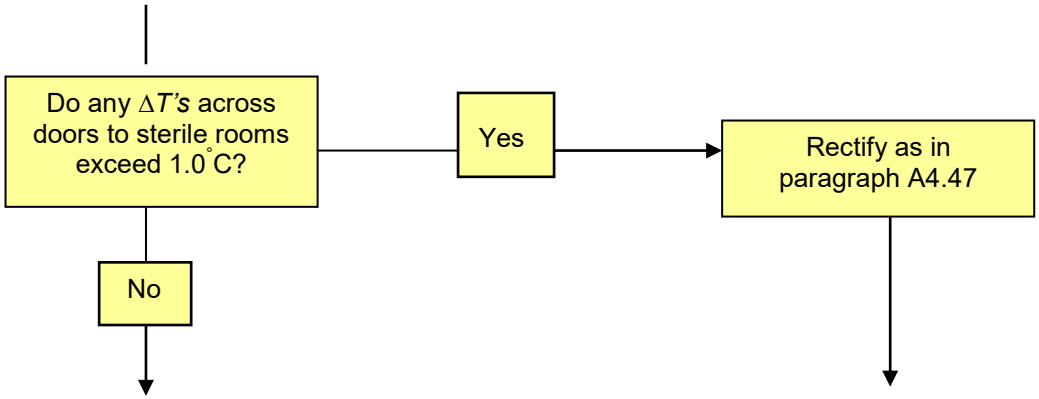


Figure A4/2: An example of an airflow network

Step	Description	Worksheet
1	Show nominal room pressures and air flow directions on the plan of the theatre suite and WS1	WS1
2	Enter heat/loss/gain data and calculate supply airflow rates for temperature control only. Categorise room types e.g. sterile, clean etc.	WS1
3	Enter airflows required for bacterial contamination control or air change rate whichever is the greater, add supply and extract volumes (S_D, E_D) on the plan.	WS1
4	Define peripheral room types, see paragraphs A4.5 - A4.11, and select appropriate worksheets.	Select from WS2a - WS2e
5	Locate air transfer devices, enter details on worksheets and locate on the plan and Figure A4/2	Selected worksheets from WS2a - WS2e
6	For each peripheral room, determine air flows through doors when open and calculate mechanical supply or extract and transfer device flows	As above
7	Select "Key Door" and calculate air supply for operating room	WS3



8	Transfer to WS1 and select final rate S_F and E_F	WS1. WS3
9	Make provision for relief of excess air with doors closed	Selected Worksheets and WS3
10	Calculate supply and extract flow rates for corridor(s)	WS4, WS5
11	Calculate room temperatures (all doors closed) and ΔT's	WS4, WS5



12	Make summary of flows	WS6a and WS6b
13	Size transfer devices, size ductwork, central plant etc	WS7
14	Design ductwork layout, control plant etc	

Figure A4/3: Airflow design procedures

Note: In the following worksheets WS1, WS2a-e, WS3, WS4, WS5, WS6a&b and WS7 it has been necessary to reduce the font size to 8pt instead of the usual 10pt in order to set out the complete tabular information for each within a single page for ease of use.

Calculation sheet for			**Worksheet WS1** **Reference:**			
Room Name:						
1. Summer Temperature Control Heat Gain	kW					
2. Acceptable Δt	°C					
3. Air flow rate (S_G) $= \frac{\text{Gain}}{\Delta t \times 1.2}$	m^3/s					
4. Winter Temperature Control Heat Loss	kW					
5. Acceptable Δt	°C					
6. Air flow rate (S_L) $= \frac{\text{Loss}}{\Delta t \times 1.2}$	m^3/s					
7. Dilution of bacterial contaminations Air flow rate	m^3/s					
S_D or E_D						
8. Desired air change rate	ac/hr					
$\frac{\text{AC/hr x room volume } (m^3)}{3600}$	m^3/s					
9. Maximum of S_G, S_L, S_D or E_D or air change rate from Step 8	m^3/s					
10. Air movement control	S m^3/s					
Air flow for air movement control S_{AMC} or E_{AMC} (from WS2, WS3, or WS4)	E m^3/s					
11. Final Supply Flow Rate (S_F)	m^3/s					
12. Final Extract	m^3/s					
13. Total Supply	m^3/s					
14. Total Extract	m^3/s					

Surveyor (AP(V)/CP(V))…… **Date**……

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Air Movement Control **Peripheral Room** ..... **type, single flow**	**Worksheet WS2a** **Reference:** **Nominal Pressure:** ..... **Pa**

Consider door to..... open

Flow required through doorway to give protection	Pa	Δt	Air flow, m^3/s Out	In	Remarks
Total					

S_{AMC} $(\sum_{OUT} - \sum_{IN})$ ____ m^3/s

or

E_{AMC} $(\sum_{OUT} - \sum_{IN})$ ____ m^3/s

Transfer S_{AMC} or E_{AMC} to WS1

Consider door to.....closed

Closed door leakage	Pa	Δt	Out	In	Remarks
Total					

Return S_F and E_F to WS1 ____ ____

Flow through transfer grille outward ($S_F - E_F - L_{OUT}$ ____

or

Flow through transfer grille inward ($E_F - S_F - L_{IN}$) ____

Surveyor (AP(V)/CP(V))..... **Date**.....

Air movement control **Peripheral Room ..... type, parallel/series multi-flow**	**Worksheet WS2b** **References:** **Nominal Pressure: Pa**

Door from this room to ..... (room of equal cleanliness) is not to be protected.
A transfer grille is located in, or adjacent to, this door.

Consider door to..... open

Room pressure now becomes [ ] or [ ] or [ ] Pa (see Appendix 6)

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
At above pressures leaks through closed doors	Pa	ΔP			
Mechanical supply or extract (S_F/E_F)					
		Total			

X ($\sum$ OUT - $\sum$IN) [ ] Or Y ($\sum$ IN - $\sum$OUT) [ ]

Transfer grille required:

or from high-pressure zone Flow = *X* [ ] at [ ] ΔPa

to low-pressure zone Flow = *Y*

Size of transfer grille (free area) A1 [ ]

Consider doors and hatch closed – room pressure becomes [ ] Pa (nominal)

Closed door leakage from Appendix 4 (assuming no transfer grille)	Pa	ΔP	Out	In	Remarks
Mechanical supply or extract					
		Total			

Air flow required through transfer grille = IN – OUT = Z' [ ]

or OUT – IN = Z'' [ ]

Transfer grille required flow *Z' or Z''* [ ] @ [ ] ΔP

Size of transfer grille (free area) A2 = [ ]

Select larger of A1 or A2 [ ]

Surveyor (AP(V)/CP(V))..... Date.....

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Air movement control **Peripheral Room ..... type, parallel multi-flow high/low or series multi-flow (unbalanced)**	**Worksheet WS2c** **References:** **Nominal Pressure: Pa**

Consider door from this room to ..... open.

Room pressure now becomes [ ] or [ ] or [ ] Pa (see Appendix 6)

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
At above pressures leaks through closed doors	Pa	ΔP			
		Total			

S_1 ($\sum_{OUT} - \sum_{IN}$) [ ] Or E_1 ($\sum_{IN} - \sum_{OUT}$) [ ]

Consider door from this room to ..... open

Room pressure then becomes [ ] or [ ] or [ ] Pa

			Out	In	Remarks
Flow required through open doorway to give protection					
At above pressures leaks through closed doors are:	Pa	ΔP			
		Total			

S_2 ($\sum_{OUT} - \sum_{IN}$) [ ] Or E_2 ($\sum_{IN} - \sum_{OUT}$) [ ]

Consider doors closed. Closed doors leakage from Appendix 4

Door to:	Pa	ΔP	Out	In	Remarks
		Total			

Return S_F and E_F to WS1 [ ] [ ]

Flow through transfer grille outward ($S_F - L_{OUT}$) [ ] to .....

or

Flow through transfer grille inward ($E_F - L_{IN}$) [ ] from.....

Transfer grille [ ] Pressure relief damper [ ]

Surveyor (AP(V)/CP(V))..... Date.....

Air movement control **Peripheral Room ..... type, parallel/series multi-flow**	**Worksheet WS2d** **References:** **Nominal Pressure:** **Pa**

Note: In this type of room the supply and extract air flow rates are equal and take no part in the air movement control (AMC)

First, open door to higher pressure area.

Room pressure then becomes [ ] or [ ] or [ ] Pa (see Appendix 2)

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
At above pressures leaks through closed doors	Pa	ΔP			
Total					

Q_1 ($\sum_{IN}$ - $\sum_{OUT}$) [ ] (+ve inwards)

Next, open door to lower pressure area.

Room pressure then becomes [ ] or [ ] or [ ] Pa

			Out	In	Remarks
Flow required through open doorway to give protection					
At above pressures leaks through closed doors are:	Pa	ΔP			
Total					

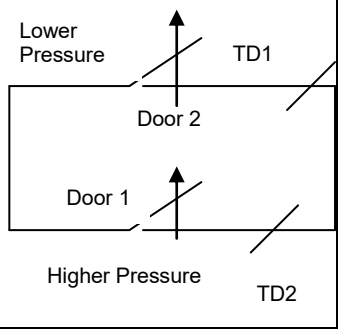
Q_1 ($\sum_{IN}$ - $\sum_{OUT}$) [ ] (+ve inwards)

Flow through transfer device (TD1) to protect Door 1 = Q1 at resultant [ ]

ΔP .....

Flow through transfer device (TD2) to protect Door 2 = Q2 at resultant [ ]

ΔP .....



Surveyor (AP(V)/CP(V))..... Date.....

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Air movement control **Peripheral Room ..... type bay (semi-open)**	**Worksheet WS2e** **References:** **Nominal Pressure:** **Pa**

Note: If the room is of the open bay type (i.e. opening is larger than normal single doorway), then room should be considered part of the main room. No air movement control considerations need then be made, and this sheet can be discarded. Supply and/or extract flow ill be based on air distribution considerations.

Consider permanent opening

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
At above pressures leaks through closed doors	Pa	ΔP			
		Total			

E_{AMC} [ ] or flow outward through transfer ($\sum_{IN} - \sum_{OUT}$) [ ]

Transfer S_{AMC} or E_{AMC} to WS1

Transfer device – transfer grille [ ]

– pressure stabiliser [ ]

Size select transfer device for flow rate [ ] @ ΔP [ ]

Note: A door from the bay is considered with the peripheral room to which it leads or, if it leads to the corridor, it is considered with the main room.

Surveyor (AP(V)/CP(V))..... Date.....

Air movement control **Operating Room**	**Worksheet WS3** **References:** **Nominal Pressure:** **Pa**

Note: To avoid considering each door open in turn, the "key door" concept is introduced. This is the door which requires the greatest mechanical flow when open. See paragraph A4.33

Select "key door" (see above).

Consider this door open – room pressure now becomes _____ Pa (See Appendix 2)

See Appendix 3 for room pressures

			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
Air flow "out" or "in" via doors, transfer devices etc.	Pa	ΔP			
Mechanical extract					
Total					

S_{AMC} $(\sum_{OUT} - \sum_{IN})$ _____ Transfer S_{AMC} to WS1

Consider all doors closed.

Return S_F and E_F to WS1 _____ Room pressure now _____ Pa (nominal)

Air flow "out" or "in" via door leakage, transfer devices etc	Pa	Δt	Out	In	Remarks
Mechanical extract					
Total					

Flow $(\sum_{IN} - \sum_{OUT})$ through transfer device _____ @ ΔP _____ to……

……

For final selection of transfer device see paragraphs A4.50 – A4.54

Surveyor (AP(V)/CP(V))…… Date……

Air movement control **Corridor**			**Worksheet WS4** **References:** **Nominal Pressure:** **Pa**		
Consider all doors closed					
			Air flow, m^3/s		
			Out	In	Remarks
Flow required through doorway to give protection					
Leaks through closed doors, transfer devices, permanent openings etc.	Pa	ΔP			
Total flow inwards (S_1)					
Add mechanical input (S_2) if necessary to increase S_1 to give 7 AC/hr					
Total Flow Outwards and Inwards					
$S_{AMC} = (\sum_{OUT} - \sum_{IN} + S_2)$		Transfer to WS5			
or $E_{AMC} = (\sum_{IN} - \sum_{OUT} + S_2)$		Transfer to WS5			

Surveyor (AP(V)/CP(V))…… **Date**……

Air movement control **Corridor**	**Worksheet WS5** **References:**

Summary of Air Supply and extract for an Operating Suite

Consider all doors closed

Air Flow to Corridor	All Doors Closed	Anaesthetic (key door open)
	m^3/s	m^3/s
From Preparation		
From Operating Room		
From Scrub		
From Anaesthetic		
Total (a)		
Air Flow to Corridor from Disposal		
From other source		
Total (b)		
Other Room Supplies.....Total (c)		
Total Air Supply (a) + (b) + (c)		

Consider corridor ventilation (see Appendix 2) and calculate air volume required, based on 7 ac/hr (see Note 1)	
	m^3/s
Additional Air to Ventilate Corridor	
Additional Air to Ventilate Service Corridor (see Note 2)	
Air Extract The size of the extract plant should be of the order of 10% below the supply to assist in maintaining the department under positive pressure relative to the outside departments.	
	m^3/s
Extract Plant = Supply less Leakage	
Less 10% of Supply	
Total Extract (see Note 3)	

Surveyor (AP(V)/CP(V))…… **Date**……

Room Temperature - Summer

Worksheet WS6a

References:

Find summer supply temperature T_{SS} = 20 – 0.828 H/(O/R) ____ = T_{SS} ____ °C

Q(O/R) ____

Note: The temperature of a space may be calculated from

$$T = \frac{t_1 Q_1 + t_2 Q_2 + \ldots\ldots\ldots\ldots + t_n Q_n + (0.828H)}{Q_1 + Q_2 + \ldots Q_n}$$

Where t_1 is temperature of source (1°C)
Q_1 is flow from source 1 when all doors are closed (m^3/s)
H is heat gain in space (kW)

Summary of Air Supply and extract for an Operating Suite

Consider all doors closed

Room	Heat Gain kWh	Supply		Flows Inwards										Temperature °C T
				From		From		From		From		From		
		Q	T_{SS}	Q	t	Q	t	Q	t	Q	t	Q	t	

Check Doors to Sterile Areas

Door Between	Calculated Room ΔT (°C)	Maximum ΔT *Permitted*	Remarks

Surveyor (AP(V)/CP(V))…… **Date**……

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Room Temperature - Winter | **Worksheet WS6b**

References:

Find winter supply temperature T_{SW} = 20 – 0.828 H/(O/R) _____ = T_{SW} _____ °C

Q(O/R) _____

Note: The temperature of a space may be calculated from

$$T = \frac{t_1 Q_1 + t_2 Q_2 + \ldots\ldots\ldots\ldots + t_n Q_n + (0.828H)}{Q_1 + Q_2 + \ldots Q_n}$$

Where t_1 is temperature of source (1°C)
Q_1 is flow from source 1 when all doors are closed (m^3/s)
H is heat gain in space (kW)

Summary of Air Supply and extract for an Operating Suite

Consider all doors closed

Room	Heat Gain kWh	Supply		Flows Inwards										Temperature °C T
		Q	T_{SW}	From		From		From		From		From		
				Q	t	Q	t	Q	t	Q	t	Q	t	

Check Doors to Sterile Areas

Door Between	Calculated Room ΔT (°C)	Maximum ΔT *Permitted*	Remarks

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Transfer Grilles, Pressure Relief Dampers and Pressure Stabilisers	**Worksheet WS7** **Reference:**

Transfer Grilles – see paragraphs A4.34 – A4.38

Check Doors to Sterile Areas

No	Location	Pressure Difference Pa	Flow Rate m^3/s	Free Area m^2	Model	Resultant Δp Pa	Remarks

Pressure Relief Dampers – see paragraph A4.39

No	Location	Pressure Difference Pa	Flow Rate m^3/s	Free Area m^2	Pressure Setting Pa	Remarks

Pressure Stabilisers –see paragraphs A4.40 – A4.43

Note: where a stabiliser is acting both as series room door protection and operating pressure control, "pressure difference" and "flow rate" are from WS2d; "pressure setting" is from WS3

No	Location	Pressure Difference Pa	Flow Rate m^3/s	Free Area m^2	Pressure Setting Pa	Remarks

Surveyor (AP(V)/CP(V))…… Date…….

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Ventilation and ductwork

CIBSE Guide B2

CIBSE

Ventilation and ductwork

CIBSE Guide B2: 2016

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Note from the publisher

This publication is primarily intended to provide guidance to those responsible for the design, installation, commissioning, operation and maintenance of building services. It is not intended to be exhaustive or definitive and it will be necessary for users of the guidance given to exercise their own professional judgement when deciding whether to abide by or depart from it.

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Foreword

Guide B provides guidance on the practical design of heating, ventilation and air conditioning systems. It represents a consensus on what constitutes relevant good practice guidance. This has developed over more than 70 years, with the Steering Groups for each edition of the Guide expanding and pruning the content to reflect the evolution of technology and priorities.

Since the last edition of Guide B in 2005, the European Energy Performance of Buildings Directive has been introduced. This requires national building energy regulations to be based on calculations that integrate the impact of the building envelope and the building services systems, formalising what was already recognised as good design practice. In addition, the use of voluntary energy efficiency and sustainability indicators has increased.

These changes have influenced the content of Guide B, but the emphasis remains on system design. The guidance in Guide B is not in itself sufficient to cover every aspect of the effective design of HVAC systems. Energy (and carbon emission) calculations will also be needed, and a range of other environmental criteria may specified by the client. These may, for example, include whole-life costing or assessments of embodied energy or carbon. The balance between building fabric measures and the energy efficiency of HVAC systems is important, as is the balance between energy use for lighting and for heating, ventilation and cooling. More detailed information on energy efficiency and sustainability can be found in Guides F and L respectively. The Guide does not attempt to provide step by step design procedures: these can be found in appropriate textbooks.

Structure of the Guide

Guide B deals with systems to provide heating, ventilation and air conditioning services, and is divided into several chapters which are published separately. It will usually be necessary to refer to several — perhaps all — chapters since decisions based on one service will commonly affect the provision of others.

— Chapter B0: *Applications and activities* focuses on how different types of building and different activities within buildings influence the choice of system. This chapter is not available in printed form, but can be downloaded from the CIBSE website. For many activities and types of building, more detailed design information is available in specialist guidance.

Chapters B1 to B4 address issues relating to specific services. There are usually several possible design solutions to any situation, and the Guide does not attempt to be prescriptive but rather to highlight the strengths and weaknesses of different options.

— B1: *Heating*, including hot water systems and an appendix on hydronic systems, which is also applicable to chilled water systems

— B2: *Ventilation and ductwork*

— B3: *Air conditioning and refrigeration*

— B4: *Noise and vibration control for building services systems* (applicable to all systems)

When all chapters have been published, an index to the complete Guide B will be made available.

The focus is on application in the UK: though many aspects of the guidance apply more generally, this should not be taken for granted. The level of detail provided varies: where detailed guidance from CIBSE or other sources is readily available, Guide B is relatively brief and refers to these sources. Examples of this are the treatment in the Guide of low carbon systems such as heat pumps, solar thermal water heating and combined heat and power. On-site energy generation such as wind power and photovoltaics are not covered.

Regulatory requirements are not described in detail in the Guide – the information varies between jurisdictions and is liable to change more rapidly than the Guide can be updated. Instead, the existence of regulations is sign-posted and their general scope explained. Sometime example tables are shown, but readers should note that these are simply examples of the type of requirement that is imposed and may not be current.

While there is some discussion of relative costs, no attempt is made to provide detailed cost figures as these are too project-specific and variable with time and location.

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Contents

2 Ventilation and ductwork

2.1 Introduction

2.1.1 Introduction

Ventilation is the process by which fresh air is provided to occupants and concentrations of potentially harmful pollutants are diluted and removed from a space. It is also used to cool a space and as a mechanism to distribute thermally conditioned air for heating and cooling. It is a fundamental component of building services design since it plays a major role in the comfort, health and productivity of occupants. In addition, ventilation can contribute significantly to a building's energy load and, in some cases, can account for 50 per cent or more of total heating or cooling loss. To stem energy loss from uncontrolled air change there is growing demand for airtightness combined with demand-controlled ventilation and heat recovery.

In large buildings, the ventilation system can be extremely complex and is invariably integrated with the heating and cooling system. Hence there is a strong connection between ventilation, heating and cooling systems, building envelope, fire protection and structural design issues (Thomas, 1999). This impinges on the whole-life costs (BSRIA, 2008) and performance (Allard, 2001) of buildings. Since building services are required to operate throughout the life of the building, their operating costs are a very significant element of the whole-life costs of the system.

For all these reasons, there is a need for up-to-date guidance on the design of ventilation systems. The overall process of design development, from the initial outline design through to system selection and detailed equipment specification, is summarised schematically in Figure 2.1. Cooling systems are separately covered by CIBSE Guide B3 (2016a) and heating systems are covered in CIBSE Guide B1 (2016b).

2.1.2 Scope

This guide is intended to be used by practising designers who hold a basic knowledge of the fundamentals of building physics and building services engineering.

Section 2.2 sets out the criteria for the design of ventilation systems, covering the contribution of ventilation to providing a safe and comfortable indoor environment, including indoor air quality, thermal comfort and noise. This chapter should be read in conjunction with chapter 1 of CIBSE Guide A (2015a).

Section 2.3 reviews the principal methods of providing ventilation: natural, mechanical and mixed-mode systems. It also describes the basic principles of related systems for air distribution, filtration, heat recovery and control.

Section 2.4 sets out the principles for designing natural, mechanical and mixed-mode systems and includes the design of ductwork, calculation techniques and methods of measuring the performance of ventilation systems.

Section 2.5 discusses other design considerations closely related to ventilation and covers noise, air leakage, fire and smoke protection. Noise and fire protection are dealt with in more detail in CIBSE Guides B4 (2016c) and G (CIBSE, 2014) respectively.

Section 2.6 covers the components of a ventilation system and includes fans, air control units, mixing boxes, terminal devices, extract hoods and duct equipment. Also included is equipment for natural ventilation.

Section 2.7 covers the important areas of testing, commissioning, maintenance and cleaning.

2.1.3 Definitions

The meaning of key terms used in this Guide are summarised below.

— *Natural ventilation*: this is the process by which airflow through ventilation openings is driven by the natural driving forces of wind (wind effect) and temperature difference (stack effect). Natural ventilation systems are described in section 2.3.2.2.

— *Mechanical ventilation*: these systems incorporate fans and control systems to drive the ventilation process. They are thus able to provide ventilation irrespective of the availability or suitability of natural forces. In many countries large buildings including city centre offices, public buildings and shopping malls are almost universally mechanically ventilated. In addition to providing fresh air, mechanical systems are also often used to distribute thermally conditioned air as part of the building's heating and cooling (air conditioning) system. There are various configurations of mechanical ventilation; these are described in section 2.3.2.3.

— *Mixed-mode or hybrid ventilation*: this utilises a combination of both natural and mechanical ventilation. The various modes of operation are described in section 2.3.2.4.

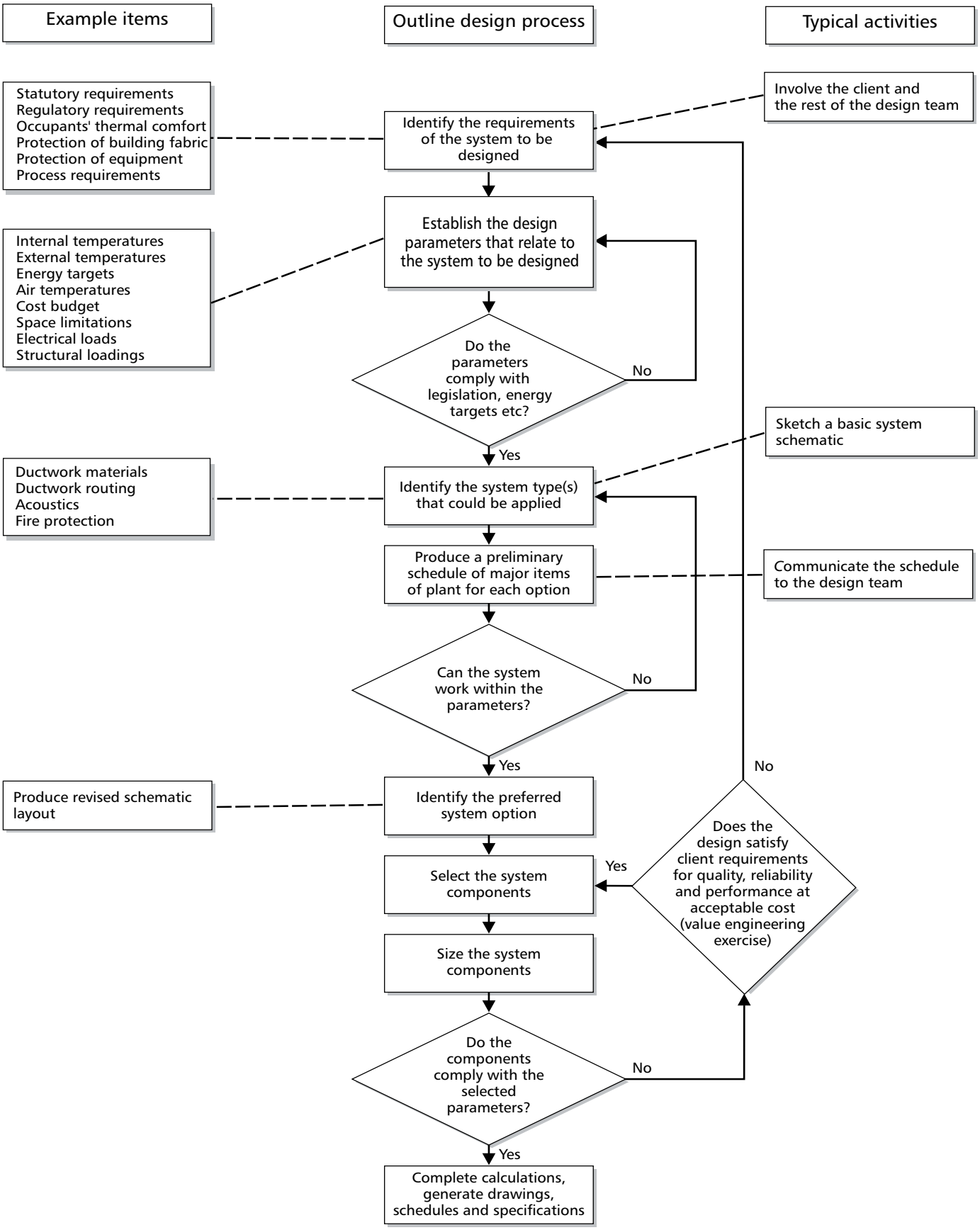


Figure 2.1 Outline of the ventilation design process

— *Air change rate*: this is the ventilation rate in m^3/h divided by the volume in m^3 of the enclosed space expressed in air changes per hour (ACH).

— *Air infiltration*: this is defined as the air ingress, under ambient conditions, that enters a building through adventitious cracks and gaps in the building envelope. The corresponding air loss is defined as air exfiltration.

— *Airtightness*: this is a measure of the air leakage rate through the building envelope for a given test pressure (typically at 50 Pa) (see section 2.4.7.2).

— *Blower door*: a device for pressure testing building airtightness.

— *Contaminant removal efficiency*: this is a term used to describe the efficiency of the removal of contaminant in a space by ventilation. It can relate to the space as a whole or to individual locations.

— *Dilution ventilation*: see 'mixing (or dilution) ventilation'.

— *Displacement ventilation*: this is a mechanism by which fresh air is introduced to a location without mixing the fresh incoming air with the room air.

— *Heat recovery*: a process by which sensible 'dry' heat from the exhaust air supply is recovered and normally used to pre-heat the supply air (see section 2.3.4). Latent heat can also be recovered with some systems.

— *Latent heat recovery*: a process by which latent heat from moisture in air is recovered.

— *Mixing (or dilution) ventilation*: a system by which incoming fresh air is thoroughly mixed with the air already in a space. This is a common approach for air-driven heating and cooling systems.

— *Percentage persons dissatisfied (PPD) thermal comfort parameter*: the percentage of people expressing dissatisfaction with the thermal environment in which they are exposed (e.g. too hot or too cold).

— *Predicted mean vote (PMV) thermal comfort parameter*: a measure by each occupant of their perception to thermal comfort varying from –3 for too cold to 0 for neutral and +3 for too hot.

— *Pressure test*: a method for testing the airtightness of a building or a component such as ductwork.

— *Recirculation*: the blending of fresh air with extract air for recycling back into a ventilated space. This forms an important part of an air-driven heating or cooling system.

— *Specific fan power*: the electrical energy used to drive each litre/second of air through a ventilation system (measured in watts per $l \cdot s^{-1}$).

— *Task ventilation*: a system by which fresh air is ducted directly to the point of need.

— *Ventilation effectiveness*: a term used to describe the degree that fresh air is mixed in a space (see section 2.4.7.5).

2.1.4 Energy and carbon considerations

Many countries are committed to significantly reducing carbon emissions with the aim of achieving carbon neutrality. There is also strong demand to improve the energy performance of existing buildings. Within Europe, energy conservation requirements for buildings are covered by the Energy Performance of Buildings Directive (EU, 2010). This requires member states to apply minimum requirements covering the energy performance of both new and existing buildings. There is currently a commitment to achieving carbon-neutral buildings by 2020. In the UK, the Government has also introduced a Climate Change Levy (HMRC, 2012), effectively a specific tax on energy use. To encourage energy efficiency it has also introduced an enhanced capital allowance scheme for certain energy-efficient measures (Carbon Trust, 2012). It is intended that these measures will stimulate a greater interest in energy efficiency amongst building owners and operators and that energy efficiency will be given a greater prominence in decisions about building design. Allied to this has been the introduction of revised Part L of the Building Regulations in England as well as revisions to Welsh and Scottish Regulations. Similarly, more demanding energy-efficiency requirements for buildings are being introduced into the regulations of many other countries. These set significantly more challenging targets for energy-conservation aspects of buildings than has hitherto been the case. The combined effect of these regulatory measures is expected to be a significant improvement in energy performance, certainly in new buildings and those undergoing major refurbishment.

As insulation and construction techniques steadily improve, ventilation losses account for an ever-greater proportion of the total building energy consumption. Therefore, there is much emphasis on improving building airtightness and regulating the rate of ventilation. However, these need to take place in conjunction with providing sufficient ventilation for air quality. Fan systems must also be energy efficient to ensure that mechanical systems operate at optimum efficiency. Part L of the Building Regulations for England and Wales (NBS, 2013a) therefore imposes requirements on airtightness performance and on the overall specific fan power of a system (see section 2.3.5.2). Where thermal ventilation losses are significant, increasing use is being made of ventilation heat recovery systems. In some instances these form a major component in reducing energy consumption and, in some countries are compulsory for some building types.

A further method for improving energy efficiency is to allow indoor temperature to drift in response to adaptation to climate conditions. Again, ventilation can play an important role by offering a degree of passive cooling and air movement.

2.1.5 System costing

System costing is inevitably a major consideration, especially in relation to payback periods and overall strategic benefit of carbon and energy reduction. Basic guidance is included in CIBSE TM30: *Improved life cycle performance of mechanical ventilation systems* (2002) and BSRIA *Rules of Thumb* (5th edition) (2011).

2.2 Design criteria

2.2.1 Introduction

The selection of a ventilation strategy is affected by location, plan depth, heat gains, internal and external pollutant sources, economics, energy and environmental concerns and internal layout. Ultimately it is the use and occupancy of a space that determines the ventilation needs. There is no universal economic solution, although there are some best practice indicators. It is essential that the client understands and accepts the ramifications of the selected strategy. Full details on the operational performance and selection of individual systems are covered in section 2.3. In selecting an appropriate ventilation strategy thought must be given to meeting the requirements of the people and processes that occupy the building without being excessive and therefore wasteful. However, the pursuance of an integrated design approach to achieve this also links the ventilation strategy with the design of the building fabric in that, as a prerequisite, all reasonable steps should be taken to maximise the potential of the fabric.

The design process must be based on a clear understanding of client and end-user needs and expectations and must be followed by effective commissioning, handover and building management. Close collaboration between the architect, services and structural engineers and the client is essential from the earliest stages of the outline design process. In each case, initial agreement should be reached on the needs required. Checks should be carried out continuously by the design team to ensure that the implications of any changes made during design, construction or subsequent fit-out are understood and mutually acceptable.

This section considers basic design criteria. More specific information about ventilation techniques and components are given in subsequent sections.

2.2.1.1 Purpose of ventilation systems

In designing any ventilation system it is necessary to understand the functions required of it. These are summarised in Table 2.1.

During periods of heating or active cooling, any fresh air ventilation above that needed to control air quality has an energy penalty. During summer, in non-air-conditioned spaces, ventilation rates above those required for air quality may reduce the demand for mechanical cooling, although this will only be possible when the outside air temperature is lower than the room temperature. Even if inside and outside temperatures are similar, increased air movement can improve comfort as described in CIBSE Guide A, chapter 1 (2015a).

2.2.1.2 Occupancy performance

There is much evidence showing that the effectiveness of building ventilation has a significant effect on the performance of those working in the building. Poor indoor air quality impairs the performance of employees in a workspace (Andersson *et al.*, 2006). It has also been shown to result in poor health in the home (Bornehag *et al.*, 2005).

Evans *et al.* (1998) have estimated that design, build and operating costs are in the ratio 1:5:200. Therefore, poor standards of building ventilation can have a significant negative effect on operating costs through their adverse effect on employee performance, given that the cost of running and staffing the business is the most significant to users. Over a system life of 10–15 years, a 1 per cent reduction in productivity may easily equal any savings made on the design and installation costs of the system. So it is worthwhile for building owners and operators to ensure that buildings are ventilated to provide a healthy and effective environment.

Table 2.1 Purposes of ventilation

Purpose	Explanation
To provide sufficient 'background' ventilation for occupants in terms of air quality for breathing and odour control	Typical rates need to be increased where smoking is permitted or additional sources of pollution are present. Most pollutants originate from sources other than people but in such cases general ventilation has been shown to be much less effective than treating the problems at source: e.g. by specification, cleanliness and local extraction.
To provide natural cooling during the occupied period	Care must be taken to avoid excessive air change rates that may cause draughts or disturb documents. Higher rates may be practicable in spaces occupied transitionally, such as atria. The balance point above which mechanical cooling will provide a more effective solution should be considered.
To provide natural cooling outside the normal occupied period	Night cooling or 'night purging' can remove heat built up in a structure and its contents and provide some pre-cooling for the following day. Practical limitations will exist in terms of acceptable secure openable areas in the case of natural ventilation and on duct size and fan energy consumption for ducted mechanical systems.
To exhaust heat and/or pollutants from localised sources or areas	Examples are kitchens, toilets, vending areas and equipment rooms. This enables adjacent areas to be more comfortable, with less conditioning of the air. Such systems often need to operate for longer hours than those serving the main spaces, therefore independent extract systems are preferred.
To act as a carrier mechanism for mechanical cooling and/or humidity control	This can be either via an all-air system in which the air is treated centrally or via air/water or unitary systems in which the air is recirculated and treated locally.
To prevent condensation within the building fabric	Adequate ventilation for condensation control exceeds the minimum rate of fresh air necessary for health and comfort. There is a specific need to address the ventilation of areas where moisture-generating activities occur.
To enable the efficient operation of processes	Needs are entirely dependent on the process. Ventilation may be required to ensure safe combustion or to ensure that machinery is maintained within a suitable temperature range, e.g. lift motor rooms.

2.2.1.3 Establishing key performance requirements

The key performance requirements that need to be clarified before a ventilation strategy can be selected are summarised in Table 2.2. Ideally, where the issues highlighted in the table have not been covered within the specification documents, the design team should expect to agree requirements with the client at the outset of the project to optimise the choice of strategy. If the client is unable to advise on the precise needs, they must at least be made aware of any limitations of the chosen design.

The design team should also be able to advise the client of the cost implications of meeting their stated requirements, on a whole-life basis (BSRIA, 2008) if requested. Requirements may be adjusted over the course of the project to meet financial constraints or changing business

Table 2.2 Establishing performance requirements

Issue	Requirement/comments
Client brief	To be developed in the context of the other issues.
Integrated design	Co-ordinated approach by the architect and other specialists from outline design.
Energy/environmental targets	Use of existing specifications or appropriate advice from the design team required. Compatibility with indoor environment standards.
Indoor environmental standards	Use of existing standards or appropriate advice from the design team required. Areas or objects with special requirements.
Provision of controls	Individual, local, team, zone or centralised basis. Required closeness of control (e.g. of temperature, humidity, air quality, airflow). The required interaction of the end user with the building services. The required basis of control, e.g. temperature, CO_2, CO or other.
Demands of the building occupants and activities	The business process(es) to be undertaken in the building may demand specified levels of availability of ventilation. Work patterns over space and over time (regularity, shifts, team structure). Cellular and open-plan mix with associated partitioning strategy and likelihood of change. Occupancy numbers and anticipated maximum occupancy over the building lifetime that might need to be taken into account. Average occupancy density and any areas of high or low density. Functions of space use, processes contained therein and subsequent internal loads (e.g. standard office space, meeting rooms, lecture theatres, photocopying rooms, sports hall, laboratories, manufacturing environments, retail space). Anticipated diversity of internal loads.
Investment criteria	Constraints imposed by 'letability' requirements.
Value engineering and whole-life costs	Understanding of the client's priorities towards capital cost and issues of whole-life costs. Requirements for calculations to be carried out on systems or system elements and the basis for these calculations. Has the client been involved in discussions of acceptable design risk? The importance of part load performance.
Reliability	The business process(es) to be undertaken in the building may demand specified levels of reliability of the ventilation systems.
Maintenance requirements	Understanding of the client's ability to carry out, or resource, maintenance. Client willingness for maintenance to take place in the occupied space. Any requirement for 'standard' or 'familiar' components.
Associated systems	Implications of any particular requirements, e.g. fire, security, lighting, acoustic consideration.
Security	Restrictions on size and location of any openings.
Future needs	Adaptability, i.e. the identified need to cope with future change of use. Flexibility, i.e. the identified need to cope with future changes in work practices within the current building use. Acceptable design margins: it is important to distinguish, in collaboration with the client, between design that is adequate for current requirements (which may not be currently accepted best practice), design that makes sensible agreed allowances for future changes and over-design.
Aesthetic considerations	The need for system concealment. Restriction on placement of grilles, diffusers etc. Restrictions imposed by local authorities, building listing etc.
Procurement issues	Time constraints. Programming constraints, particularly for refurbishment projects.

Table 2.3 Issues affecting the choice of ventilation

Issue	Comments	Reference
Location	Adjacent buildings can adversely affect wind patterns. The proximity of external sources of pollution can influence the feasibility of natural ventilation. The proximity of external sources of noise can impact on the feasibility of natural ventilation.	CIBSE AM10 (2005)
Pollution	Local levels of air pollution may limit the opportunity for natural ventilation. It may not be possible to provide air inlets at positions suitable for natural ventilation given the inability to filter the incoming air successfully.	CIBSE TM21 (1999)
Orientation	Buildings with their main façades facing north and south are much easier to protect from excessive solar gain in summer. West façade solar gain is the most difficult to control, as high gains occur late in the day. Low sun angles occurring at certain times of year affect both east and west facing façades.	CIBSE Guide F (2012)
Form	At building depths greater than 15 m the ventilation strategy becomes more complex; the limit for daylighting and single- sided natural ventilation is often taken as 6 m. An atrium can enhance the potential for natural ventilation.	Section 2.3.2.2 CIBSE Guide F (2012)
	Tall buildings can affect the choice of ventilation system due to wind speeds and exposure. Adequate floor-to-ceiling heights are required for displacement ventilation and buoyancy-driven natural ventilation; a minimum floor-to-ceiling height of 2.7 m is recommended.	CIBSE Guide F (2012) Section 2.2.8
Insulation	Insulation located on the external surface de-couples the mass of the structure from the external surface and enables it to stabilise the internal environment. In well-insulated buildings provision must be made for the removal of excess heat, for example through night cooling.	Section 2.4.2
Infiltration	Ventilation strategies, whether natural or mechanically driven, depend on the building fabric being appropriately airtight. This implies a good practice standard of 5 $m^3 \cdot h^{-1}$ per m^2 of façade (excluding consideration of the ground floor) and requires suitable detailing. Site quality checks should be followed by air leakage pressure testing as part of the commissioning requirement.	CIBSE TM23 (2000a) Approved Document B (NBS, 2013f)
Shading	The appropriate use of external planting or other features can reduce solar gain. In terms of effective reduction of solar gain, shading devices can be ranked in order of effectiveness as follows: external (most effective), mid pane, internal (least effective).	CIBSE Guide F (2012)
	Horizontal shading elements are most appropriate for reducing high angle solar gains, for example in summer time on south facing façades. Vertical shading devices are most appropriate for reducing low angle solar gain, e.g. on east and west façades. Control of solar shading devices should be linked with that of the ventilation system. Glare must be controlled to avoid a default to 'blinds-down' and 'lights-on' operation.	CIBSE AM10 (2005)
Window choice	Openable areas must be controllable in both summer and winter, e.g. large openings for still summer days and trickle ventilation for the winter time. Window shape can affect ventilation performance; deep windows can provide better ventilation than shallow. High-level openings provide cross-ventilation; low-level openings provide local ventilation, although draughts should be avoided at working level. The location of the opening areas affects the ability of the window to contribute to night cooling (see section 2.4.2). Window operation must not be affected by the choice of shading device. See section 2.6.9 for details of window characteristics.	CIBSE TM21 (1999a)
Glazing	Total solar heat transmission through window glazing can vary over a sixfold range, depending on the combination of glass and shading mechanisms selected.	CIBSE TM21 (1999a) Baker and Steemers (1994)
	At concept stage the percentage of glazed area (normally 20–40 per cent of façade area) and selection of glazing type must balance thermal, ventilation and lighting needs. The choice includes single, double and triple glazing with selective coatings or gaseous fill. The type of coating may have a greater influence than the glazing type. Ideal glazing is transparent to long-wave radiation and reflective to short-wave radiation. Selective low-emissivity double-glazing is equivalent to air-filled triple-glazing.	
	The use of tinted glazing may increase the use of supplementary electric lighting, increasing internal heat gains and energy use. Window frame construction and detailing must also be considered.	
Thermal mass	Thermal mass is used to reduce peak cooling demands and stabilise internal radiant and air temperatures. The first 50–100 mm of the structure is most effective on a 24-hour basis. Thermal mass can be introduced into the ceiling/floor slab (most effective), walls or partitions, but must be 'accessible' in all cases. Heat transfer can be via the surface of the material or via cores/channels within it. The exposure of thermal mass has architectural and other servicing implications, although these effects can be reduced, e.g. by the use of perforated ceilings. See section 2.4.2.4 for further details of incorporating thermal mass.	

needs. The design team must also be able to advise on the impact of any such changes on building performance.

An appreciation of the issues shown in Table 2.2 is an essential part of the briefing process. Further guidance on briefing as it applies to building services is given in the *Building Services Job Book: A Project Framework for Engineering Services* (BSRIA, 2009a)

2.2.1.4 Interaction with fabric/facilities

Building fabric

The required ventilation rate is based on fresh air requirements and any additional ventilation required for comfort and cooling purposes. Additional needs for comfort and cooling must take into account:

— internal heat gains generated by the occupants, e.g. occupancy itself, lighting and small power loads such as office equipment, including computers, screens and photocopiers

— solar heat gains

— the thermal properties of the building fabric including insulation, glazing and thermal mass.

Although the architect is associated with making many of the fabric-related decisions, the building services engineer must be able to advise on their implications for ventilation, energy use etc. and must, therefore, be involved in the decision-making process as far as is practical and at as early a stage as possible. The building services engineer should also be consulted prior to any changes that could affect ventilation system performance.

In instances where designs seek to take full advantage of ventilation to maximise natural cooling, the architect and the building services engineer must be able to enter into a dialogue on the issues introduced in Table 2.3, as a minimum. (Note that this table focuses solely on issues relating to the interaction between the building fabric and services. To these must be added, for example, consideration of the building function and broader issues, as raised in Table 2.2.) Where the ventilation strategy for the building depends on its thermal mass (see section 2.4.2.4 and Braham *et al.*, 2001), early consultation with the structural engineer is also needed to consider, for example, the implications for roof design. At some point it may also be necessary to involve a façade specialist, who could advise the client accordingly.

It is important to note that maximising the 'passive contribution' to be gained from the building fabric itself requires an understanding of both the advantages and disadvantages of this approach. For example, external shading reduces the need for cooling but increased insulation and airtightness may lead to the need for increased ventilation and cooling.

For a detailed explanation of the role of the building fabric in contributing to an energy-efficient solution, see CIBSE Guide F: *Energy efficiency in buildings* (2012) and other publications cited in Table 2.3.

Airtightness

It is also important to consider the risks of air leakage through the building fabric and its subsequent impact on infiltration rates and heat loss calculations (see section 2.5.4.4). The most common locations susceptible to air leakage are:

— junctions between the main structural elements

— joints between walling components

— periphery of windows, doors and roof lights

— gaps in membranes, linings and finishes

— service penetrations, e.g. gas and electricity entry points and overflow pipes

— access and emergency openings

— some building materials, e.g. poor quality brickwork, may be permeable.

Airtightness is becoming a mandatory requirement in an increasing number of countries. Full guidance on achieving airtightness is available in Jaggs and Scivyer (2011). In the UK, airtightness requirements are incorporated in Part L of the Building Regulations (NBS, 2013a). The pressurisation test for determining whole-building airtightness is described in 'Building airtightness' in section 2.4.7.2. Optimum duct performance is also dependent on effective duct airtightness (see 'Duct airtightness' in section 2.4.7.2).

Internal heat gains

Heat gains impact on the ability of a ventilation system to meet thermal comfort needs efficiently. In the absence of information from the client, the British Council for Offices (BCO, 2009) recommends the following allowances for internal gains when specifying ventilation systems:

— solar gains not to exceed 60–90 $W \cdot m^{-2}$ depending upon façade orientation

— occupancy based upon 1 person per 12 m^2, but diversified wherever possible to 1 person per 14 m^2 at the central plant

— lighting gains of not more than 12 $W \cdot m^{-2}$

— office equipment gains of not more than 15 $W \cdot m^{-2}$ when diversified and measured over an area of 1000 m^2 or more, but with an ability to upgrade to 25 $W \cdot m^{-2}$. Local workstation levels are quoted as typically 20–25 $W \cdot m^{-2}$.

Interaction with the lighting system

The design strategy for daylight provision forms part of the selection process for window and glazing types and shading devices. Integration of the electric lighting system to minimise its impact on the design and operation of the ventilation system requires that internal heat gains from the lighting be minimised by:

— maximising the use of daylighting

— the selection of light levels, differentiating between permanently occupied workspaces and circulation areas (guidance on lighting levels can be found in CIBSE Guide A1 (2015a))

— the selection of efficient light fittings (decorative fittings may have a lower efficiency)

— the installation of an effective lighting control system, relative to time of day and occupancy level

— the use of ventilated light fittings (see section 2.6.4).

Consideration should be given to the impact of the chosen ventilation strategy on the lighting system, for example the use of uplighting with exposed thermal mass (Braham *et al.*, 2001).

Small power loads

Small power loads, arising from IT and other office-type equipment, are an increasingly significant component of internal heat gains. Accounting for them in the design of the ventilation system requires a realistic calculation of their impact in terms of peak load and anticipated diversity. In order to reduce internal heat gains the designer should:

— encourage the client to select low-energy equipment and introduce power cut-off mechanisms

— locate shared equipment, e.g. vending machines and photocopiers, in a space that can be readily cooled

— where possible separate IT equipment and servers from occupied spaces such that the heat from this equipment does not impact on the occupied space.

2.2.1.5 Solar gain

Solar gain primarily occurs through glazing. Short-wave infrared radiation from the sun enters into the space and warms solid surfaces, often making them hot to touch. These then re-radiate into the space at much longer wavelengths that are impermeable to the glass. As a result, the heat becomes trapped causing overheating and indoor air temperatures to rise above the outdoor value. Solar gain is, potentially, a substantial component of excess heat load and can cause serious overheating, especially in a naturally ventilated or non-air-conditioned space. Hence solar gain must be accurately determined and, where necessary, reduced. Mitigation methods include choice of glazing and the use of external shading. While internal shading may reduce glare and the direct impact of radiant heating on a person, it rarely reduces the overall heat gain into a space This topic is covered in greater detail in CIBSE Guides A (2015a), B1 (2016b) and B3 (2016a).

2.2.1.6 Provision of controls: end-user perspective

The provision of easy-to-use and quick-acting controls is fundamental to occupant comfort satisfaction. Any requirements of the client must be considered in the light of the designer's own experience of end-user behaviour. Control systems are covered in section 2.3.6.

2.2.1.7 Whole-life cost

In the UK it is now a requirement that public sector purchasers move to whole-life cost-based procurement. The UK Private Finance Initiative (PFI) has stimulated a marked increase in interest in whole-life costing and there has been a growth in the availability of data to support the activity (CIBSE, 2002; BSRIA, 2008).

The proper design of ventilation systems can significantly reduce the whole-life costs. Additionally costly modifications and alterations can be avoided by ensuring that the system requirements are properly defined and the design fully addresses the requirements.

Buildings have to adapt and change in response to business needs. Taking account of this at the design stage can also help to ensure that the system is designed to enable such adaptations to be carried out in the most cost-effective manner, again reducing the whole-life costs of the system.

2.2.2 Contaminant control

A fundamental role of ventilation is contaminant control. It is important therefore to understand the characteristics and significance of key pollutants and pollutant sources. Indoor pollutants are derived from both outdoor and indoor sources and each of these sources imposes different requirements on the ventilation control strategies needed to secure good health and comfort conditions. This topic is covered in more detail in sections 1.7 and 8.4 of CIBSE Guide A: *Environmental design* (2015a).

2.2.2.1 Outdoor air pollution

Clean outdoor air is essential for achieving good indoor air quality. Although air cleaning by filtration is possible, it is costly and not appropriate in the many buildings that are naturally ventilated, leaky or ventilated by mechanical extract systems. Also, general filtration is less effective at controlling respirable fine particulates (e.g. at less than 2.5 μm) and gaseous pollutants. Filtration is covered in more detail in section 2.3.3.

Some air quality problems are global and can only be controlled by international effort. Other pollutants are more regional and may be associated with local industry and traffic. Nature, too, presents its own problems, with large volumes of dust and gaseous emissions being associated with volcanic activity, while naturally occurring radon can penetrate buildings from the underlying geological strata. Even rural areas are not immune to pollution, where the presence of pollen and fungi spores can result in allergic reactions. Typical sources of airborne pollutants are:

— industrial emission

— construction dust

— traffic pollutants

— emissions from buildings (boiler exhausts, cooling towers, etc.)

— rural pollution (pollen, insecticides, etc.)

— soil-borne pollutants (radon, methane, etc.).

Increasing concern about outdoor emissions has resulted in the introduction of emission controls and 'clean air' regulations in many countries. In the US, legislation is covered by the Clean Air Act. In Europe, emissions controls fit within the Air Quality Framework Directive (EC, 2008). Implementation in the UK is set out in the Air Quality Strategy for England, Wales, Scotland and Northern Ireland

(DEFRA, 2007). This report explains the measures being undertaken to reduce pollutant concentration in the air including the designation of Air Quality Management Areas at locations identified as having particularly poor air quality. This is based on the nationwide monitoring of key outdoor pollutants. Building developers must check with local authorities for local air quality conditions and must also provide information on how a proposed development will affect the local air quality. UK guidelines on minimising the risk of pollutant ingress into buildings have been published by BRE (Kukadia and Hall, 2011).

Mitigation within buildings of outdoor pollutant sources is not easy but methods include:

— airtightness to prevent the uncontrolled ingress of outdoor pollutant (see section 2.5.4)
— locating air intakes to avoid outdoor sources (CIBSE, 1999)
— filtration (section 2.3.3)
— temporarily reducing ventilation during transient periods of high pollution (CIBSE, 2015a).

2.2.2.2 Indoor pollutants

Pollutants emitted inside buildings are derived from metabolism, the activities of occupants and emissions from materials used in construction and furnishing. Major pollutants include:

— carbon dioxide from metabolism and gas appliances
— carbon monoxide (highly toxic and emitted from poorly maintained gas and other combustion)
— formaldehyde from fibre boards and foam insulation
— moisture (principally generated by occupant activities such as cooking, washing and clothes drying)
— odour (generated as part of metabolism and emitted from furnishings and fabrics)
— ozone (from electrical appliances normally associated with poor maintenance)
— particulates, including dust, organic fragments, fibres and smoke particles
— volatile organic compounds (VOCs) from furnishing fabrics and household chemical products
— laboratory contaminants (chemicals, biohazards, radioactive products).

CIBSE no longer provides recommendations covering ventilation for tobacco smoking. In public buildings in the UK smoking is banned and toxic pollutants generated by smoking are largely regarded as unacceptable, regardless of ventilation rate. Harmful indoor pollutant emissions should always be eliminated where possible. Restrictions on emissions, particularly of VOCs and particles generally apply. More information is given in CIBSE Guide A: *Environmental design* (2015a).

2.2.2.3 Exposure limits

Exposure limits for particular airborne pollutants depend upon a range of factors, including the length of exposure and the general level of health of the person exposed. A detailed discussion is provided in CIBSE TM40: *Health issues in building services* (2006a) and limits for specific pollutants are set out in chapter 8 and Table 1.5 of CIBSE Guide A (2015a).

2.2.2.4 Metabolic carbon dioxide

In densely occupied spaces, metabolic carbon dioxide is widely used as a marker for the adequacy of ventilation. Even at quite high concentrations it is generally regarded as a non-toxic gas that, in itself, is unlikely to cause injury except under extremely unusual conditions. However a build-up of CO_2 in a room leads to a feeling of stuffiness and can impair concentration. Elevated levels of CO_2 in the body cause an increase in the rate of respiration. Slightly deeper breathing begins to occur when the atmospheric concentration exceeds 5000 ppm (0.5 per cent by volume). This is the maximum allowable concentration of CO_2 for 8-hour exposures by healthy adults (HSE, 2011). Within the UK, a CO_2 figure of 800–1000 ppm is often used as an indicator that the ventilation rate in a building is adequate. A concentration of 1000 ppm approximately equates to a 'fresh air' ventilation rate of 8 $l \cdot s^{-1}$ per person (CIBSE, 2015a). The actual ventilation value depends on the local outside concentration (approximately 350 to 400 ppm outside urban areas) and the level of metabolic activity. Carbon dioxide monitoring for ventilation control is becoming increasingly more common and relatively inexpensive (see section 2.3.6).

2.2.3 Fresh air supply rates

2.2.3.1 Introduction

Ventilation reduces the concentration of harmful pollutants emitted within a space. It is for this reason that higher ventilation rates are usually associated with improved health. Commonly applied methods for determining suitable outdoor air ventilation rates are:

— a prescriptive method
— a calculation method for the control of a single known pollutant being released at a known rate.

These are briefly described below. More details are provided in section 1.8 of CIBSE Guide A: *Environmental design* (2015a).

2.2.3.2 Prescriptive method

In occupied spaces, the fresh air requirement is increasingly specified in terms of flow rate per person. Where ventilation is needed to dilute room pollutants not arising from occupancy, fresh air requirements may be expressed as a volumetric flow rate for the space (e.g. $m^3 \cdot s^{-1}$ per m^2). Formerly, much use was made of expressing ventilation rate in terms of air changes per hour (ACH). This is now falling out of favour because of its high dependency on room volume, which fails to reflect the physical need to provide fresh air or remove heat.

European Standard BS EN 13779: *Ventilation for non-residential buildings. Performance requirements for ventilation and room-conditioning systems* (BSI, 2007a) provides basic definitions of air quality standards in occupied spaces and

Table 2.4 Ventilation requirements (reproduced from BS EN 13779: 2007 (BSI, 2007a), by permission of the British Standards Institution)

Classification	Indoor air quality standard	Ventilation range ($l \cdot s^{-1}$ per person)	Default value ($l \cdot s^{-1}$ per person)
IDA1	High	>15	20
IDA2	Medium	10–15	12.5
IDA3	Moderate	6–10	8
IDA4	Low	<6	5

relates these to fresh air ventilation rates required for each occupant (in terms of $l \cdot s^{-1}$ per person), using a methodology set out in BS EN 15251: 2007: *Indoor environmental input parameters for design and assessment of energy performance of buildings addressing indoor air quality, thermal environment, lighting and acoustics* (BSI, 2007b). These are summarised in Table 2.4.

It is important to note that these rates relate to comfort air quality and do not necessarily reflect the purity of air with respect to health-related contaminants. They are most applicable for spaces that are relatively free from sources of pollution and for ventilation air that is itself pure.

Building Regulations Part F (NBS, 2013b) require a minimum ventilation rate of 10 $l \cdot s^{-1}$ per person for office applications. This fits between classes IDA2 and IDA3 in Table 2.4.

General minimum fresh air requirements for specific building types are given in CIBSE Guide A (2015a).

2.2.3.3 Calculating the ventilation rate to control a single pollutant

Where a single known pollutant is emitted at a known rate the required ventilation rate is based on risk assessments, for example in the UK, pollutants under the Control of Substances Hazardous to Health (COSHH) Regulations.

For a single contaminant under steady conditions, the steady dilution equation 2.1 may be applied to determine the flow of outdoor air that, with good mixing, would maintain the contaminant concentration at a specified level.

$$Q = \frac{q\,(10^6 - C_i)}{(C_i - C_o)} \qquad (2.1)$$

where Q is the outdoor air supply rate ($l \cdot s^{-1}$), q is the pollutant emission rate ($l \cdot s^{-1}$), C_o is the concentration of pollutant in the outdoor air (ppm) and C_i is the limit of concentration of pollutant in the indoor air (ppm). Full details are given in CIBSE Guide A (2015a).

This equation can be adapted for:

— pollutant thresholds quoted in $mg \cdot m^{-3}$ and situations where C_i is small or the incoming air is free of the pollutant in question (see CIBSE Guide A, section 1.8.3.1 (2015a)).

— situations where the ventilation results in a non-uniform concentration so that higher than average concentrations exist in the occupied zone and the outdoor air supply rate requires to be increased (see CIBSE Guide A, sections 1.8.3.1 and 1.8.4 (2015a)).

— non-steady state conditions that might allow the outdoor air supply rate to be reduced (see CIBSE Guide A, section 1.8.3.2 (2015a)).

A more comprehensive analysis of the relationship between contaminant concentration and ventilation rate is given in BS 5925: 1991: *Code of practice for ventilation principles and designing for natural ventilation* (BSI, 1991).

Note that the existing guidelines for the calculation of outside air ventilation rates are based on the assumptions that the air outside the building is 'fresh' and that the pollutant load is inside the building. For buildings in city areas or adjacent to busy roads the quality of the outside air needs to be assessed, as this can also be a source of pollutants. Where specific problems are anticipated, an air quality survey should be undertaken. This should include measurements at likely times of peak pollution. This is covered in more detail by Kukadia and Hall (2011).

Ventilation should not be used in place of source control to minimise pollutant concentrations in a space.

2.2.4 Ventilation for thermal comfort

Ventilation provides an essential means to control thermal comfort. This includes the use of air-conditioning systems for the distribution of heated and chilled air (see CIBSE Guide B3 (2016a)) as well as the use of ventilation to passively cool a space. In the case of natural or passive cooling the ventilation rate required to maintain thermal comfort in a space is often far higher than that needed to meet minimum ventilation rates for air quality. A detailed discussion of the factors that affect thermal comfort is given in chapter 1 of CIBSE Guide A (2015a).

2.2.5 Humidity

The role of humidity in maintaining comfortable conditions is discussed in section 1.3.1.3 of CIBSE Guide A (2015a) where an acceptable range of 40–70 per cent relative humidity (RH) is suggested. However, to minimise the risk of mould growth or condensation and maintain comfortable conditions, a maximum design figure of 60 per cent RH is suggested for the design of air-conditioning systems. Within naturally ventilated buildings, humidity levels as low as 30 per cent RH (or lower) may be acceptable for short periods of time. However, low RH can result in unpleasant static electricity shocks, especially when touching metallic objects.

2.2.6 Ventilation to avoid interstitial condensation

Many structures are vulnerable to interstitial condensation, which can cause rotting of wood-based components, corrosion of metals and reduction in the performance of thermal insulation. Condensed water can also run or drip back into the building causing staining to internal finishes or damage to fittings and equipment. The traditional view has been that these problems are caused by water vapour generated in the building diffusing into the structure. Avoidance measures have therefore concentrated on the

inclusion of a vapour control layer on the warm side of the structure, appropriate placing of insulation and ventilating the structure to intercept the water vapour before it can condense. In the UK guidance and requirements are given in Part C of the Building Regulations (NBS, 2013c). Ventilation is specifically required in cavities above the insulation in cold pitched and flat roofs, behind the cladding of framed walls and below timber floors. Commonly this is achieved by using natural ventilation openings, which are often required by building codes. Many problems can occur from water entrapped within materials moving within the structure under diurnal temperature cycles. Under these circumstances it is helpful to distinguish between 'ventilated' and 'vented' air spaces. A ventilated space is designed to ensure a through flow of air, driven by wind or stack pressures, whereas a vented space has openings to the outside air that allow some limited, but not necessarily through, flow of air. As the air in the space expands and contracts under diurnal temperature cycles, water vapour will be 'breathed' out of the structure. This mechanism can be very effective in large span structures where it can be very difficult to ensure through ventilation of small cavities.

Detailed design guidance for the provision of ventilation within structures is available in CIBSE Guide A (2015a), BS 5250: 2011: *Code of practice for control of condensation in buildings* (BSI, 2011a) and BRE Report BR 262: *Thermal Insulation: Avoiding Risks* (BRE, 2002).

2.2.7 Air movement: limiting air velocities

Excessive air movement creates uncomfortable draughts. Guidelines and standards have been developed to provide guidance on maximum values. Draughts are a particular problem in the vicinity of cold air diffusers and in the presence of uncontrolled cold outdoor air ingress. In warmer weather, the draught caused by air movement can be beneficial and adds to the sensation of cooling. It also reduces the operative temperature on which thermal comfort criteria are largely based. For this reason circulation fans are commonly used to provide comfort in a non-air-conditioned environment. The effect of air movement is function of both mean airspeed and a measure of the fluctuating component, usually turbulence intensity. BS EN ISO 7730 (BSI, 2005a) defines a draught rating (DR) for mechanically ventilated and air-conditioned buildings that combines the effect of velocity, turbulence intensity and air temperature. Discussion of acceptable levels of draught rating and other aspects of air movement is included in CIBSE Guide A, section 1.6.6.5 (2015a).

2.2.8 Air distribution

Fresh ventilation air needs to be draught free and maintain a safe level of pollutant concentration in the vicinity of occupants. Important air distribution techniques are used to achieve this, each with a particular purpose. The main approaches are described in the following sections.

2.2.8.1 Mixing (or dilution) ventilation

Mixing ventilation is based on the air being supplied into the room in a manner that creates sufficient turbulence for the contaminants within the space to be equally distributed. The extraction of air then dilutes the concentration of pollutants within the space. Mixing systems are particularly used with conventional warm air heating and cooling systems since this is able to distribute the thermally conditioned air uniformly. Because the amount of air needed to provide thermal conditioning is usually much greater than that needed to provide fresh air, recirculation is widely used (see section 2.4.3). Mixing system performance is not dependent upon room height or room layout. Air can enter the space via either the floor or the ceiling (see Figure 2.2(a) and (b)). Guidance on diffuser design to create mixing is given in section 2.4.3

2.2.8.2 Displacement ventilation

This is based on the provision of low-velocity air supply that does not mix with the room air. Air is supplied at a low velocity from low-level, wall-mounted or floor-mounted supply air terminal devices directly into the occupied zone, at a temperature slightly cooler than the design room air temperature, see Figure 2.2(c). The air from a wall-mounted terminal flows downward to the floor due to gravity and moves around the room close to the floor, creating a thin layer of cool air. Natural convection from internal heat sources, such as occupants and equipment, causes upward air movement in the room. The warm, contaminated air forms a stratified region above the occupied zone, which is then exhausted at high level. The depth of this layer depends upon the relationship between the incoming airflow and the rate of flow in the plumes. The boundary

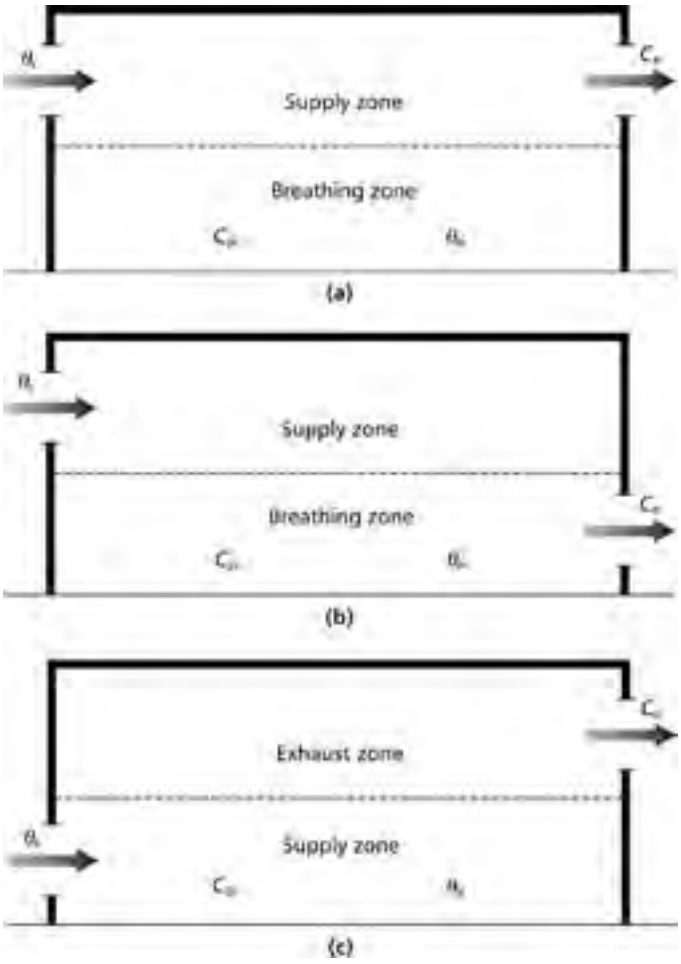


Figure 2.2 Supply/extract arrangements for ventilation: (a) mixing, supply and exhaust at high level, (b) mixing, supply at high level, exhaust at low level, (c) displacement

will stabilise at a level at which these two flow rates are equal.

The airflow in displacement ventilation has both horizontal and vertical air movement characteristics. Horizontal air movement occurs within the thermally stratified layers that are formed between the upper (warm) and lower (cool) air layers in the room. Vertical air movement is caused by the presence of cold and warm objects in the space. Warm objects, such as people, create upward convection currents; cold objects, such as cold windows and walls, cause downward currents.

For given rates of ventilation and pollutant discharge, the air quality in the occupied zone of a room with displacement ventilation can be higher than that using a mixed-flow ventilation method. In displacement ventilation, air movement above the occupied zone is often mixed and it is when this mixed region extends down into the occupied zone that the air quality becomes similar to that in a mixed-flow system.

There is limited cooling capacity unless it is combined with active cooling systems such as chilled ceilings or beams (see CIBSE Guide B3 (2016a)). Heating must normally be provided using hydronic radiators. In the true meaning of displacement ventilation, natural ventilation is not possible since it cannot provide the precision control that is necessary. Sometimes, however, the definition is loosely applied to the situation where an airflow pattern is established across a building in which fresh air enters through one side and propagates across the building to exhaust openings elsewhere.

With displacement ventilation, a vertical temperature gradient is unavoidable. BS EN ISO 7730 (BSI, 2005a) recommends a vertical temperature gradient for sedentary occupants of less than 3 K. This equates to approximately 3 $K \cdot m^{-1}$ if workers are assumed to be seated, although a limit of 1.8 or 2 $K \cdot m^{-1}$ is often proposed for offices (i.e. 5 K limit for a typical floor-to-ceiling height of 2.5 m). However, as 30–50 per cent of the overall supply-to-extract temperature difference occurs between the supply air and that at ankle level in the main space, a limiting difference between floor and ceiling height for typical office applications can be taken as 7–10 K. The supply air temperature should not be lower than 18 °C for sedentary occupancy and 16 °C for more active occupancy. It is also recommended that the limits of variation of temperature across the room should be within a temperature range of 3 K, i.e. ±1.5 K about the mean room air temperature.

A combination of near-floor temperatures below 22 °C and airflows in excess of 0.15 $m \cdot s^{-1}$ may cause discomfort due to cold feet, so occupants should be located a sufficient distance from diffusers. Equipment manufacturers should be consulted for detailed performance characteristics.

The zone around a supply air diffuser within which the supply air conditions have the greatest effect is labelled the near-zone. The permitted near-zone extent together with the maximum allowable comfort temperature at the near-zone perimeter for a given supply air temperature dictates the air volume per diffuser and its size. In an office the near-zone may be 1 m, in a commercial application or in a foyer it may be 3 m. The maximum cooling load that can be delivered by displacement ventilation is therefore limited to 25 $W \cdot m^{-2}$ due to discomfort considerations (Sandberg and Blomqvist, 1989).

There are conditions under displacement systems that are less effective than traditional mixed-flow ventilation strategies. These include (Jackman, 1990):

— where the supply air is warmer than the room air (except under particular circumstances where cold down-draughts exist over the supply position)

— where contaminants are cold and/or more dense than the surrounding air

— where surface temperatures of heat sources are low, e.g. <35 °C

— where ceiling heights are low, i.e. <2.3 m (the preferred height is not less than 3 m)

— where disturbance to room airflows is unusually strong.

2.2.9 Noise

Noise is generated by mechanical systems or can enter into the building from outside sources. Naturally ventilated buildings can be particularly prone to outside noise through open windows while mechanically ventilated buildings can be prone to system noise. Guidance on maximum noise thresholds are given in chapter 1 of CIBSE Guide A (2015a). Noise is considered in more detail in section 2.5.2 and CIBSE Guide B4 (2016c).

Solutions to minimising noise include the following.

— Naturally ventilated buildings:
  — acoustic vents
  — noise barriers (vegetation and fences)
  — location of intakes away from noise zones; reduced noise locations can include high-level intakes (e.g. by using wind towers), courtyards and at locations away from busy roads.

— Mechanically ventilated buildings:
  — control of external noise sources
  — limitations on mechanical duct flow velocity
  — use of silencers.

2.3 Systems

2.3.1 Introduction

A wide range of ventilation systems and associated technologies is needed to meet the air-quality needs of buildings. Ventilation solutions vary from basic natural ventilation systems to complex mechanical approaches. In addition, the maintenance of air quality may often require air cleaning methods, while energy efficiency demands efficient fans, low-loss systems and good control technology. Providing fresh air to complex spaces also requires the use of duct systems, which must meet the often conflicting requirements of restricted space while providing ducting of sufficient cross-section to minimise pressure losses. This

chapter describes the systems needed to accomplish effective ventilation.

2.3.2 Ventilation systems

2.3.2.1 Background

The variability of building type and climate conditions results in the need for a wide variety in the type of ventilation system required to maintain good indoor air quality. Within the UK, large city-centre office buildings tend to be mechanically ventilated. On the other hand, many smaller buildings and public buildings, such as schools and hospitals, tend to be predominantly naturally ventilated. Almost all the existing housing stock is naturally ventilated, although modern airtight housing is increasingly being fitted with mechanical systems incorporating heat recovery (see section 2.3.4). Demand for improved thermal comfort, combined with large internal heat gains, is resulting in an increasing requirement for mechanically ventilated air-conditioned spaces. In some buildings a combined 'mixed-mode' or 'hybrid' approach to ventilation is used in which natural ventilation is applied for some of the time or to some of the spaces while mechanical ventilation is used when and where natural ventilation is unsuitable.

2.3.2.2 Natural ventilation

Natural ventilation may be defined as ventilation that relies on moving air through a building under the natural forces of wind and buoyancy. A building can be considered to be naturally ventilated when most of the space is ventilated by such forces for most of the period during which ventilation is needed. Some spaces, such as bathrooms, kitchens, WCs and other polluting areas, may be required to incorporate intermittent mechanical extractor fans. Full details on natural ventilation theory and design are given in CIBSE AM10: *Natural ventilation in non-domestic buildings* (2005) (see also section 2.4.2).

In a mild and warming climate, such as the UK, there is still very strong demand for natural ventilation. The Carbon Trust (2007) stated that 'average overall energy consumption of air conditioned buildings is approximately twice that of similar sized naturally ventilated buildings'. It also stated that 'making the most of natural ventilation is a simple and cost-effective way of achieving big savings' (Carbon Trust, 2006). In the case of schools, the UK Commission for Architecture and the Built Environment (CABE, 2009) requires that natural ventilation be used wherever possible. Similarly, the carbon reduction strategy of the UK National Health Service (NHS, 2009) states that 'Buildings designed with passive ventilation have improved resilience to energy supply failure and are more energy efficient than mechanically ventilated buildings. In an acute hospital up to 70 per cent of net floor space could be entirely or partially naturally ventilated.' However, natural ventilation may not always be the best choice and it is important that the economic benefits are properly assessed and compared with alternative solutions.

Typical natural ventilation configurations are summarised in Figure 2.3. Purpose-provided ventilation openings can consist of a combination of vents, stacks, wind towers and openable windows. Traditionally, the provision of an openable area equivalent to 5 per cent of floor area has been regarded as a satisfactory default minimum for fulfilling occupant ventilation needs and general purging by natural ventilation. This, however, does not necessarily satisfy requirements for special air quality needs or satisfy all the requirements needed for natural summer cooling.

A prerequisite for the use of natural ventilation to provide cooling for thermal comfort is the control of heat gains into the occupied space. Natural ventilation cannot provide a constant flow rate but the important parameter is the time-averaged flow, rather than the instantaneous flow rate. This means that, within reason, the fresh air rate can vary without there being any significant variation in indoor air quality because of the fresh air quality reservoir provided by the volume of the space.

Wind-driven natural ventilation

Wind pressure acting on a building drives airflow through windows, natural vents or mechanically controlled openings, as well as through adventitious leakage openings in the building fabric. Wind-driven ventilation is caused by varying surface pressures acting across the external building envelope see (Figure 2.4). The distribution of pressure depends on:

— the terrain

— localised obstructions

— the wind speed and its direction relative to the building

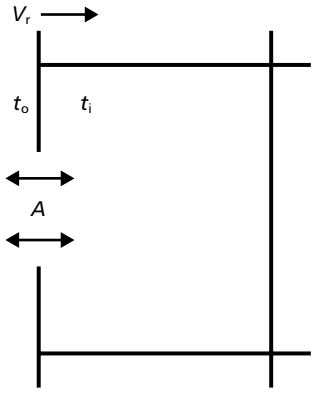
— the shape of the building.

Air will flow through the building from areas of high pressure to areas of low pressure. In very general terms, building surfaces facing into the wind will experience positive pressures; leeward surfaces and those at right angles to the wind direction will experience negative pressure (suction). Since wind velocity increases with height and the wind pressure increases as the square of wind speed, the top of high-rise buildings can therefore experience relatively large wind pressures compared with ground level.

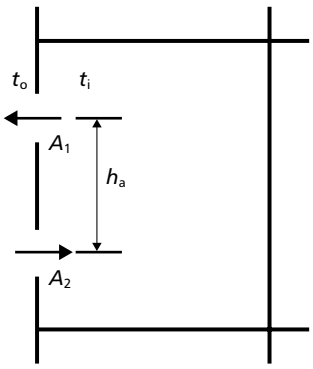
By locating openings in the positive and negative pressure regions, a suitable flow pattern through the building can be planned. Knowledge of local climate conditions is essential. Suitable openings include windows vents and wind towers (see section 2.6.9).

Stack or buoyancy-driven ventilation

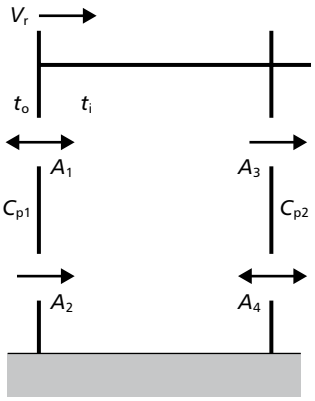
Stack-driven ventilation is driven by the pressure differences created between the inside and outside of a building by temperature difference (see chapter 4 of CIBSE Guide A (CIBSE, 2015a)). Warm air inside a space rises to be replaced by colder air, as shown in Figure 2.5. In the normal situation, where the inside of the building is warmer than outside, the pressure difference acts inwards at the lower levels of the building and outwards at the high levels. The driving pressures created by stack effect can often be similar in magnitude to wind-driven ventilation pressure, especially in sheltered locations. Stack ventilation is therefore an important contributor to natural ventilation design. Systems can be applied to both single-storey and multi-storey buildings by utilising interconnected openings



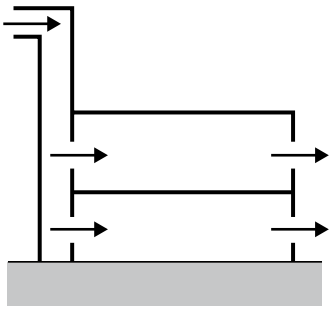
(a) Single sided single opening



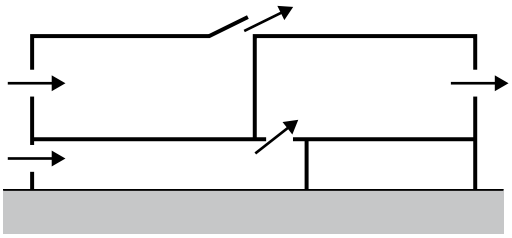
(b) Single sided double opening



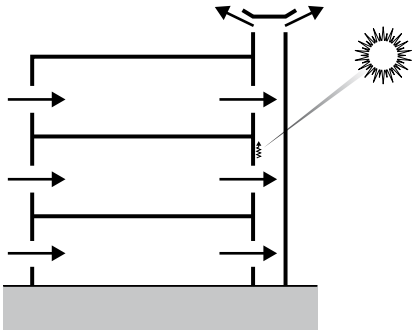
(c) Cross ventilation



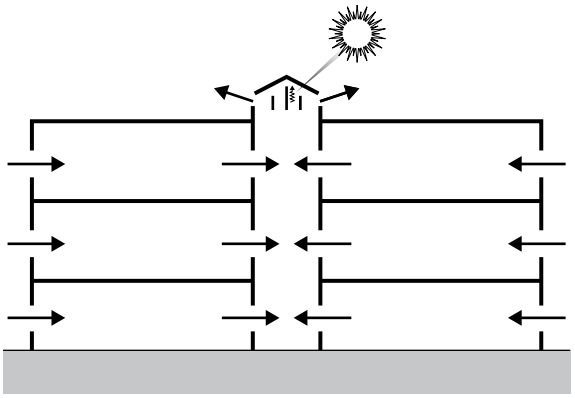
(d) Scoop cross ventilation



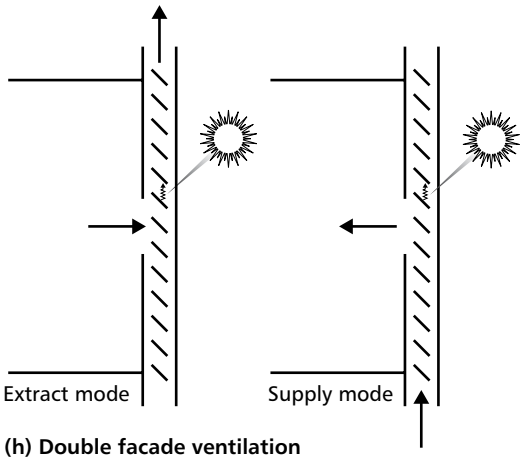
(e) Ducted cross ventilation



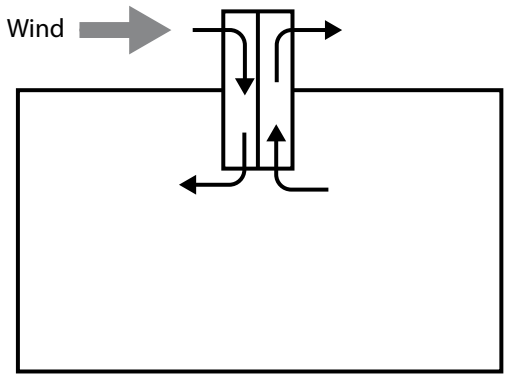
(f) Chimney



(g) Atrium ventilation



(h) Double facade ventilation



(i) Wind tower/catcher

Figure 2.3 Typical natural ventilation configurations

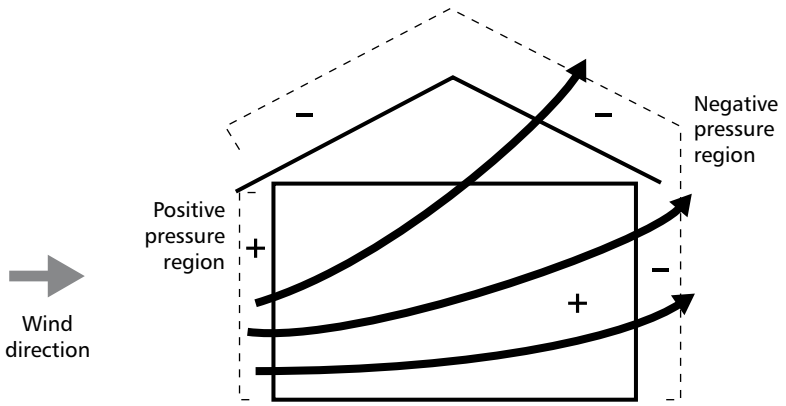


Figure 2.4 Wind-driven ventilation (from *Guide to Ventilation* (AIVC, 1996) reproduced by kind permission of AIVC)

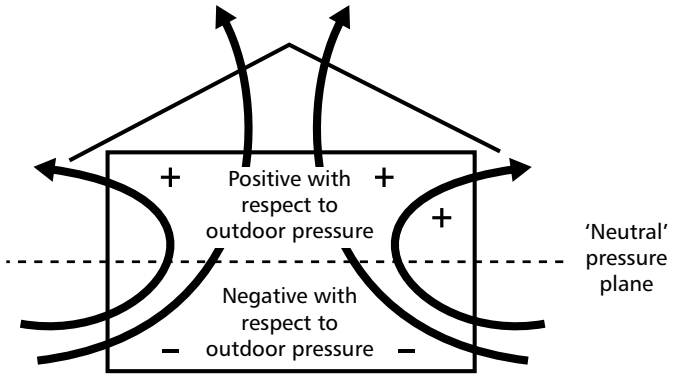


Figure 2.5 Stack-driven ventilation. Flow pattern for outside temperature less than inside temperature (from *Guide to Ventilation* (AIVC, 1996), reproduced by kind permission of AIVC)

placed at different heights. Design details are covered in section 2.4.2.

Stack-driven ventilation is enhanced by maximising the vertical distances between openings. This may be accomplished by atrium design (see 'Atrium ventilation' in section 2.3.2.2) or by the use of passive stacks (see section 2.6.9.12).

Combined wind and stack-driven ventilation

Combined wind and stack systems can provide ventilation irrespective of driving force. Good designs of natural ventilation should seek to utilise both forces. This is accomplished by optimising the location of openings to benefit from wind effect and temperature difference. In particular wind pressure can enhance stack effect by placing stack outlets in the negative pressure region above the roof (see 'Wind-driven natural ventilation' in section 2.3.2.2). An example of the interaction of wind and stack pressure is given in Figure 2.6.

Atrium ventilation

An atrium is a variation on the chimney ventilation principle (see Figure 2.7) The essential difference is that the atrium serves more functions than the chimney; for example it can also provide space for circulation and social interaction. These can restrict the flexibility to locate the atrium to maximum advantage for ventilation purposes. The design of atria is discussed in detail by Saxon (1986).

With a centrally located atrium, the air can be drawn from both sides of the building, thereby doubling the plan width of the building that can be ventilated by natural means (see 'Cross-flow ventilation: maximum penetration depth' in section 2.3.2.2). Note that the same effect could be achieved by a central spine of chimneys and wind terminals.

The atrium also provides an opportunity for introducing daylight into the centre of a deep-plan building. Because atria are designed to capture natural light, they are by definition solar assisted. To promote natural ventilation, the air temperature in the atrium should be as high as possible over as great a proportion of the atrium height as possible. If the atrium is open to the surrounding space, or if it provides high-level walkways between floors, then excess temperatures at occupied high levels may be unacceptable. The design should therefore seek to allow solar energy to be absorbed by surfaces such as:

— elements of the structure

— solar baffles or blinds that act as shading devices.

As stack ventilation, roof vents must be carefully positioned within the form of the roof so that positive wind pressures do not act on the outlets thereby causing reverse flow. This is achieved by:

— designing the roof profile so that the opening is in a negative pressure zone for all wind angles

— using multiple vents that are automatically controlled to close on the windward side and open on the leeward side

— using dampers on the outlets to control the air path in high winds

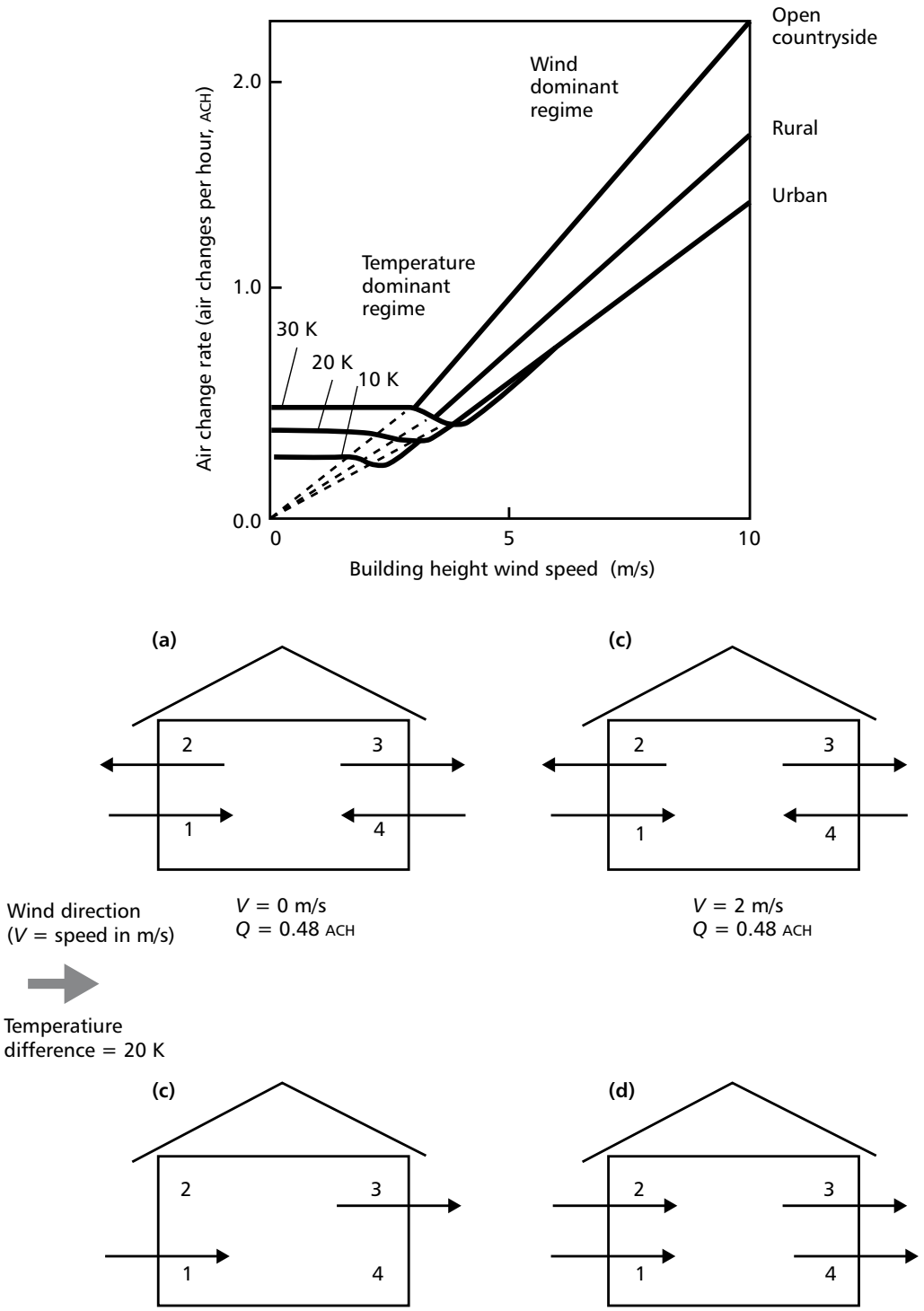


Figure 2.6 Combined effect of wind and temperature difference on ventilation rate and airflow pattern (from *Guide to Ventilation* (AIVC, 1996) reproduced by kind permission of AIVC)

Notes

While the rate of ventilation can be held almost constant for a range of weather conditions, the pattern of airflow changes.

In (a), ventilation is dominated by temperature (temperature dominant regime). Air enters through the lower openings (1 and 4) and leaves through the upper openings (2 and 3).

As wind increases in situation (b), wind pressure reinforces stack pressure at the windward lower opening (1) and leeward upper opening (3), while opposing the stack pressure at the other openings (2 and 4). Although the pattern and magnitude of flow essentially remains unaltered, the flow rate through each opening changes.

At (c) the wind exactly opposes stack pressure at openings 2 and 4, leaving flow only through 1 and 3. The effective reduction in the number of openings reduces slightly the overall air change rate. This effect is less pronounced as the number of openings increase since it is unlikely that a significant proportion of them would simultaneously experience exactly opposing pressures.

At greater wind speeds (d), flow enters the building through the windward side (1 and 2) and leaves through the leeward openings (3 and 4). This marks the start of the wind dominant regime.

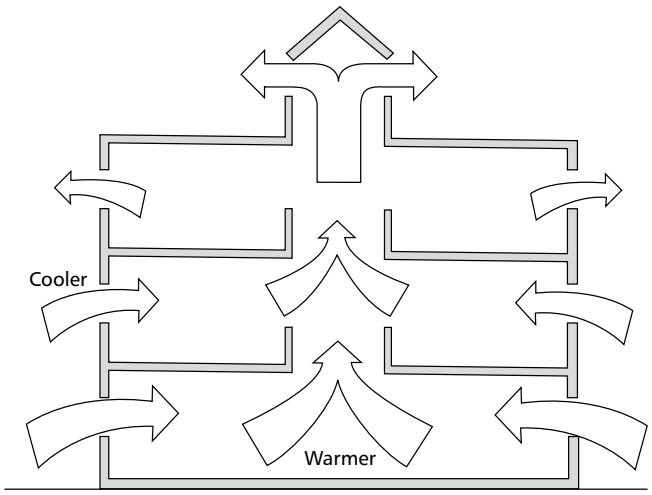


Figure 2.7 Buoyancy-driven ventilation

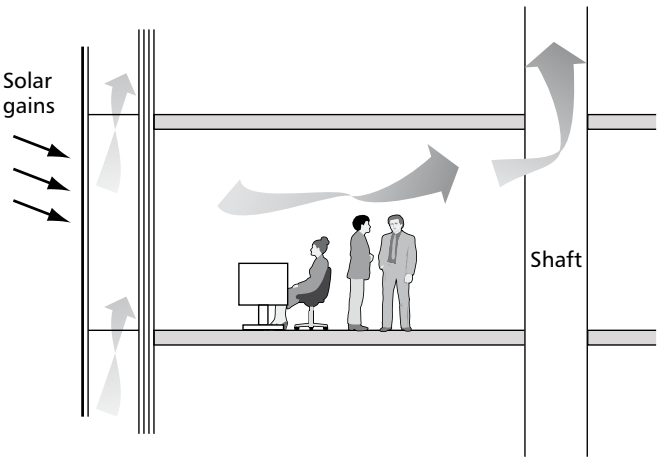


Figure 2.8 Double façade ventilation

— using multiple dampers in a controls philosophy to open and close on the windward or leeward side as necessary.

Natural ventilation can be supplemented on hot still days by the use of extract fans in the atrium roof. Subject to approval by the fire officer, these can also form part of the smoke control system. It is likely that any components used in such a system should have fire or smoke classifications (see section 2.5.3).

Double façade natural ventilation

The double façade is a special form of solar chimney, where the whole façade acts as an air duct (see Figure 2.8). It can act as an extract plenum similar to a solar chimney. In order to provide absorbing surfaces to promote convective flow in the façade, cavity blinds are used. These also prevent direct solar gain passing through the façade to the occupied space.

Alternatively, the cavity could be used as a supply plenum. Outside air is introduced into the cavity at low level and the cavity acts as a solar collector, pre-heating the outside air. The warmed air is then supplied into the occupied zones via ventilation openings between the cavity and the space. If the air in the cavity is too hot, then it can be exhausted to outside or to a heat recovery device.

The efficiency of the solar collector mode can be significantly reduced if the conduction losses are too high. The possibility of condensation should also be checked based on the conditions of the air entering the cavity and the temperature of the glass.

Single-sided natural ventilation: maximum penetration depth

Sometimes natural ventilation may only be provided through openings on a single side of a space (e.g. a row of windows, see Figure 2.9). This can restrict the impact of wind-driven ventilation since the same openings must provide for both supply and extract. To ensure that the full depth of a single-sided space is adequately ventilated, the depth of a single-sided ventilated room should not generally exceed 2.5 times the ceiling height (see Table 2.5).

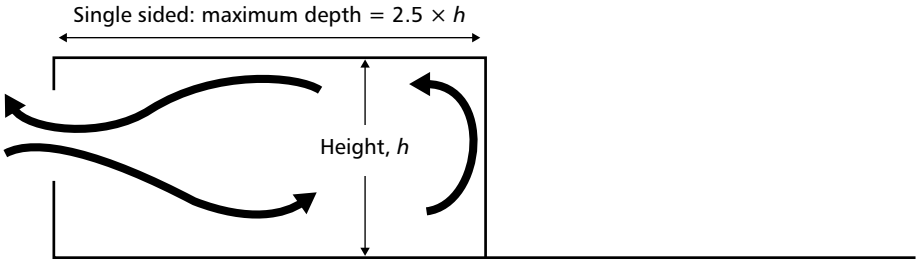


Figure 2.9 Single-sided ventilation maximum penetration (from *Guide to Ventilation* (AIVC, 1996) reproduced by kind permission of AIVC)

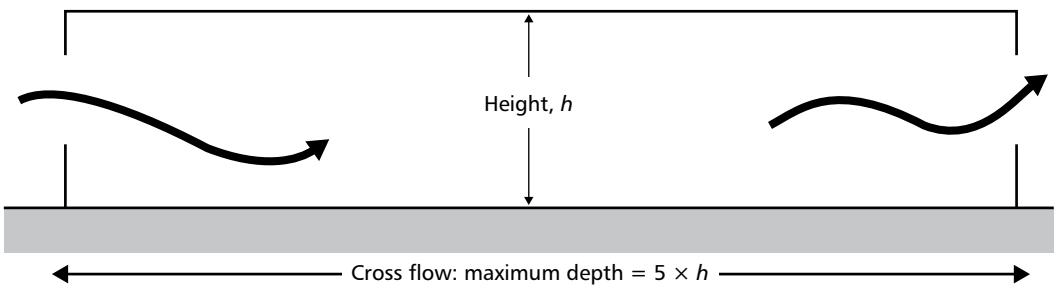


Figure 2.10 Cross-flow ventilation (from *Guide to Ventilation* (AIVC, 1996) reproduced by kind permission of AIVC)

Cross-flow ventilation: maximum penetration depth

Cross-ventilation occurs where there are ventilation openings on both sides of the space concerned (see Figure 2.10). Depending on weather conditions and the configuration of openings, cross-ventilation can be driven by wind or stack pressure or a combination of both. As the air moves across the zone, there will be an increase in temperature and a reduction in air quality as the air picks up heat and pollutants from the occupied space. Consequently there is a limit on the depth of space that can be effectively cross-ventilated. This implies a narrow plan depth for the building, which has the added benefit of enhancing the potential for natural lighting. Cross-ventilation is only generally effective up to a maximum of five times the floor-to-ceiling height (see Table 2.5).

In the case of an atrium, passive stack or a wind tower it may be possible to extend the building depth to 10 times the ceiling height by creating fresh air cross-flow paths towards or from the centre of the building. More information about natural ventilation components is given in section 2.6.9.

Advantages and limitations of natural ventilation

Natural ventilation offers many advantages, especially in a mild climate. However, there are also important limitations that can restrict its use, especially in urban environments and where energy efficiency can be improved by heat recovery.

Advantages include the following points:

— It can provide acceptable levels of thermal comfort and indoor air quality under many seasonal conditions and can also meet acoustic requirements for the internal conditions with a minimum use of energy.

— User control: anecdotal evidence suggests that users are reported to favour access to openable windows or some form of local override facility.

— It is relatively inexpensive to install, however costs are heavily influenced by the complexity of window or ventilator design and by the building form necessary to achieve effective natural ventilation.

— Minimal maintenance needs: natural ventilation systems are generally more accessible for cleaning and maintenance than mechanical systems, and there are no components subject to high humidity, such as cooling coils or humidifiers, which can harbour biological growth.

— There is no plant noise.

— It can be integrated with cooling systems to prevent overheating.

— Wind towers, stacks and atria can increase the depth of space that can be naturally ventilated.

— There is no need to house mechanical plant rooms therefore there is more floor space available for occupation.

Limitations include the following points:

— Under-ventilation can occur at low driving forces.

— Inadequate control could lead to excessive winter heat loss. Although close control over temperature and humidity is possible, it requires a tight control strategy. Poor control could lead to inadequate ventilation.

— Risk of draught: poorly located openings could result in cold draughts. Cold back-draught is possible from passive stacks if the air in the stack is not heated to room temperature.

— Restrictions on the maximum penetration depth of natural ventilation could result in limitations on building and/or room size.

— Flexibility is difficult to achieve if extensive partitioning is introduced.

— Overheating risk: natural ventilation may reach its limits if heat gains increase and no mechanical cooling is installed. This limit will depend on many factors including indoor heat gain, solar gains and outdoor temperature. A full thermal analysis is needed to assess the potential of passive cooling. The long-term impact of global warming also needs to be considered.

— Mechanical heat recovery is not possible.

— Predictability: performance can be modelled in theory, but in practice is subject to variation in the motivating forces of wind and weather.

— Noise: there may be problems associated with external noise or the transmission of internal noise.

— Ability to deal with polluted outdoor environments: protection from outdoor pollutants by filtration is not possible but effects of transient pollutants can be mitigated by closing windows and other types of opening during times of pollution (e.g. periods of peak traffic movement).

— Where air is passed from one zone to another the flow of fresh air must be sufficient to provide acceptable air quality in the downstream zone.

Table 2.5 Natural ventilation options and maximum recommended depths (from CIBSE AM10: *Natural ventilation in non-domestic buildings* (2005))

Strategy	Maximum effective depth relative to floor-to-ceiling height
Single-sided opening	2.5 × floor-to-ceiling height
Cross flow	5.0 × floor-to-ceiling height
Stack ventilation	5.0 × floor-to-ceiling height
Atria	10 × floor-to-ceiling height if centrally located

2.3.2.3 Mechanical ventilation

Mechanical ventilation strategies

Mechanical ventilation systems incorporate fans and control systems to drive the ventilation process. They are thus able to provide ventilation irrespective of the availability or suitability of natural forces. Large buildings including city centre offices, public buildings and shopping

malls are almost universally mechanically ventilated. In addition to providing fresh air, mechanical systems are also commonly used to distribute thermally conditioned air as part of the building's heating and cooling or air-conditioning system.

The main roles for mechanical ventilation are:

— to provide fresh air ventilation

— to assist in naturally cooling a building when the outside air temperature is less than the indoor air temperature, e.g. night cooling by mechanical ventilation assistance

— to distribute thermally conditioned air from a heating and air-conditioning system.

There are several possible arrangements for the supply and extraction of air in mechanical ventilation systems. These are summarised in Figure 2.11.

Large building 'balanced' mechanical ventilation

A schematic of the main elements of a typical large commercial building ventilation system is illustrated in Figure 2.12). This arrangement forms the basis of mechanical systems in large buildings throughout the world and is fundamental to modern heating, ventilation, and air conditioning (HVAC) design. This approach incorporates a separate network of fans and ducts to supply fresh (and often thermally tempered) air to a space and extract polluted air from a space.

Supply air is drawn from the outside via an air intake. This may be pre-heated or cooled by an exhaust air heat recovery unit (see section 2.3.4) before being blended with recirculated air in a mixing box. The air is then filtered and thermally conditioned (heated or cooled) before being supplied to the ventilated space via an air terminal unit and diffuser. Additional heating or cooling may be applied at the air terminal unit. The characteristics of a diffuser depend on the type of ventilation system. In the case of mixing systems (see section 2.6.4) the diffuser is designed to maximise the level of turbulence and hence encourage the rapid mixing of supply air with room air. The orientation of the flow jets and the flow velocity must be designed such that the heat or cooling characteristics of the supply air is rapidly dispersed into the occupied zone without causing draught or thermal discomfort.

Displacement systems (see section 2.2.8.2)

In the case of displacement systems the diffuser must be designed to avoid mixing. Detailed information is given in section 2.4.3.5. Primary thermal treatment may be minimal in the case of a displacement ventilation system. Recirculation is also usually avoided with displacement systems since thermal needs are not provided by the supply air.

Advantages

This is a well-established ventilation approach, which has the following advantages:

— It can control indoor climate irrespective of outdoor conditions.

— Control can be provided at an individual level, regardless of location.

— Closeness of control: close control over temperature and humidity is possible (subject to air being at a suitable temperature), but with higher energy use.

— Flexibility: this can be achieved but with cost penalties.

— Predictability: performance can be predicted subject to commissioning and maintenance.

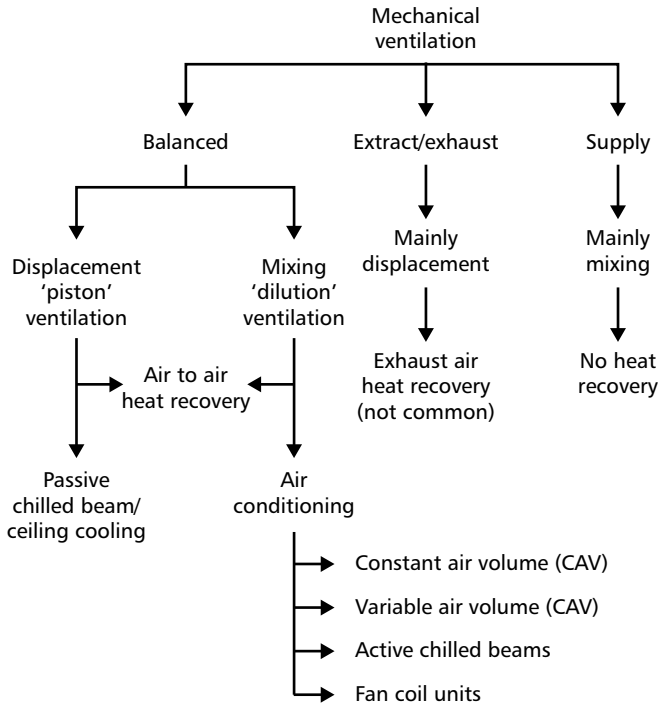


Figure 2.11 Summary of mechanical systems

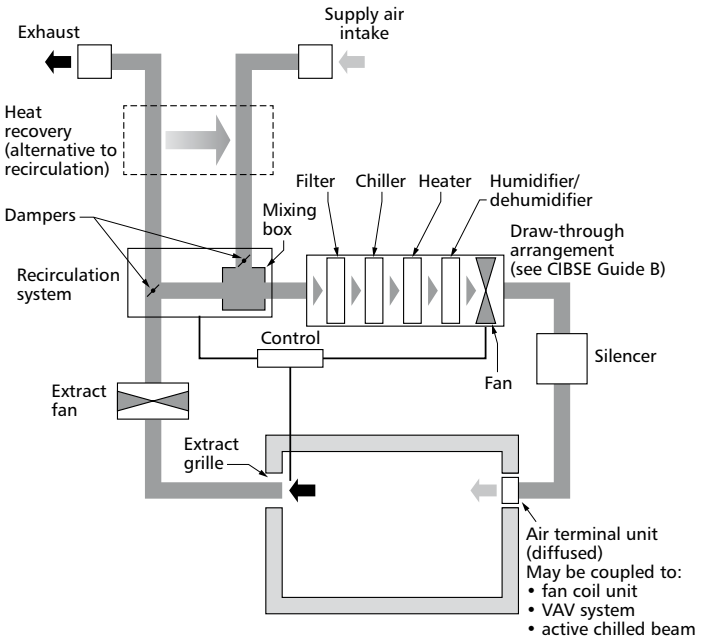


Figure 2.12 Mechanical balanced ventilation for non-residential building (source: Good Practice Guide GPG 257 (Action Energy, 1997) (Crown copyright))

— Ability to deal with polluted environments: there is control of air intake positioning. These should be located away from pollutant sources (see CIBSE, 1999 and BSRIA, 2000). Filtration is possible in harsh environments (see section 2.3.3). However, gaseous and fine particle control may involve considerable expense and regular maintenance.

— It is suitable for hot and cold climates.

— It is suitable for large buildings.

— It is suitable for urban and city centre locations.

Disadvantages

Disadvantages are as follows.

— *High capital costs*: costs are heavily influenced by the amount of mechanical plant and the need for a dual duct system, i.e. one for supply and one for extract.

— *High running costs*: the system incurs electrical energy demand and regular maintenance costs; power is now limited by regulation (NBS, 2011d/e).

— *Risk of draught from displacement units*: poor design may lead to draught risk.

— *High space demand*: space is needed for ductwork and equipment.

— *Building airtightness*: for the associated heating and cooling system to work at maximum efficiency the building needs to be as airtight as possible.

Mechanical extract ventilation

In smaller commercial buildings and dwellings, the complexities of balanced systems may be reduced by installation of an extract only system (Figure 2.13). In this case air is extracted from 'wet' or contaminated areas such as process areas, kitchens, toilets and bathrooms.

Clean, make-up fresh air is provided by a network of purpose-provided 'passive' supply openings to occupied zones as well as natural leakage openings. Because air is extracted from the space, the enclosure will be at a negative pressure relative to the ambient outdoor atmospheric pressure.

When the pressure generated by the mechanical system is greater than the pressures generated by the natural driving forces of wind and stack pressure, the airflow rate is dominated by the mechanical ventilation rate (this process is covered in more detail in CIBSE Guide A (2015a)). Thus this system can inhibit the impact of air infiltration driving forces. However, for full control of ventilation the building should be reasonably airtight.

In the domestic setting, extract ventilation is placed in 'wet' rooms such as WCs, bathrooms and kitchens. The resultant suction pressure prevents moisture, generated in wet spaces, from entering the living area thus reducing the risk of condensation. In addition, cooking fumes and other pollutants are prevented from spreading to occupied zones. In the commercial setting extract ventilation is used for containment. Examples include industrial fume hoods, commercial kitchens and laboratory applications (see CIBSE Guide B0 (2016b)).

A further important advantage of extract ventilation is that contaminants from the exhaust air can be centrally collected and removed by filtration before discharge into the atmosphere. Waste heat can also be extracted using 'run-around' coils for use as supply air pre-heat or, in the case of low-grade heat, for use in conjunction with a heat pump.

Excessive under-pressures will lead to high fan energy consumption and could cause back-draught from flued appliances in adjacent spaces. Hence a full risk assessment will be needed to identify any problem. Part F of the Building Regulations (NBS, 2013b) provides guidance on the avoidance of back-draught when using extract systems.

Fans can be window, ceiling or wall mounted but are most effectively located at a high level away from the source of fresh air such as an internal door or trickle ventilator. In a kitchen they are ideally combined with a cooker hood. Ceiling-mounted fans should be ducted to outside; however, it should be noted that ductwork lengths of as little as 1 m can considerably impair performance due to pressure

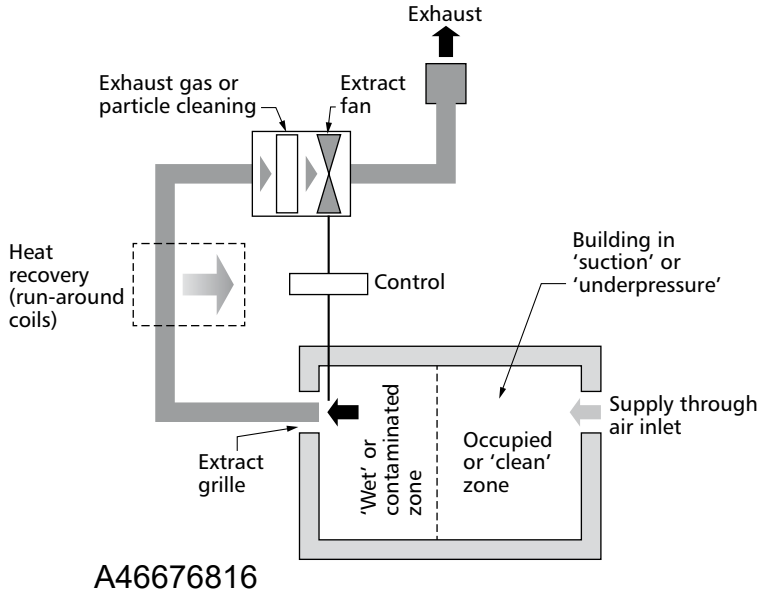


Figure 2.13 Mechanical extract ventilation system (source: Good Practice Guide GPG 257 (Action Energy, 1997) (Crown copyright))

losses, hence correct selection is imperative. In all cases, manufacturers' data on pressure drop should be applied.

Fans should be located so as not to produce draughts or draw combustion products from open-flue appliances. Guidance is covered in Part J of the Building Regulations (NBS, 2013f), BS 5864: 2010: *Installation in domestic premises of gas-fired ducted-air heaters of rated input not exceeding 70 kW* (BSI, 2010a) and BRE IP 13/94: *Passive Stack Ventilation in Dwellings* (BRE, 1994). Note that cooker hoods require permanently open vents as close as possible to the hood. Control can be by manual switching or through being wired into a door or light switches. Another option is humidity control with manual override, although the sensor may cause the fan to operate when moisture generation is not taking place, for example on warm, humid summer days. The sensor needs to be positioned with consideration to where the major source of moisture is located. It may be more suitable to install cowled shutters to avoid noise problems with external gravity back-draught shutters rattling in the wind.

When exhaust air is ducted and discharged at a single location, it is possible to recover heat using a run-round coil (see section 2.3.4.3). This recovered heat may be used to pre-heat hot water systems or provide space heating pre-heat by means of a heat pump

Advantages

— It is simple and widely applicable.

— There is a reduced duct demand compared with a combined supply-and-extract system.

— It provides the possibility of rapid extract.

— The system is easily understood.

Heat recovery is possible for secondary purposes using a run-around coil or heat pump to absorb heat from the exhaust air (see section 2.3.4.3).

Disadvantages

— The distribution of fresh air supply can be uncertain, depending on the size of the opening area servicing a space and the resistance to flow in the paths leading to the extract system.

— It can be perceived by occupants to have high running costs and is prone to tampering by occupants.

— Noise can be an issue.

— The system requires maintenance.

— Air cleaning not is possible.

— Risk of back-draught: resultant under pressure makes this system unsuitable in locations that use open-flue heating appliances.

Mechanical supply ventilation

Mechanical supply systems incorporate mechanical fans to supply fresh air to a space (see Figure 2.14). Air is exhausted through purpose-provided passive vents and air infiltration openings. Because air is supplied to the space, the enclosure will be at a positive pressure relative to the ambient outdoor atmospheric pressure

Mechanical supply ventilation provides fresh air directly to a space. The positive pressure inhibits infiltration ingress from outdoors and adjacent spaces. Additionally, the supply air can be cleaned by filtration (see section 2.3.3) and therefore this method has important applications in clean room design. However, in hot, humid climates, supply ventilation can force moisture-laden outdoor air into the building fabric.

In dwellings the supply fan is typically mounted in the roof space and delivers air that has been filtered and tempered by the roof space into the dwelling. The system works on the principle of continuous dilution, displacement and replacement of air in the dwelling. Air discharge from the dwelling is via purpose-provided extract vents and/or leakage paths. Fans typically run continuously at low speed,

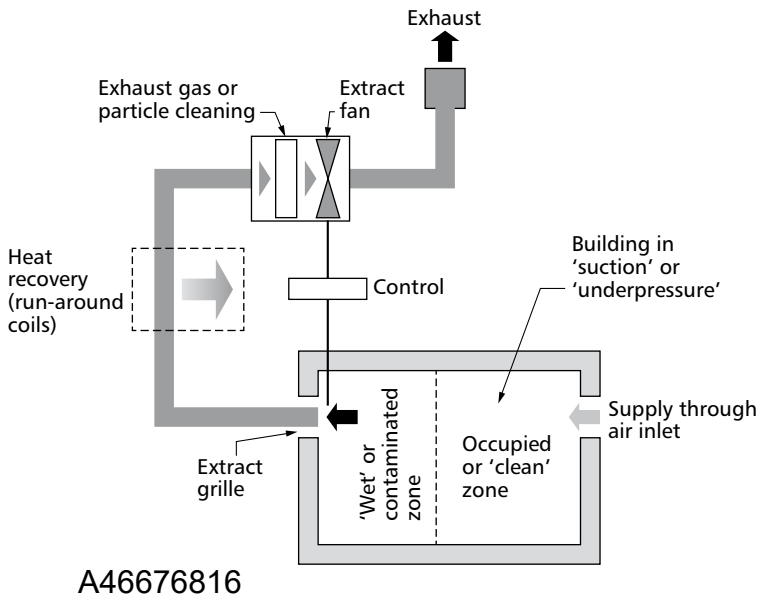


Figure 2.14 Mechanical supply ventilation (source: Good Practice Guide GPG 257 (Action Energy, 1997) (Crown copyright))

with manual or humidity controlled boost to a higher speed when required. Temperature controls can incorporate single roof space sensors or sensors in both the roof and living spaces. The latter system adjusts the flow rate of the unit to suit the temperatures in both spaces, thereby providing the optimum energy benefits for the occupants. Fan units incorporating highly efficient motor technology can provide a significant net energy gain to the dwelling.

Advantages

— It is simple and well established as a means of controlling condensation.

— It is compatible with open-flued appliances.

— It utilises any heat gain in the roof space.

— It allows filtration of the air before it enters the space.

Disadvantages

— Occupants perceive the systems to have high running costs.

— Noise can be an issue.

— Systems are prone to tampering by occupants.

— Maintenance (particularly filter replacement) is required.

— Effectiveness depends on building shape/layout.

— Since there will usually be multiple extract vents it is not possible to recover heat or pollutants from the exhaust air

Domestic 'balanced' mechanical ventilation system with heat recovery

A scaled-down version of the commercial balanced system is becoming increasingly common in dwellings. A schematic is presented in Figure 2.15.

Almost invariably, the fundamental benefit of a balanced ventilation system is to combine it with an air-to-air heat recovery system (see section 2.3.4).

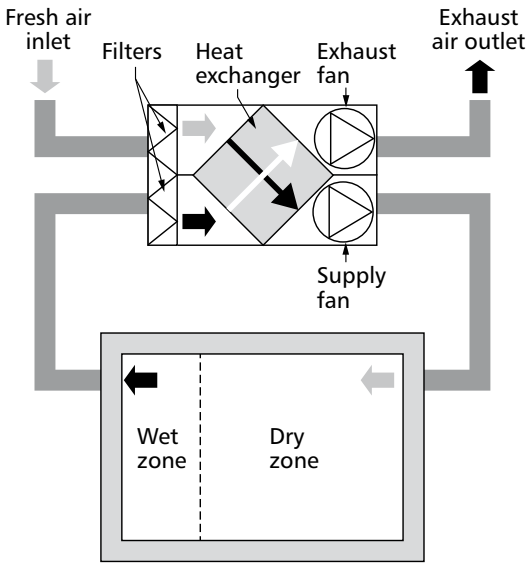


Figure 2.15 Domestic heat recovery system

In operation, warm, moist air is extracted from kitchens, bathrooms, utility rooms and toilets via a system of ducting and passed across a heat exchanger before being exhausted. Fresh incoming air is pre-heated and ducted to the living room and other habitable rooms.

Ducts may be circular or rectangular and typically range in size from 100 to 150 mm in diameter. Air velocities should be kept below 4 $m \cdot s^{-1}$. Vertical exhaust ducts should be fitted with condensate traps; horizontal exhaust ducts should slope away from fans to prevent condensate running back. Both supply-and-extract grilles should be located at high level as far as practical from internal doors but at a sufficient distance from each other to avoid 'short circuiting', i.e. a minimum of 2 m. Suitable louvres or cowls should be fitted to prevent ingress of rain, birds or insects.

Such systems can provide the ideal ventilation almost independent of weather conditions. During normal operation the total extract airflow rate will be 0.5–0.7 air changes per hour (ACH) based on the whole dwelling volume, less an allowance for background natural infiltration if desired. Individual room air change rates will be significantly higher, possibly 2–5 ACH, in rooms with an extract terminal. To be most effective a good standard of air tightness is required, typically the permeability should be better than 5 $m^3 \cdot h^{-1}/m^2$ at 50 pa. Airflows need to be balanced at the time of installation. Extract rates from bathrooms and kitchens can be boosted during times of high moisture production although care should be taken not to cause draughts. The system can be acoustically treated to reduce noise ingress. Commissioning should follow CIBSE Commissioning Code A: *Air distribution systems* (2006b).

Transfer grilles or clearance beneath internal doors are necessary. Part F of the Building Regulations (NBS, 2013b) requires bottom edges of internal doors to be clear of the floor surface by 10 mm. Transfer grilles are usually positioned not more than 450 mm above the floor. If placed higher they may allow the rapid movement of toxic combustion products or facilitate the spread of fire. Fire dampers should be inserted where the ductwork passes through separating walls and floors, and are desirable in kitchens, for example cooker hoods. In dwellings, the principal requirement is to maintain the separation of fire compartments, for example where ducts pass through protected escape routes. The most common approach is to use a means of preserving the partition, such as intumescent duct sleeves. Dampers should not be used in kitchen extracts, instead protection is required through fire-resisting ductwork (see section 2.3.5).

It is claimed that such systems are effective in reducing condensation due to the controlled ventilation and airtight structure reducing cold air draughts. Manufacturers also claim that they improve indoor air quality and help in controlling dust-mite populations.

Advantages

— It provides controlled pre-heated fresh air throughout the house.

— It reduces the heating demand in very airtight dwellings (typically effective in dwellings with infiltration rates < 5 $m^3 \cdot h^{-1}/m^2$).

— It reduces the risk of condensation.

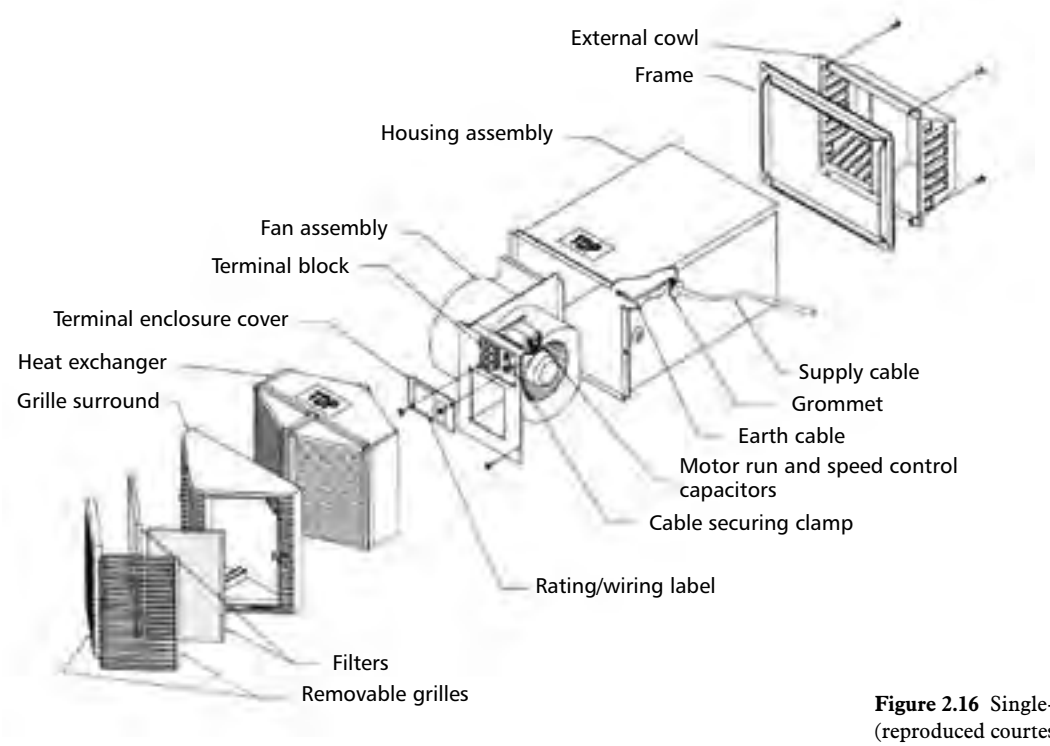


Figure 2.16 Single-room ventilation heat recovery unit (reproduced courtesy of Vent-Axia)

Disadvantages

— Ductwork can be difficult to accommodate.

— Initial costs are high.

— The systems have an ongoing maintenance liability.

— A suitable level of airtightness must be provided.

— Installation and commissioning is more complex than for other systems.

— Because of increased electrical demand to offset fossil fuel heating, a carbon benefit must be demonstrated.

— Systems can freeze and cease to function below 0 °C. Anti-frost measures include switching off, heating or operating at reduced efficiency. All these impact on cost and energy performance.

In cold climates heat recovery systems have become popular for dwellings since considerable energy saving is possible with heat recovery efficiencies of up to 92 per cent being attainable. In milder climates payback periods become more difficult to justify. However, at low temperatures the performance of heat recovery can be hampered by the need for frost protection.

Heat recovery room ventilators

This is a single-room version of a mechanical ventilation heat recovery system, which is mounted in an external wall (often to replace an extract fan, see Figure 2.16). These ventilators incorporate a heat exchanger that recovers approximately 60 per cent of the heat from the outgoing air. This is passed across to the incoming air to pre-heat it. The extract fan is often dual speed, providing low-speed, continuous trickle ventilation or high-speed extract. High-speed extract can be under manual or humidity control. This system is principally designed for wet rooms although versions are now available for living and bedrooms.

Advantages

— It provides continuous low-level ventilation.

— It provides the option of rapid extract.

— It recovers heat energy.

— It allows filtration of the supply air.

— It is almost silent in operation at trickle speed.

Disadvantages:

— Occupants perceive the systems to have high running costs.

— Regular maintenance is required.

— Some recirculation is possible, due to the close proximity of supply-and-extract grilles.

— It is ineffective unless the building is airtight

2.3.2.4 Mixed-mode or hybrid ventilation systems

Mixed-mode ventilation may be defined as the combination of natural and mechanical ventilation and/or cooling systems. These systems are described in full detail in CIBSE AM13: *Mixed mode ventilation* (2000a).

Sub-classifications of mixed-mode systems given in CIBSE AM13 are as follows.

— *Contingency designs*: contingency designs are usually naturally ventilated buildings that have been designed to permit the selective addition of mechanical ventilation and cooling systems where these may be needed at a later date. Occasionally the passive measures may themselves be the contingency plan, with an initially fully air-conditioned building designed to be amenable to subsequent naturally ventilated operation, either in part or in whole.

— *Complementary designs*: natural and mechanical systems are both present and are designed for integrated operation. This is the most common variety of mixed-mode system. Complementary designs can operate in two modes.

  — *Concurrent operation*: the most widely used mode, in which background mechanical ventilation, with or without cooling, operates in parallel with natural systems. Often the mechanical system suffices, controlling draughts and air quality and removing heat, but occupants can open the windows if they so choose.

  — *Changeover operation*: natural and mechanical systems are available and used as alternatives according to need, but they do not necessarily operate at the same time. Changeover may be on the basis of a variety of conditions as suggested below under Control (see section 2.3.6). The chosen control strategy must guard against the risk that changeover systems may default to concurrent operation. Problems of this kind tend to increase with the complexity of the proposed operating strategies.

— *Zoned systems*: these allow for differing servicing strategies to occur in different parts of the building. The zoned approach works best where the areas are functionally different. Many buildings operate in this manner, e.g. a naturally ventilated office with an air-conditioned computer room and a mechanically ventilated restaurant and kitchen. Mixed-mode increases the range of options available, e.g. offices with openable windows at the perimeter and mechanical ventilation in core areas. The zoned approach works best where the areas are functionally different or where the systems are seamlessly blended.

A selection process for choosing a mixed-mode approach is illustrated in Figure 2.17. The mixed-mode approach should not be seen as a compromise solution. It needs to be chosen at a strategic level and the appropriate option selected. The ability to provide general advice on applicability is limited because the final design can range from almost fully naturally ventilated with a degree of fan assistance for still days, to almost fully air conditioned with the option to revert to natural ventilation at a later date. Selection issues to be considered are listed below.

— *Costs*: capital and operating costs are highly variable. A balancing factor is to what extent supplementary mechanical systems have been installed.

— *Maintenance*: poor designs could result in excessively complex maintenance requirements.

— *Operability*: as above, poor designs in terms of controls complexity can result in inefficient and misunderstood system operation.

— *Window design*: a mixed-mode approach might allow this to be less complicated and more robust than in buildings designed for natural ventilation alone.

— *Energy efficiency*: in relation to fully air-conditioned buildings, mixed-mode systems should use less energy for fans, pumps and cooling. However, this is dependent upon the savings in mechanical plant that have been attained.

— *Occupant satisfaction and comfort*: mixed-mode buildings offer the potential for a high level of occupant satisfaction in that they provide more options for correcting a situation.

Advantages

— It can take advantage of natural ventilation to reduce mechanical energy consumption.

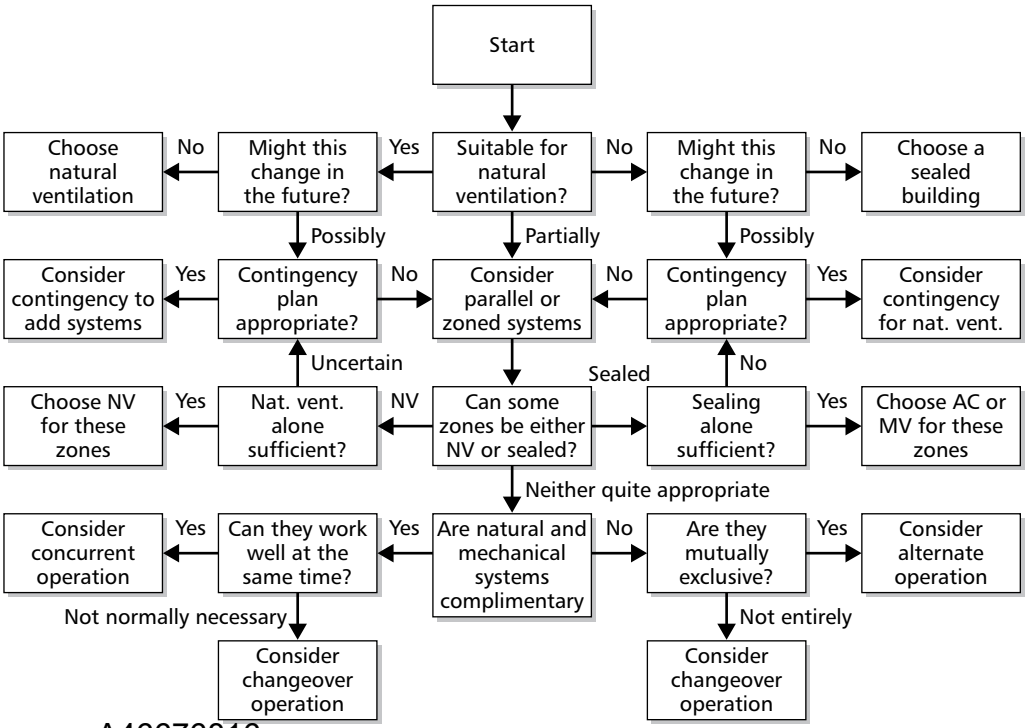


Figure 2.17 Decision chart for selecting mixed-mode ventilation

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— Mechanical components are usually quite basic, hence costs can be lower than a full mechanical system.

— It can be incorporated with mechanical or passive cooling systems.

Disadvantages

— It is less controllable than a full mechanical system.

— Complementary systems could be expensive.

2.3.3 Filtration systems

In mechanically ventilated buildings, effective air filtration relies on good maintenance (see CIBSE TM26: *Hygienic maintenance of office ventilation ductwork* (2000b)). Poor filtration performance can allow dirt and dust to accumulate within a ductwork system, reducing the efficiency of heat exchange equipment and providing potential sites for microbiological activity. Spores and bacteria can then be released into the occupied space, causing potential comfort and health problems. Natural ventilation systems, on the other hand, are generally more accessible for cleaning and maintenance, and there are no components subject to high humidity, such as cooling coils, or humidifiers, which can harbour biological growth.

2.3.3.1 Nature of airborne contaminants

Atmospheric dust is a complex mixture of solid particulate matter, comprising dusts, smokes, and fumes and non-particulate vapours and gases. A sample of atmospheric dust may contain minute quantities of soot and smoke, minerals such as rock, metal or sand, organic material such as grain, flour, wool, hair, lint and plant fibres and, perhaps, mould spores, bacteria and pollen. Particles are not generally called dust unless they are smaller than 80 μm.

Smokes are suspensions of fine particles produced by the incomplete combustion of organic substances, such as coal or wood, or by the release into the atmosphere of a wide variety of chemical compounds in a finely divided state. Smoke particles vary considerably in size from about 0.3 μm downwards. Fumes are solid particles, predominantly smaller than 1.0 μm, formed by the condensation of vapours.

Non-particulate contaminants consist of vapours condensable at normal pressures and temperatures and gases, of which the most damaging to plants and buildings is sulphur dioxide. Carbon monoxide and various oxides of nitrogen are also present in minute quantities. There is a wide variation in atmospheric solids between rural, suburban and industrial areas, as shown in Table 2.6.

Table 2.7 shows an analysis of a sample of atmospheric dust, in terms of the total numbers of particles for the size range. The figures may be considered typical for average urban and suburban conditions, but wide variations may be encountered in particular cases. Current emphasis in office and other 'standard' accommodation is on the removal of particles smaller than 10 μm. These, along with chemicals outgassed from carpets and furnishings in modern workspaces, have been linked with reports of sick building syndrome and are able to penetrate into the lungs, causing respiratory problems.

2.3.3.2 Definitions

The following definitions, drawn from BS EN 779: 2012: *Particulate air filters for general ventilation* (BSI, 2012a), are commonly used in describing the properties of air filters.

— *Test airflow rate*: volumetric airflow rate through the filter under test. Expressed in $m^3 \cdot s^{-1}$ (for a reference air density of 1.20 $kg \cdot m^{-3}$).

— *Face velocity*: the airflow rate divided by the face area ($m \cdot s^{-1}$).

— *Initial pressure drop*: the pressure drop (Pa) of the clean filter operating at the test airflow rate.

— *Final pressure drop*: the pressure drop (Pa) up to which the filtration performance is measured for classification purposes.

— *Average efficiency* (E_m): weighted average (%) of the efficiency of 0.4 μm particles for the different specified dust loading levels up to final pressure drop.

— *Average efficiency* (E_{ij}): average efficiency (%)for a size range i at different loading intervals j.

— *Minimum efficiency*: lowest efficiency among the discharged efficiency, initial efficiency and the lowest efficiency throughout the loading procedure of the test.

— *Initial arrestance* (%): arrestance of the first 30 g loading dust increment.

— *Average arrestance*: ratio of the total amount of loading dust retained by the filter to the total amount of dust fed up to the final pressure drop.

2.3.3.3 Filter testing

Applicable standards

The applicable test standard for particulate air filters for general ventilation is BS EN 779: 2012: *Particulate air filters for general ventilation* (BSI, 2012a).

These filters are classified according to their performance as measured in this test procedure.

In order to obtain results for comparison and classification purposes, particulate air filters are tested against two synthetic aerosols—a fine aerosol for measurement of filtration efficiency as a function of particle size within a particle size range 0.2 μm to 3.0 μm and a coarse one for obtaining information about test dust capacity and, in the case of coarse filters, filtration efficiency with respect to coarse loading dust (arrestance).

This European Standard applies to air filters having an initial efficiency of less than 98 per cent with respect to 0.4 μm particles. Filters should be tested at an airflow rate between 0.24 $m^3 \cdot s^{-1}$ (850 $m^3 \cdot h^{-1}$) and 1.5 $m^3 \cdot s^{-1}$ (5400 $m^3 \cdot h^{-1}$).

The performance results obtained in accordance with this standard cannot by themselves be quantitatively applied to predict performance in service with regard to efficiency and lifetime.

For higher efficiencies, BS EN 1822-5: 2009: *High efficiency air filters (EPA, HEPA and ULPA). Determining the efficiency of filter elements* (BSI, 2009a) is applicable.

The BS EN 779: 2012 classification system previously in use (comprising groups F and G filters) has been changed to three groups (F, M and G filters). Filters found to have an average efficiency value of less than 40 per cent of 0.4 μm particles are allocated to group G and the efficiency reported as '<40%'. The classification of G filters (G1–G4) is based on their average arrestance with the loading dust.

Filters found to have an average efficiency value from 40 per cent to less than 80 per cent of 0.4 μm particles will be allocated to group M (M5, M6) and the classification is based on their average efficiency (0.4 μm). The filter classes F5 and F6 have changed to M5 and M6, but with same requirements as in the old classification system.

Filters found to have an average efficiency of 80 per cent or more of 0.4 μm particles will be allocated to group F (F7–F9) and the classification is based on their average efficiency (0.4 μm) as in the old system and the minimum efficiency during the test.

Filters are classified according to their average efficiency or average arrestance under the following test conditions.

— The airflow shall be 0.944 $m^3 \cdot s^{-1}$ (3400 $m^3 \cdot h^{-1}$) if the manufacturer does not specify any rated airflow rate.

— 250 Pa maximum final test pressure drop for coarse (G) filters.

— 450 Pa maximum final test pressure drop for medium (M) and fine (F) filters.

If the filters are tested at 0.944 $m^3 \cdot s^{-1}$ and at maximum final test pressure drops, they are classified according to Table 2.6, for example G3, F7. Filters tested at airflows and final test pressure drops different from those above shall be classified according to Table 2.6, and the classification should be qualified by test conditions in parentheses, e.g. G4 (0.7 $m^3 \cdot s^{-1}$, 200 Pa), F7 (1.25 $m^3 \cdot s^{-1}$).

Test for high efficiency filters

The preferred pan-European test method for testing high efficiency EPA (efficient particulate air filter), HEPA (high efficiency particulate air filter) and ULPA (ultra-low particle arrestor) filters is BS EN 1822-5: 2009: *High efficiency air filters (EPA, HEPA and ULPA). Determining the efficiency of filter elements* (BSI, 2009a). This test method is based on scanning by a particle counter at the most penetrating particle size (MPPS) of the filter. MPPS is variable and is determined by testing samples of the filter medium used in the manufacture of the filter being tested. The challenge aerosol is di-ethyl-hexyl-sebacat (DEHS) mineral oil or equivalent, but other oils are permitted. Condensation nucleus counters (CNC) are used for monodispersed aerosols and laser particle counters (LPC) for polydispersed aerosols.

The most recent version of the standard introduced a category of EPA grade filters, formally H10 to H12. This was done because the previous classification did not fully represent the test method employed for all the H grades, particularly regarding leak testing. It was decided that the filter grades should be grouped by test method. The grades are now as follows.

— Group E: EPA filters

— Group H: HEPA filters

— Group U: ULPA filters.

Filters are classified in 'groups' and 'classes'. For each group a slightly different test procedure applies. All filters are classified according to their filtration performance.

Group E filters are subdivided in three classes:

— Class E10

— Class E11

— Class E12.

Group H filters are subdivided in two classes:

— Class H13

— Class H14.

Group U filters are subdivided in three classes:

— Class U15

Table 2.6 Classification of general ventilation filters

Group	Class	Final test pressure drop / Pa	Average arrestance (A_M) of synthetic dust / %	Average efficiency (E_M) of 0.4 μm particles / %	Minimum efficiency* of 0.4 μm particles / %
Coarse	G7	250	$50 \le A_M < 65$	—	—
	G2	250	$65 \le A_M < 80$	—	—
	G3	250	$80 \le A_M < 90$	—	—
	G4	250	$90 \le A_M$	—	—
Medium	M5	450	—	$40 \le E_M < 60$	—
	M6	450	—	$60 \le E_M < 80$	—
Fine	F7	450	—	$80 \le E_M < 90$	35
	F8	450	—	$90 \le E_M < 95$	55
	F9	450	—	$95 \le E_M$	70

* Minimum efficiency is the lowest efficiency among the initial efficiency, discharged efficiency and the lowest efficiency throughout the loading procedure of the test.

Table 2.7 Classification of EPA, HEPA and ULPA filters

Filter group/class	Integral value		Local value (see BS EN 1822-4)*	
	Efficiency / %	Penetration / %	Efficiency / %	Penetration / %
E10	≥ 85	≤ 15	Group E filters not leak tested for classification purposes	
E11	≥ 95	≤ 5		
E12	≥ 99.5	≤ 0.5		
H13	≥ 99.95	≤ 0.05	≥ 99.75	≤ 0.25
H14	≥ 99.995	≤ 0.005	≥ 99.975	≤ 0.025
U15	≥ 99.9995	≤ 0.0005	≥ 99.9975	≤ 0.0025
U16	≥ 99.99995	≤ 0.00005	≥ 99.99975	≤ 0.00025
U17	≥ 99.999995	≤ 0.000005	≥ 99.9999	≤ 0.0001

* Local penetration values lower than those given here may be agreed between the supplier and purchaser.

— Class U16

— Class U17.

After testing, filter elements are classified according to Table 2.7 on the basis of their integral efficiency (Group E) or their integral efficiency and local (Groups H and U) MPPS efficiency or penetration. The other addition is that filters with filter media having an electrostatic charge are classified according to the table on the basis of their discharged efficiency or penetration as per Annex B of BS EN 1822-5: 2009: *High efficiency air filters (*EPA, HEPA *and* ULPA*). Determining the efficiency of filter elements* (BSI, 2009a).

On-site testing

The efficiency of a filter installation depends not only on the filter efficiency but also on the security of the seal between the filter and the air system. This is particularly vital in HEPA filter installations; hence penetration must be established immediately prior to use and at regular intervals throughout the working life of the system.

A common methodology utilises an oil-based aerosol to challenge the installed filter. Concentrations are determined using photometry:

— DOP (an abbreviation for di-octylphthalates) is an oily liquid with a high boiling point. Normally, DOP vapour is generated at a concentration of 80 $mg \cdot m^{-3}$ and the downstream concentration is determined using a light scattering photometer via a probe that scans the entire downstream face of the filter installation.

Gas and vapour removal

Most manufacturers quote efficiencies for removal of a wide range of gases and vapours based on upstream and downstream concentrations. Adsorption filters are also rated in terms of the mass of gas/vapour that can be adsorbed before saturation of the adsorbent.

Specification and testing methods have been developed for gas and vapour removal by filters and recirculating air cleaning units (Gilbert, 1999). This work has looked at the performance of a wide range of systems including active bonded carbon units and electrostatic filters. Specialist advice should be sought on any requirements.

Dry testing

In applications such as cleanrooms used for the production of semi-conductors, testing for local leaks with an oil-based aerosol would result in filter contamination and subsequent production problems. In these circumstances filters are tested using atmospheric air or polystyrene latex spheres (PSL).

2.3.3.4 Filter application and selection

Table 2.8 presents a broad classification of air cleaners and Figure 2.18 illustrates the various characteristics of dusts, mists etc., together with other relevant data.

Table 2.9 provides recommended filter specification data drawn from the National Engineering Specification Y42: *Air Filtration* (NES, 1996) and promoted within BSRIA guidance (Pike, 1996; Bennett, 1996). CIBSE TM26: *Hygienic maintenance of office ventilation ductwork* (2000b) considers other means of reducing the admittance of micro-organisms other than just the installation of a HEPA filter. Under certain conditions, air filters can support the growth of micro-organisms and act as a source of contaminants. Standard air filters can be obtained with an anti-microbial coating that is reported to kill or inhibit the growth of micro-organisms on the filter material and any trapped dust and debris. However, due to the potential for the active biocide to outgas from the surface, the user of such systems should take steps to ensure that they are safe for building occupants. Anti-microbial ductwork coatings are also available, however they also have a potential for the active biocide to outgas from the surface.

Ultraviolet germicidal irradiation (UVGI) is provided by ultraviolet lamps mounted in the supply ductwork. The ultraviolet (UV) light causes inactivation of micro-organisms by disrupting their DNA. This system is claimed to be effective against all types of bacteria and fungi, as well as spores and viruses that are normally found in the air. The user of such systems should ensure that staff are protected from exposure to the UV radiation. Photo-catalytic oxidation technology involves the action of low-energy UV on a catalyst in the presence of water vapour that generates hydroxyl radicals that destroy micro-organisms. As this is

an oxidation process, the microbial hydrocarbons are reduced to carbon dioxide and water. This technique can be used against bacteria, fungi/spores, viruses and allergens.

2.3.3.5 Filter maintenance

The life of a filter depends upon the:

— concentration and nature of contaminants

— filter efficiency

— dust-holding capacity corresponding to rise in pressure loss between clean and dirty conditions

— face velocity at the filter.

A maintenance regime can be based on time intervals or on condition. Details of external conditions that may affect filter life, such as the entering pollution concentration, may be determined in consultation with the local environmental health officer. Alternatively, a local survey may be undertaken. Some filter manufacturers provide prediction data for hours of use for different localities. Tables 2.10 and 2.11 give typical data on the amount and nature of solids in the atmosphere. Issues of external air quality, including sulphur dioxide and particulate matter (PM_{10}), are discussed in CM 4548: *Air Quality Strategy for England, Scotland, Wales and Northern Ireland* (DEFRA, 2007), which is subject to periodic review.

If condition-based maintenance is being used, the filter pressure differential should be monitored. Replacement filters are installed when a specific differential is attained. If the filter represents a significant proportion of the total pressure loss of the system, and there is no provision for automatic fan duty adjustment (e.g. a variable air volume (VAV) system), then the rise in pressure loss due to filter soiling should not exceed 20 per cent of the total system loss with a clean filter. This differential can be reported via a building energy management system (BEMS). Note that a method of alerting maintenance staff of filter failure or blockage is also required for the time-based replacement method.

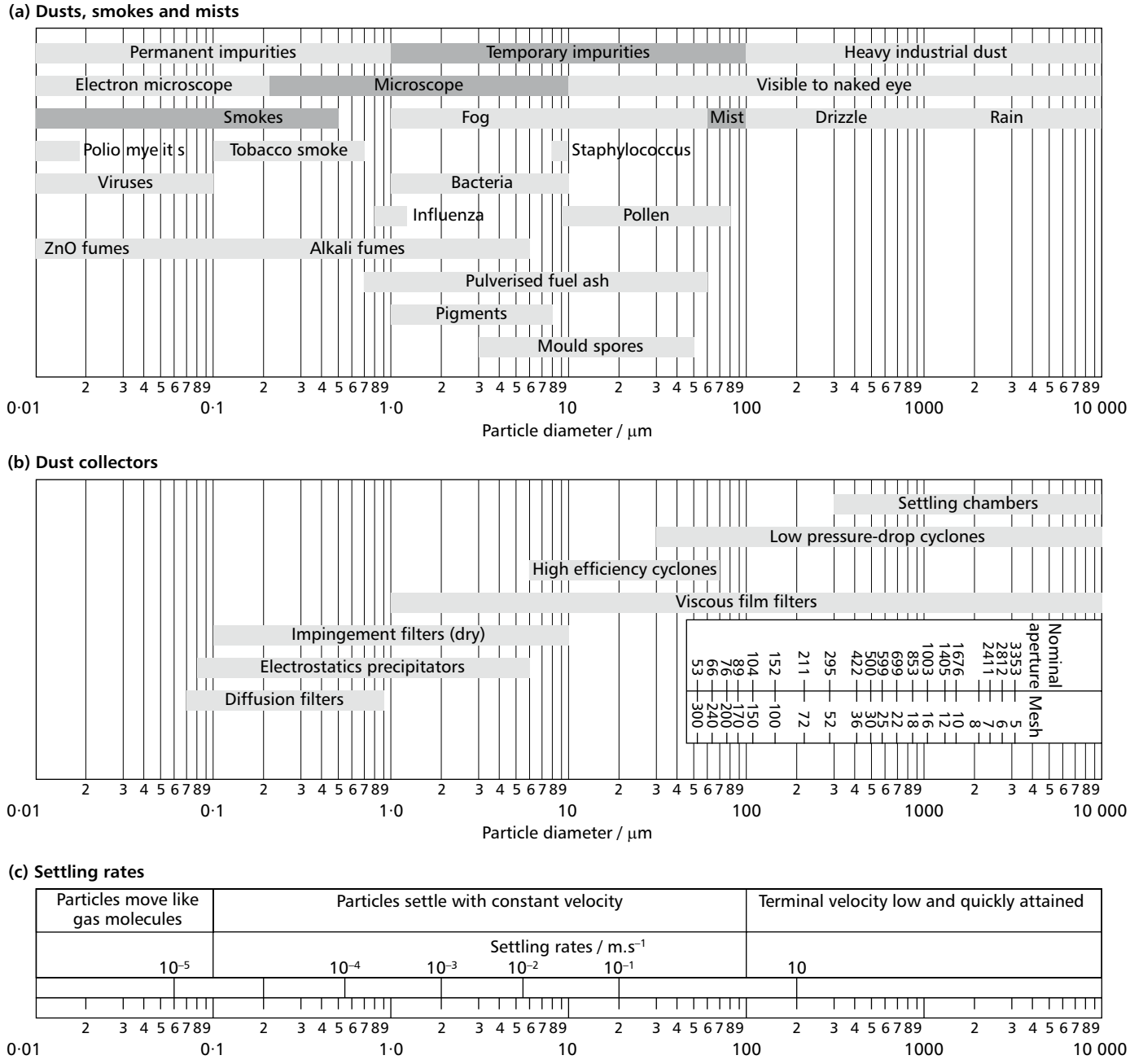


Figure 2.18 Characteristics of dusts and mists

Table 2.8 Classification of air cleaners

Type	Remarks	Method of cleaning	Face velocity / m·s^{-1}	Resistance at face velocity / Pa		Dust holding capacity	Relative efficiency / %		Relative cost
				Initial	Final		Sodium flame	Synthetic dust	
Viscous impingement:									
— panel or unit	Thickness ranges 12–100 mm; small or intermediate air volumes; good for particles > 10 μm diameter; efficiency decreases with dust loadings; used as after-cleaners	Permanent (washable) or disposable	1.5–2.5	20–60 (depending on thickness)	100–150	High; can be critical	10	> 85	Low
— moving curtain	Will handle heavy dust loads; intermediate or large air loads; used as precleaners etc.	Continuous or intermittent; can be automatic	2–2.5	30–60	100–125 (operating)	Self-cleaning by immersion	10	> 85	Medium
Dry:									
— panel, bag, cartridge or unit with fabric or fibrous medium	Small or intermediate air volumes	Usually disposable	1.25–2.5	25–185 (depending on efficiency)	125–250 (depending on efficiency)	Generally not as high as viscous impingement; can be critical	30–80 (depending on filter type, medium and face velocity)	96–100 (depending on filter type, medium and face velocity)	Low to high
— moving curtain	Intermediate or large air volumes	Continuous or intermittent; can be automatic or disposable	2.5	30–60		Self-cleaning	Can be selected over a wide range		Medium to high depending on efficiency
— absolute or diffusion (HEPA)	Pre-filter necessary; small air volumes; particles down to 0.01 μm diam.	Disposable	Up to 2.5	Up to 250		Low	> 99.9	100	High
Electrostatic:									
— charged plate	Pre-filter desirable; after-filter used to collect agglomerates; power-pack and safety precautions necessary (up to 12 kV); particles down to 0.01 μm diam; intermediate to large air volumes	Washable or wipeable; can be automatic	1.5–2.5	Negligible; resistance added (40–60 Pa) to improve uniformity of air distribution	Negligible; resistance added (40–60 Pa) to improve uniformity of air distribution	Can be critical	—	Not suitable over 5 μm diam.	High; low maintenance costs
— charged medium	As for charged plate	Disposable	1.25	25	125	High	55–65	Not suitable over 5 μm diam.	High; low maintenance costs
Adsorption units	Should be protected from dust, oil and grease; used for odour removal*	Can be reactivated	Low	Low; can be selected; constant	Low; can be selected; constant	Medium adsorbs up to half its own weight of many organic substances	95 (dependent on gas to be removed)		High
Mechanical collectors	Not suitable for particles less than 0.01 μm diameter	To be emptied	Varies with design	50–100	Constant (some act as air movers)	High	—	—	High; low maintenance costs

* Odours can also be removed by combustion, masking or liquid absorption devices

Note: air washers used for humidification or dehumidification purposes sometimes also act as air cleaning devices. These include capillary air washers, wet filters, adsorption spray chambers etc., for which manufacturers' data should be consulted.

Table 2.9 Recommended filter specification data

Filter data to be specified	Essential	Desirable
Air flow rate ($m^3 \cdot s^{-1}$)	*	
Air velocity ($m \cdot s^{-1}$)		*
Initial filter pressure drop (Pa)	*	
Final filter pressure drop (Pa)	*	
Average arrestance (%)	*	
Initial dust spot efficiency (%)	*	
Average dust spot efficiency (%)	*	
Minimum dust holding capacity (g)	*	
Class of filter (EU number)		*
Size of filter (height, width, limiting depth (mm))	*	
Casing		*
Test standards	*	
Access		*
Filter medium		*

Further details on filter maintenance can be found in guidance produced by BSRIA (Pike, 1996) and BESA (2012). Designers are also referred to CIBSE TM26: *Hygienic maintenance of office ventilation ductwork* (2000b).

2.3.3.6 Filter installation

BSRIA has analysed the whole-life performance of filter systems (Pike, 1996; Bennett, 1996) (i.e. the balance between space and capital costs and the operating costs such as inspection, change, energy and costs of associated equipment, e.g. duct cleaning and redecoration). The conclusion is that filter performance depends not only on the filter specification but also on the design and installation of the filter system.

Poor filter installation will neutralise the benefits of specifying good filters. The overall efficiency for the filter installation must be not less than that specified for the filter. It is suggested that:

— air intakes are located at a high level away from the direction of the prevailing wind to prolong filter life and improve the quality of the intake air

— air filters should be protected from direct rain by using weather louvres to prevent waterlogging

— filters should be installed upstream of mechanical equipment to provide protection for that equipment; a final filter should be located downstream of the fan under positive pressure to reduce the risk of dust entering the system downstream of the filter

— adequate access for cleaning should be provided

— filter frames should be of good quality to prevent leakage and distortion; side withdrawal will make this difficult to achieve.

For filters installed in air-handling units (AHUs), and with specific fan power (SFP) in mind, lower filter pressure drops are necessary. Table 2.12 gives maximum 'dirty' conditions.

Table 2.10 Typical amounts of solids in the atmosphere for various localities

Locality	Total mass of solids / $mg \cdot m^{-3}$
Rural and suburban	0.05–0.5
Metropolitan	0.1–1.0
Industrial	0.2–5.0
Factories or work rooms	0.5–10.0

Table 2.11 Analysis of typical atmospheric dust in relation to particle size

Range of particle size (diameter)/mm	Amount of solid as percentage of number of particles and total mass of particles / %	
	Number of particles	Total mass of particles
30 to 10	0.005	28
10 to 5	0.175	52
5 to 3	0.250	11
3 to 1	1.100	6
1 to 0.5	6.970	2
Less than 0.5	91.500	1

2.3.4 Ventilation heat recovery systems

2.3.4.1 Background

Heat recovery devices used in ventilation systems generally provide heat recovery from exhaust to supply air in winter and can also recover cooling in peak summer conditions. They are also used in specific system configurations such as indirect evaporative cooling (see CIBSE Guide B, Chapter 3 on air conditioning. Devices used to recover heat from process applications (e.g. dryers, flues) may transfer the heat to the process or to another application. Selection of equipment should be suitable for process exhaust temperatures. Where the recovered heat is fed to a ventilation system, modulation control is normally required to prevent overheating in warm weather.

Buildings should be airtight, as infiltration has a significant impact on the viability of heat recovery (AIVC, 1994).

Technical considerations for design and selection of heat recovery devices include:

— heat recovery efficiency (sensible and total)

— airflow arrangement

Table 2.12 Maximum final pressure drops for filters (reproduced from Table 9 of BS EN 13053 (BSI, 2006c), by permission of the British Standards Institution)

Filter class	Final pressure drop / Pa
G1–G4	150
F5–F7	200
F8–F9	300

The final pressure drops are the typical maximum values for AHUs in operation and lower than those used in BS EN 779: 2012 (BSI, 2012a) for classification purposes, for reasons of energy saving, and the performance obtained from tests according to BS EN 779 are not necessarily met at these lower pressure drops.

— fouling (filters should be placed in both supply and exhaust airstreams)
— corrosion (particularly in process applications)
— cross-leakage
— condensation and freeze-up
— pressure drop
— face velocity
— construction materials (suitability for temperatures, pressures, contaminants)
— maintenance (in particular cleaning of surfaces)
— controls.

2.3.4.2 Efficiency analysis

The heat recovery efficiency (or effectiveness) of a device is normally defined as follows:

$$\text{Efficiency} = \frac{\text{Actual heat transfer}}{\text{Maximum possible heat transfer}}$$

The maximum theoretical efficiency is a function of the exchanger flow configuration; counter-flow exchangers have a higher theoretical efficiency than parallel flow exchangers. Practical considerations often favour cross-arrangements that lie between the two (ASHRAE, 2008).

Sensible heat recovery devices do not transfer moisture. Latent heat is only transferred when the warmer airstream is cooled below its dew-point and condenses. Total heat recovery devices transfer both sensible heat and moisture between the airstreams. Moisture transfer is desirable in hot, humid climates to reduce the moisture in the supply air and in cold, dry climates to raise the moisture in the supply air.

Drains should be included to collect and dispose of the condensate. In extreme conditions, where the temperature also drops below 0 °C, frosting or icing can occur. This can be prevented by pre-heating the supply air or reducing the effectiveness of the heat exchanger. Alternatively, the heat exchanger may be periodically defrosted.

Pressure drops depend on a number of factors including exchanger design, airflow rates, temperatures and connections. These pressure drops should be minimised, as they impose a fan energy penalty that will need to be balanced against the recovered energy. Face velocities are normally limited by the need to avoid excessive pressure drops. Larger devices will have lower pressure drops and higher efficiency but will cost more and require more space. The selection and evaluation of heat recovery devices should include the following parameters:

— cost expenditure on device, filters etc. and savings on other plant (e.g. boilers) due to heat recovery
— energy, both recovered and required to operate the system (e.g. fan, pump, wheel)
— maintenance requirements
— space requirements of device, filters etc.

Energy analysis may be undertaken using simulation modelling or spreadsheet calculations based on hourly conditions (see CIBSE AM11: *Building performance modelling* (2015c)). Table 2.13 compares a number of heat recovery devices as described below. Recent guidance on heat recovery is also given in BSRIA HRS 1/2009: *Heat Recovery Systems* (2009b).

Heat recovery within mechanical ventilation systems becomes economic when the value of the recovered heat or cooling outweighs the increase in fan capital and running costs, as well as those of the heat recovery equipment. The viability of heat recovery increases:

— as the number of air changes per hour increases and the heating/cooling season lengthens
— as the temperature difference between supply-and-extract airstreams increases
— with increased proximity of the supply-and-extract airstreams, although it can still be considered when they are not adjacent through the use of a run-around coil.

Table 2.13 Comparison of heat recovery devices (based on 'Chapter 8: Air-to-air energy recovery' in *ASHRAE Handbook: HVAC Systems and Equipment* (ASHRAE, 2008))

Device	Typical heat recovery efficiency / %	Typical face velocity / $m \cdot s^{-1}$	Cross-leakage / %	Typical pressure drop / Pa	Modulation control	Features
Recuperator	50 to 80 (sensible)	1 to 5	0 to 5	25 to 370	Bypass	No moving parts Easily cleaned
Run-around coil	50 (sensible)	1.5 to 3	0	100 to 500	Pump or bypass valves	Flexibility; exhaust airstream can be separated from supply
Thermal wheel	65 to 90 (total)	2.5 to 5	1 to 10	100 to 170	Wheel speed or bypass	Latent transfer Compact large sizes Cross air contamination possible
Heat pipe	50 to 65 (sensible)	2 to 4	0	100 to 500	Tilt angle down to 10% of maximum	No moving parts except tilt High cost, few suppliers
Regenerator	85 to 95 (sensible)	1.5 to 3	<1 to5	70 to 300	Regulating changeover period	Relatively high capital cost but high efficiency Self-cleaning action from flow reversal

Heat recovery can increase the overall pressure drop and subsequent fan power used by 50 per cent, although options such as double accumulators offer high heat recovery efficiencies and lower pressure drops.

When heat recovery devices are used in full fresh air systems, parasitic losses should be avoided in summertime operation by the use of a bypass. Effective damper control for minimum fresh air and free cooling on recirculation systems should be provided through enthalpy control.

2.3.4.3 Types of systems

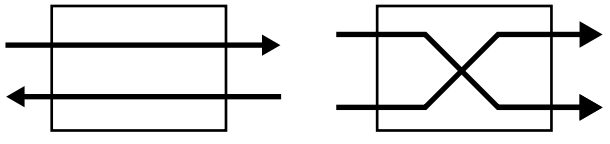
Various heat recovery systems are available, including the following.

Plate heat exchangers

These contain no moving parts and consist of separated interleaved flow channels through which the exhaust and supply air flows. The channel walls have high thermal conductance to facilitate the rapid transfer of heat (this makes little difference due to the limiting effect of the boundary layers). Maximum heat transfer is achieved with a counter-flow configuration (see Figure 2.19 (a)) in which the direction of flow of the exhaust air is in the opposite direction to the flow of the supply air. Practical heat transfer efficiencies of up to 90 per cent are possible from this configuration only with low velocities. In practical systems a cross-flow arrangement is commonly used in which the flow direction of the exhaust air is at right angles to the supply air (Figure 2.19 (b)). This results in slightly lower efficiency (typically up to 70 per cent) but permits a simple layout.

Run-around coils

Finned air-to-water heat exchangers are installed in the ducts between which the heat is to be transferred. A water or water/glycol (for freeze protection) circuit is used to transfer heat from the warm extract air to the cooler supply air (or vice versa in summer) (see Figure 2.20). An expansion tank is required to allow fluid expansion and contraction. Overall heat transfer efficiencies are relatively low, as it is a two-stage heat transfer process, and pump energy (in addition to the fan energy penalty) and maintenance costs need to be taken into account. However, the system is flexible in application, as it places no constraints on the relative location of the two airstreams and can be extended to include multiple sources and uses. They are suitable for applications where contaminants in the exhaust airstream prohibit recirculation.



(a) Counter-flow heat exchanger; theoretical heat transfer 100%

(b) Cross-flow heat exchanger; theoretical heat transfer 70%

Figures 2.19 Heat recovery devices: (a) counter-flow and (b) cross-flow (from *Guide to Ventilation* (AIVC, 1996) reproduced by kind permission of AIVC)

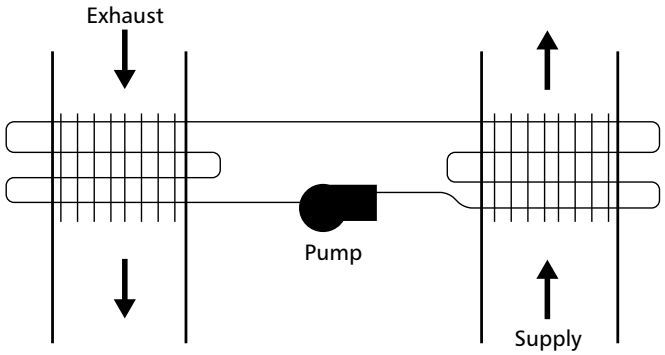


Figure 2.20 Run-around coil heat recovery method (from *Guide to Ventilation* (AIVC, 1996))

Modulation control can be achieved by pump operation and/or valve bypass arrangements on the coils. These consist of finned heat exchangers located in the supply and exhaust ducts. Heat transfer efficiencies can vary between 40 and 60 per cent.

Thermal wheels

A thermal wheel comprises a cylinder packed with a suitable heat transfer medium, which rotates slowly within an airtight casing that bridges the ducts between which heat is to be transferred (see Figure 2.21). Thermal wheels are generally quite compact and achieve high efficiencies due to a counter-flow configuration. The heat transfer properties are determined by the material contained in the wheel, i.e:

— *corrugated, inorganic, fibrous, hygroscopic material that transfers both sensible and latent heat:* air flows through the channels formed by the corrugations

— *corrugated metal (aluminium, stainless steel or Monel):* latent heat transfer is restricted to that resulting from condensation when the temperature of the heat transfer medium falls below the dew-point temperature of the warm airstream.

Maintenance requirements for the thermal wheel need to be taken into account, since they can be difficult to clean (Hamilton, 1986), as do the additional energy penalties due to the drive (although these are usually low).

Cross-contamination occurs by carryover and leakage. Carryover occurs as air entrained within the wheel is transferred to the other airstream. A purge section can be installed where recirculation is undesirable. Leakage occurs due to the pressure difference between the two airstreams. This can be minimised by avoiding large pressure

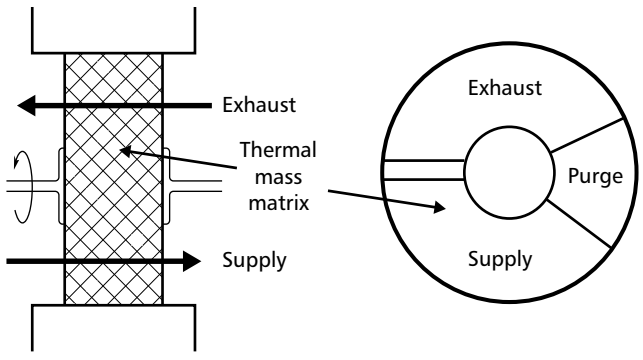


Figure 2.21 Thermal wheel (from *Guide to Ventilation* (AIVC, 1996) reproduced by kind permission of AIVC)

differences, providing an effective seal and placing the fans to promote leakage into the exhaust airstream. Hygroscopic media may transfer toxic gases or vapours from a contaminated exhaust to a clean air supply.

Modulation control is commonly achieved either by the rotational speed of the wheel or by bypassing the supply air. Heat recovery efficiency increases with wheel speed but is ultimately limited by carryover. This consists of a revolving cylinder packed with a coarse mesh of metal or other highly conducting medium. The cylinder passes through the extract and supply streams with the metallic medium passing heat from one to the other (see Figure 2.21). Some thermal wheel media are designed to absorb moisture thus enabling latent heat as well as sensible heat recovery. Thermal wheels are usually used in large building systems.

Heat pipes

The heat pipe is a passive heat exchanger of which there are two main types:

— *horizontal:* in which a wick within the tubes transfers liquid by capillary action

— *vertical:* in which heat from the warmer lower duct is transferred to the cold upper duct by means of a phase change in the refrigerant (see Figure 2.22).

Finned tubes are mounted in banks in a similar manner to a cooling coil. Face velocities tend to be low (e.g. 1.5 to 3.0 $m \cdot s^{-1}$) in order to improve efficiency. Modulation control is normally achieved by changing the slope, or tilt, of the heat pipe.

Regenerator

A regenerator (see Figure 2.23) consists of two accumulators (or a single unit split into two halves) with a damper arrangement to cycle the supply and exhaust airflows between the two. In the first part of the cycle, the exhaust air flows through and heats one of the accumulators. The dampers then change over so that supply air flows through and absorbs the heat from that accumulator. The second accumulator acts in reverse to match, heating the supply air in the first part of the cycle and absorbing heat from the exhaust air in the second. The changeover period is normally of the order of one minute.

Claimed sensible efficiencies for these systems can be quite high at 85 per cent. Latent efficiencies are normally significantly lower and vary with flow velocity and accumulator material. Modulation of the heat recovery efficiency can be achieved by regulating the changeover period.

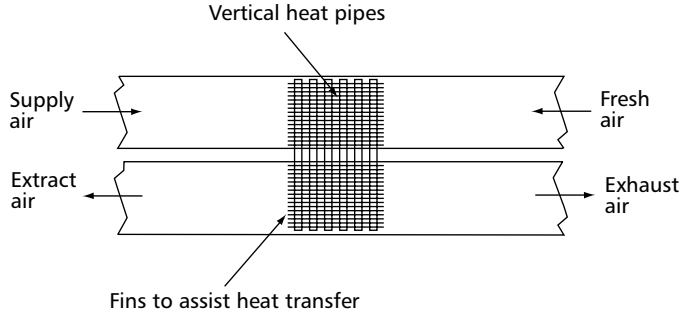


Figure 2.22 Vertical pipe heat arrangement

On damper changeover, the exhaust air contained within the damper, accumulator and exhaust ductwork reverses and becomes supply air. The length of exhaust ductwork should be minimised to limit this cross-leakage. The time required for damper changeover should be kept to a minimum using high torque dampers. Cross-leakage can range from below 1 per cent on well-designed systems to up to 5 per cent and above. Typical face velocities are 1.5 to 3.0 $m \cdot s^{-1}$. Reducing the velocity will reduce the pressure drop, but will have only a limited heat transfer benefit, as efficiencies are normally high anyway.

2.3.4.4 Advantages and disadvantages

Advantages

— Heat recovery efficiencies of up to 90 per cent means that a substantial proportion of lost heat from ventilation systems can be recovered. For this reason, significant importance has been attached to heat recovery systems.

— Flat plate heat exchangers are very reliable.

— Performance is best for very cold climates.

— Thermal wheels can be used to recover latent heat and can therefore have valuable applications in air-conditioned spaces.

— Run-around coils enable complex configurations to be considered. Also exhaust heat can be used for other purposes such as the pre-heat of water or connection to a heat pump.

— Properly sized systems can equal the efficiency performance of other system types.

Disadvantages

— Buildings need to be very airtight since infiltration adds to the overall air change rate and heat loss through infiltration is not recovered. This can adversely affect overall heat recovery performance. In addition, the quality of airtightness must be maintained throughout the operational lifetime of the building

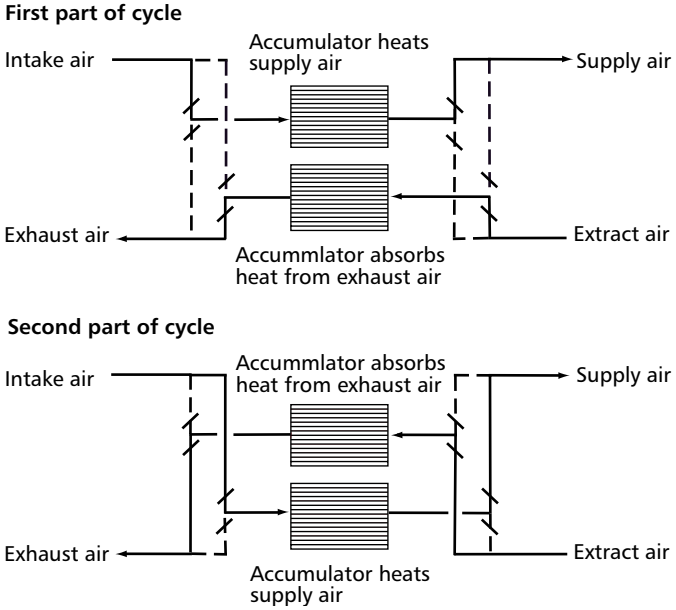


Figure 2.23 Regenerator

— The building must be mechanically ventilated; heat recovery does not work with natural ventilation.

— There are extra costs associated with installation, operation and maintenance.

— Leakage can occur between the supply and exhaust air in the case of thermal wheels. This can be reduced by including a purge zone.

2.3.5 Duct systems

2.3.5.1 Background

The purpose of duct systems is to convey air to and from spaces as part of a ventilation or air-conditioning system. Designers will need to ensure that the design criteria chosen for ductwork systems, associated air pressurisation devices and other in-line equipment can meet the requirements of Part L of the Building Regulations (NBS, 2013a). Any fire safety issues must also be considered to meet the requirements of Part B of the Building Regulations (NBS, 2013g). It is necessary, by law, to pass on all design, installation and actual position details for any fire protection under regulation 38 of the Building Regulations 2010 (TSO, 2010).

This section is intended to be used by practising designers who hold a basic knowledge of the fundamentals of building physics. As such, rigorous mathematical derivations of formulae are not given. Chapter 4 of CIBSE Guide C: *Reference data* (2007) provides detailed information on pressure drops in ducts and duct fittings. The quantitative data apply to the flow of clean air in ducts, but these may also be used for vitiated air where the concentration of contaminant gas is low. The airflow data should not be applied to the conveyance of particulates in ducts.

Constructional aspects of ductwork are not covered in detail. For the UK, reference should be made to the ductwork specifications published by the Building Engineering Services Association (BESA).

The designer must first fully map the design process that is being undertaken. The process for each application will be unique, but will follow the general format, as follows:

— problem definition

— ideas generation

— analysis

— selection of design solution.

Ductwork types and components are described in detail in section 2.6.7.

2.3.5.2 Strategic design issues

Background

The aim of this section is to provide a source of information on current practice in the design of ductwork for ventilation and air-conditioning systems. The information is intended to provide an overview of design criteria and application requirements.

Duct design must balance the need to minimise energy use and noise generation against space availability and the costs of materials and installation, whilst providing adequate means of access for installation, cleaning and maintenance. Materials, equipment and construction methods should be chosen with respect to the whole-life cycle cost of the installation. This is particularly important for new installations for which Part L of the Building Regulations (NBS, 2013a) sets down strict requirements for maximum fan power. The developing sustainability agenda is imposing new constraints on system performance and therefore designers need to look carefully at energy-efficiency issues.

Users of the environmental space serviced by the ductwork will require:

— sufficient air volume for ventilation

— sufficient air volume delivered and removed to provide either comfort conditions or conditions that satisfy the requirements of the process being served

— satisfactory temperature of delivered air

— satisfactory noise levels within the occupied space due to the ductwork installation

— visual impact of the ductwork in keeping with the internal environment and décor

— that on entry to the space, the air is well diffused and does not cause draughts

— satisfactory air quality

— access to fire-protection systems and equipment, such as fire dampers for cleaning and maintenance; under the Regulatory Reform (Fire Safety) Order (RRFSO) (TSO, 2005), records need to be kept of all such positioning, how to clean and maintain and records of such maintenance.

Classification of ductwork

Ductwork systems for ventilating and air-conditioning applications can be divided into low-, medium- and high-pressure systems.

High-pressure systems permit smaller ductwork but result in greater friction pressure drop, requiring the fan to generate higher pressures and noise generation. They are more expensive to install and, because of their greater input power requirements, are more expensive to run. This has led to a trend towards lower design pressures in systems.

Table 2.14 sets out the classification of ductwork systems followed in DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a). The table also gives air leakage limits (see 'Air leakage limits' in section 2.3.5.2).

The duct air velocity is not a major factor in the constructional specification of ductwork. Recommended velocities for particular applications using these three system classifications are given in Tables 2.16 and 2.17.

It is permissible to operate these systems at velocities higher than the recommended values. DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a) limits are up to 10 $m \cdot s^{-1}$, 20 $m \cdot s^{-1}$ and 40 $m \cdot s^{-1}$ in the cases of conventional low-, medium- and high-pressure systems respectively.

Table 2.14 Maximum positive and negative pressures and velocities for low, medium and high-pressure ductwork

System classification	Design static pressure / Pa		Maximum air velocity / $m \cdot s^{-1}$	Air leakage limit per m^2 of duct surface area* / $litre \cdot m^{-2}$
	Maximum positive	Maximum negative		
Low pressure (Class A)	500	500	10	$0.027 \times p^{0.65}$
Medium pressure (Class B)	1000	750	20	$0.009 \times p^{0.65}$
High pressure (Class C)	2000	750	40	$0.003 \times p^{0.65}$
High pressure (Class D)	2000	750	40	$0.001 \times p^{0.65}$

* where p is the static gauge pressure in the duct (Pa)

However, since pressure losses go up by square of velocity, thus impacting substantially on fan power, the use of higher velocities than those recommended is not likely to be economic, and the trend is towards lower air velocities.

Two factors influence velocity selection. First, for a given volume flow, velocities should fall as the size of the duct is reduced, to avoid increasing pressure gradients. Second, noise generation increases rapidly with increases in velocity at grilles, bends and other fittings where the flow separates from the walls, leaving turbulent eddies in its wake. The noise generated at grilles and terminals is of particular importance. High-velocity systems require noise control by using sound-absorbent units between the duct system and the room outlets and inlets.

Systems with design pressures outside the values given in Table 2.14 or where the mean duct velocity exceeds 40 $m \cdot s^{-1}$ should be treated as special and the designer will need to refer to the original references or other source material to confirm the appropriate design parameters.

Layout

In most installations, the constraints imposed by the building or other structures (e.g. single or multiple plant rooms, split systems based on tenancy arrangements etc.) and the siting of fans, plant items and terminals can lead to the adoption of an overall duct layout that is not ideal. Room must be given for the installation of fire dampers at compartment boundaries. This should also allow for access for maintenance. The performance of a system can also be adversely affected by a lack of care and thought in the arrangement and detailing of the ductwork. The designer and installer should be aware of the characteristics of airflow in ducts and fittings so that the objectives of the design are compromised as little as possible by the constraints imposed and by space restrictions. In general, good design should ensure that the air velocities are relatively uniform across the duct section and that the generation of eddies in ducts is minimised.

The site will often dictate the main routing of ductwork systems but in general the design should seek to make the layout as symmetrical as possible; that is, the pressure loss in each branch should be as nearly equal as possible. This will aid regulation and may reduce the number and variety of duct fittings that are needed.

The number of duct fittings should be kept to a minimum and there should be a conscious attempt to achieve some standardisation of types and sizes. Increasing the numbers and variety of fittings in a system can markedly raise its overall cost.

The shorter the ductwork length, the lower is the pressure drop. Distribution lengths are influenced by:

— the shape of the building

— the number and location of plant rooms

— the provision of space for distribution.

In large buildings or industrial plants a choice between a single distribution system and multiple smaller systems may arise. Large distribution systems and their plant can have the advantage of lower operating costs but require more floor space for vertical shafts. In general, very long runs of ducting should be avoided to prevent undue heat losses or gains, excessive leakage and difficulties in balancing during commissioning. Also, the pressure losses in long runs are likely to be higher, and a more expensive class of ductwork may be needed. Multiple smaller distribution systems may be more expensive in capital and operating costs but they avoid long runs, large ducts and vertical shafts, and this may reduce overall building costs.

Spatial requirements

Provision of sufficient space for ductwork is essential and must be addressed at an early stage in the design process of the building.

Laying out the space required for ductwork is, to an extent, an amalgam of experience, skill and three-dimensional visualisation. Adequate space must be provided for installation and maintenance of the ductwork and associated equipment, such as fire dampers at compartment boundaries. The designer should ensure that ductwork is co-ordinated with the other engineering services to be accommodated in the same space, particularly in false ceiling voids and riser spaces where there may be several distribution systems vying for restricted space.

Branches from vertical risers to serve horizontal distribution routes should be considered with care, as this is likely to be the most congested area of the service core. If the service core is enclosed on three sides (e.g. by a lift shaft and an external wall) the horizontal distribution from the core will be extremely difficult, with little space for installation and maintenance.

The area served by a single riser will dictate the size of the horizontal branch duct. The depth selected for a branch duct will have a significant influence on the false ceiling or raised floor depth. It will also affect the overall floor-to-floor heights and hence have significant influence on building costs.

The depth of the horizontal element is a function of the number of vertical risers, generally:

— maximum number of vertical risers equates to minimum horizontal element depth

— minimum number of vertical risers equates to maximum horizontal element depth.

Adequate space must be allowed around ducts for fitting of insulation, hangers and supports during installation and for access during subsequent maintenance. Access will also be dependent on the clearance from adjacent objects such as structural items and the type of jointing method. Suitable allowances are given in Appendix 2.A2, which also shows examples of common problems associated with ductwork access.

Adequate space must also be allowed at compartment boundaries for the installation of fire dampers using a tested installation method. The fire damper installation method to be used should be clearly defined as part of the ductwork/supporting construction design, so that it meets the fire classification of the boundary.

Ductwork clearances can be reduced with care, providing jointing, insulation and maintenance of any vapour barrier is achieved. Consideration should also be given to how the ductwork will be tested and how it will eventually be replaced.

Further information is available in Design and Maintenance Guide 08: *Space requirements for plant access, operation and maintenance* (DEO, 1996), BSRIA TN 10/92: *Spatial Allowances for Building Services Distribution Systems* (1992) and BS 8313: 1997: *Code of practice for accommodation of building services in ducts* (BSI, 1997).

Aesthetics

Where ductwork is hidden in risers, ceiling voids and below the floor it will not have an effect on the visual environment. In some situations, ducts can be large (e.g. 1–2 m in diameter) and difficult to locate within the overall building design. In such circumstances the ductwork may be exposed and possibly made an architectural feature. The design, including the shape, location and visual appearance, will need to be addressed to ensure sympathy with the visual environment.

Shopping centres, airports, auditoria, display galleries and large office complexes are possible examples where exposed ductwork may be used. Installation standards and sealing systems for such ducts may require more attention to the final appearance of the duct system than with ducts in concealed spaces.

Approximate sizing

Because ductwork can be large, it will often be necessary to assess the size of individual ductwork in critical locations, particularly where horizontal branches leave the main vertical risers. It is often possible to adjust the size of the vertical space well into the detailed design. Horizontal branches, however, cannot encroach on the necessary headroom.

To make a preliminary estimate of a branch size, calculate the airflow rate required in the area served by multiplying the zone volume by the number of air changes per hour and divide by 3600 to obtain the zone flow rate in $m^3 \cdot s^{-1}$. Two air changes an hour may be appropriate for offices with a separate heating system for fabric losses. Where the air is used for heating, four air changes an hour may be required or six air changes or more for an air-conditioned space. Dividing this flow rate by the velocity given in Tables 2.16 and 2.17 (in 'Duct air velocities' in section 2.3.5.3) gives the duct cross-sectional area required. For conventional systems, the aspect ratio (long side to short side) of rectangular ducting should not exceed 3:1.

Interaction with structure/building form

Because ductwork is likely to be the most space-intensive service provided, it is important that the ductwork design is fully co-ordinated with the design of the building structure to minimise the number of bends and other fittings, each of which will increase the resistance to airflow. The selection of the AHU is also critical (see section 2.6). This is particularly important for new installations for which, for example, Part L of the Building Regulations (NBS, 2013a) sets down strict requirements for maximum specific fan power. The structural design may have reached beyond an outline design and shape by the time that ductwork design commences.

Provided they are allowed for early in the design, it is usually possible to accommodate vertical ducts of any desired size without great difficulty from both structural and planning viewpoints. Horizontal ducts present more problems; if they are located between floors, headroom will be restricted and there will be limits on the floor area that a horizontal duct can serve. Early checks should be carried out to ensure that the vertical main ducts enable horizontal distribution without compromising the performance of the installation or the available headroom and that structural members allow branch ducts to leave the main ducts.

Distribution of the engineering services within a building are likely to follow a pattern associated with the main building circulation route, which represents the main functional pattern of the building. This may not be the most efficient route for the ductwork. The large space requirements for ductwork mean that it can be desirable to locate plant close to the areas they serve.

Sufficient space needs to be provided for ease of fitting the ductwork. Providing access for maintenance is also important since it will be expensive to install retrospectively, whether ducts are horizontal or vertical. Space should also be allowed for additions and alterations. This should include space to fit fire dampers that are suitable to any supporting construction used. The requirements of Part B of the Building Regulations (NBS, 2010g) should be followed. Details of fire damper installation methods are given in DW/145: *Guide to Good Practice for the Installation of Fire and Smoke Dampers* (BESA, 2010) and *Fire Dampers (European Standards)* ('the ASFP Grey Book') (ASFP, 2010).

Co-ordination of the engineering services should ensure that the area for removal of access panels and covers and entry into the ductwork is free of services and readily accessible without obstructions.

Zoning

Loads due to mechanical ventilation of a space are likely to be constant, and zoning, if appropriate, should be based on siting plant as centrally as possible to minimise the distance that the air has to travel. Strategic issues such as availability

of space for multiple plant rooms or the need for separate systems to service different tenants in the building may determine the zoning arrangements.

The ductwork system may be providing heating, cooling or air conditioning, in which case the load will change due to factors such as solar gain, occupancy and the use of lights.

If the loads throughout a building vary together (i.e. are in phase), or the variations are not large enough to cause the internal conditions to drift outside the acceptable limits, a single zone can be adopted. However, if different areas experience load changes that are out of phase, supply air must be provided at a rate or condition appropriate to each zone.

Most deep-plan buildings require division into perimeter and internal zones. The depth of perimeter zones mainly depends on the penetration of sunlight and daylight, which is determined by orientation, external shading, shape and size of windows, characteristics of the glass and the type and pattern of use of blinds. The depth of a typical perimeter zone is 3–6 m.

For a typical multiple-zone system with heating and cooling application, the following should be noted.

— For a constant volume flow rate to be maintained to each zone, the system must be capable of supplying air at various temperatures at any one time; this may involve simultaneous heating and cooling of supply air.

— All rooms with similar solar gain patterns can be zoned together provided that other variables are in phase. However, the number and position of the zonal sensors will be important. Corner rooms pose further problems.

— North-facing rooms experience less variation and can be grouped with internal zones for cooling provided that heating is dealt with by other means.

— Gains through poorly insulated roofs are similar to gains on south-facing surfaces but, if adequately insulated, they may be treated as intermediate floors.

The success of an air-conditioning system depends largely on appropriate zoning and careful positioning of sensors in relation to the sources of heat gains.

Air leakage limits

It is recommended as good practice that all significant installations (e.g. those with a fan capacity greater than 1 $m^3 \cdot s^{-1}$) should be tested in accordance with DW/143: *Guide to Good Practice: Ductwork Air Leakage Testing* (BESA, 2013b). Air leakage testing is required by Part L2A of the Building Regulations (NBS, 2013a). Air leakage testing of high-pressure ductwork is mandatory. Refer to BESA (2013b) for details of the testing procedure. Air leakage limits for the four classes of ductwork are given in Table 2.14. The leakage factors given for classes A, B and C are those for the classes similarly designated in European Standards BS EN 12237: 2003: *Ventilation for buildings. Ductwork. Strength and leakage of circular sheet metal ducts* (BSI, 2003a) and BS EN 1507: 2006: *Ventilation for buildings. Sheet metal air ducts. Requirements for strength and leakage* (BSI, 2006a).

Leakage from ducted air-distribution systems is an important consideration in the design and operation of ventilation and air-conditioning systems. A ductwork system having air leakage within defined limits will ensure that the design characteristics of the system can be maintained. It will also ensure that energy and operational costs are not greater than necessary.

Leakage from sheet metal air ducts occurs at the seams and joints and is therefore proportional to the total surface area of the ductwork in the system. The level of leakage is similarly related to the air pressure in the duct system and, whilst there is no precise formula for calculating the level of air loss, it is generally accepted that leakage will increase in proportion to pressure to the power of 0.65.

The effect of air leakage from high-pressure ductwork is critical in terms of system performance, energy consumption and the risk of high frequency noise associated with leakage. These problems are less critical with medium-pressure systems, but should be considered. Low-pressure ducts present the lowest risk in terms of the effect of leakage on the effective operation of the system.

It is important that ductwork should be made as airtight as possible. Conventional sheet metal ductwork is formed by seaming sheets and jointing sections; these seams and joints, penetrations made by damper spindles, control sensors, test holes, access doors etc. all give rise to air leakage. The designer should accept that some leakage will occur in conventional ductwork and make an assessment of the acceptable level in a given system. In some cases it may not be important, for example for a general extract system where the ducting is all in the space being served. In others it may be very important, for example where obnoxious or hazardous contamination is being handled. In the latter case a completely airtight system may be necessary, where fully welded ducting with airtight enclosures at all penetrations could be the basis of a special specification, outside the scope of DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a).

For most ventilating and air-conditioning applications, compliance with the construction and sealing requirements of DW/144 (BESA, 2013a) will ensure acceptably low leakage rates. For sheet metal ductwork, the specification requires sealant to be applied to all longitudinal seams (except spirally wound, machine-made seams) and cross-joints; for plastic and resin bonded, glass fibre ductwork, similar sealing requirements are specified. The sheet metal specification also gives details of an air leakage test procedure. Recommended acceptable leakage rates in $l \cdot s^{-1}$ per square metre of surface area are given in Table 2.14.

Appendix 2.A3 shows these limits for a range of duct static pressure differentials. These rates are in accordance with the comparable classes in BS EN 12237 (BSI, 2003a) and BS EN 1507 (BSI, 2006a) but these provisional European Standards do not cover the full range of high-pressure ductwork.

Whilst leakage occurs at seams, joints and penetrations, the purpose of giving acceptable leakage rates in terms of surface area of ductwork is to require that the airtightness is of a consistent standard for air leakage test systems. It does not follow that the total leakage of a system that meets specified leakage requirements will always be a set percentage of the total flow rate; the percentage leakage

from short runs can be substantially less than that from long runs. The design therefore plays a very important part in the likely total leakage loss from ductwork systems, since long runs not only provide more crackage and penetration, but also require higher working pressures to operate. Where limitation of air leakage is important, the designer should first ensure that the duct runs are as short as possible, that the operating pressure is as low as possible, that the number of seams, joints and penetrations is kept to a minimum and that there is adequate room around the ducts for site-made joints to be effectively sealed.

Items of equipment and plant installed in ductwork systems can also leak, and particular attention should be paid to the sealing of these items. Where leakage testing is required, the designer should ensure that suppliers of these items can demonstrate that their equipment meets the required airtightness standards. The designer should make adequate allowance in the fan selection for some air leakage so that the completed installation can meet its intended purpose without subsequent adjustments to the fan(s) and motor(s). Table 2.15 gives some recommendations for margins that should be included for complete installations (i.e. ductwork and equipment).

System leakage loss

There is no direct relationship between the volume of air conveyed and the surface area of the ductwork system. It is therefore difficult to express air leakage as a percentage of total air volume. Operating pressure will vary throughout the system and, since leakage is related to pressure, the calculations are complex. However, it is generally accepted that, in typical good-quality systems, the leakage from each class of duct under operating conditions will be in the region of:

— *low pressure* (Class A): 6 per cent

— *medium pressure* (Class B): 3 per cent

— *high pressure* (Class C): 2 per cent

— *high pressure* (Class D): 0.5 per cent.

Designer's calculations

The designer can calculate with reasonable accuracy the predicted total loss from a system by:

— calculating the operating pressure in each section of the system

— calculating the surface area of the ductwork in each corresponding pressure section

— calculating the allowable loss at the operating pressure for each section of the system (see above for indicative leakage figures).

Variable pressures in systems

Designers can achieve significant cost savings by matching operating pressures throughout the system to constructional standards and appropriate air leakage testing. The practice of specifying construction standards for whole duct systems based on fan discharge pressures may incur unnecessary costs on a project.

For example, some large systems could well be classified for leakage limits as follows:

— *plant room risers*: Class C

— *main floor distribution*: Class B

— *low-pressure outlets*: Class A.

Further information on air leakage is given in section 2.5.4.

Fan power energy requirements

Fan energy requirements are commonly specified in terms of specific fan power (SFP) which is defined in Building Regulations Approved Document L (NBS, 2013a) as 'the sum of the design total circuit watts including all losses through switchgear and controls such as inverters, of all fans that supply air and exhaust it back to outdoors (i.e. the sum of supply-and-extract fans) divided by the design ventilation rate through the building'.

Energy-efficiency requirements invariably specify maximum SFP values of typically of 2.0 W/litre·s^{-1} or less. Actual maximum SFP values should always be checked against the relevant current regulations such as Part L of the Building Regulations (NBS, 2013a).

The formula for calculating fan power is:

$$P_{\mathrm{ef}} = \frac{\Delta p_{\mathrm{t}}\, q_{\mathrm{v}}}{\eta_{\mathrm{o}}} \qquad (2.2)$$

where P_{ef} is the fan power (W), Δp_{t} is the difference in total pressure around the air circuit (Pa), q_{v} is the volume flow (m^3·s^{-1}) and η_{o} is the overall efficiency (%).

The selection of a fan type is primarily determined by the application and, where a choice is available, the most efficient should be chosen. Fans should be sized as close to the actual demand as possible in order to keep capital and running costs to a minimum. Motors should not be significantly oversized, as efficiency and power factor will reduce. Dependent on the fan type selected, the motor may be located within or external to the duct. Motors within the duct can increase the air temperature.

In general, centrifugal fans are more efficient, more controllable and quieter. Backward-curved centrifugal fans

Table 2.15 Recommended air leakage margins for design figures

Margin	Value of margin for stated class of system / %		
	Low pressure	Medium pressure	High pressure
System total pressure loss margin:	+10	+5	+5
(*a*) allowance for margin on volume flow rate	+10	+5	+5
(*b*) allowance for uncertainty in calculation	+10	+10	+10
(*c*) combined system total pressure loss margin (sum of (*a*) and (*b*))	+20	+15	+15

have high efficiency (up to 80 per cent) with aerofoil backward curved fans providing even higher efficiency. Maximum efficiency for axial flow fans is about 75 per cent. With all fans the efficiency varies with flow rate, so the chosen fan needs to have an operating point close to the point of peak efficiency. This is covered in more detail in section 2.6.

Fan characteristics should be matched to the chosen method of control of volume. This can be achieved by various means, such as variable speed motors to optimise fan performance at part load. Inlet guide vanes, disc throttles and dampers are not generally recommended for energy efficiency due to the 'throttling' effect.

In theory, fans can operate at better than 80 per cent efficiency but in practice less efficient units tend to be specified to save money or provide a safety margin. The loss of efficiency (termed 'fan gains') is dissipated as heat. This can result in an air temperature rise of up to 2 K, which can make the difference between a comfortable building and one that is too warm. Heat will also be dissipated into the ductwork from fan motors located in the duct.

Significant energy savings can be achieved by reducing unnecessary pressure drops in the system by careful sizing, routing and detailing of ductwork. In particular, pinch points in index runs require higher pressure drops than much of the rest of the system.

Variable flow control of air systems, which can be used on most distribution systems, can give considerable savings in fan energy. Variable flow control VAV systems have potentially greater air distribution savings over other central plant systems, provided that pressures are well controlled and air-handling plant and drives are intrinsically efficient.

Variable speed drives also allow rapid matching of fan duties during commissioning and will provide significant savings compared with manual regulation dampers. Typical energy savings are 20 per cent at 90 per cent flow and 40 per cent at 80 per cent flow, dependent upon characteristics. Damper control increases system resistance and therefore energy savings are reduced.

Energy can be reduced in ventilation systems by:

— avoiding unnecessary bends
— using bends instead of mitred elbows
— having a 'shoe' on the branch fittings for tees
— avoiding reduced duct size (i.e. maintain cross-sectional area)
— minimising duct length
— minimising the length of flexible ducting
— good inlet and outlet conditions either side of fan (see fan inlet and outlet below)
— using equipment with low pressure drops (i.e. filters, attenuators, heat exchangers).

Poor inlet and outlet conditions can cause poor fan performance, and hence inefficient operation, often referred to as 'installation effects'. These can alter the aerodynamic characteristics of the fan so that its full potential is not realised. This can be the result of practical difficulties installing the ductwork and associated equipment, which may not be in exact accordance with the original design routing. Measures to reduce installation effects at the fan inlet and outlet include the following.

(*a*) Fan inlet:

— Ensure that air enters axial fans without spin by improved inlet design or a by installing a splitter.
— Include turning vanes where there is a duct bend close to a fan inlet.
— Include a transition piece where the duct size reduces.
— Ensure flexible connections are correctly fitted without offset or slack.
— Where fans are installed in plenum chambers, ensure the fan inlet is a minimum of one diameter from the plenum wall with no obstructions.

(*b*) Fan outlet:

— Ensure a minimum of two diameters of straight duct.
— Where bends are close to the outlet, ensure that radius bends with splitters are used.
— Axial and propeller fans should preferably be fitted with guide vanes to provide energy recovery. (Where guide vanes are not fitted, air swirl will significantly increase system resistance, i.e. pressure drop. This can be corrected by a carefully designed cross-piece.)

Fan connections are considered in detail in section 2.6.1.

Environmental issues

For a typical air conditioned and mechanically ventilated building, fan energy can consume up to 8 per cent of the electrical consumption and therefore every effort must be made to ensure that the ductwork installation is energy efficient.

Cleaning of ductwork must be taken into account in the design and installation stages by ensuring adequate and safe provision is made for access. Clear guidance is given in BS EN 15780: 2011: *Ventilation for buildings. Ductwork. Cleanliness of ventilation systems* (BSI, 2011b).

Filter removal and replacement must be considered by ensuring sufficient space and means of access is provided. Noise in ductwork can be contentious, particularly where the system or components (e.g. intake, exhaust, AHU etc.) produce a noise nuisance to the building occupants, neighbours or passers-by. Noise is generated where eddies are formed as flow separates from a surface. The generated noise level is particularly sensitive to the velocity. See section 2.5.2.3 and section 2.6 for further details.

The visual effect of ductwork can be an environmental issue because of its physical size and location. Whilst ductwork may be hidden in risers, ceiling voids and below the floor, there will be occasions where it is exposed and possibly made an architectural feature. The design, including the shape, location and visual appearance will need to be addressed to ensure sympathy with the visual environment. Where ducting is exposed, the installation

standards may require additional attention, particularly to jointing and sealing.

Fire issues

The ventilation system will have fire safety requirements, mainly at compartment boundaries.

Where a standard ventilation duct passes through a supporting construction (wall or floor) designed as a fire compartment boundary, that penetration is required to be protected. This is achieved by using a fire damper specifically tested using an installation method to suit the particular wall (masonry, blockwork, dry wall partition, etc.) or floor that is being used. The classification of the fire damper should meet that of the supporting construction being penetrated by the duct. Fire dampers selected to protect escape routes and areas of sleeping risk are required to act in response to a smoke alarm signal, not just their integral fusible links. They are also required to have an 'ES' classification. To achieve this fire dampers have to have been tested to BS EN 1366-2: 2015: *Fire resistance tests for service installations. Fire dampers* (BSI, 2015a) and classified to BS EN 13501-3: 2005 + A1: 2009: *Fire classification of construction products and building elements. Classification using data from fire resistance tests on products and elements used in building services installations: fire resisting ducts and fire dampers* (BSI, 2005b). ES-classified fire dampers are generally known as fire and smoke dampers.

Fire dampers in other areas should have a minimum 'E' classification (BS EN 1366-2 (BSI, 2015a) and BS EN 13501-3 (BSI, 2005b)) and may close simply under the action of a fusible link.

In the case where all fans are to be turned off in the event of fire, dampers tested to BS 476-20: 1987/BS 476-22: 1987 (BSI, 1987a/b) may be allowed. Note, however, that fire dampers tested to these standards cannot be classified ES, so they must never be used to protect escape routes.

In all cases fire dampers shall be installed following the methods provided by the fire damper manufacturer in line with their testing. Care shall be taken to make sure that there is room to do this and that there is adequate access to the damper for maintenance and cleaning, inside and out.

Further information on fire dampers is available in and *Fire Dampers (European Standards)* ('the ASFP Grey Book') (ASFP, 2010) and DW/145: *Guide to Good Practice for the Installation of Fire and Smoke Dampers* (BESA, 2010).

Where fire-resisting ductwork is used, care must be made that this is installed in the supporting construction using the method of installation recommended by the manufacturer.

Where fire-resisting ductwork is used to protect fire compartments, the junction where it passes through a supporting construction (wall or floor) designed as a fire compartment boundary, the method of sealing the penetration must be made using the method of installation recommended by the manufacturer. This should be proven by using a fire-resisting duct specifically tested using an installation method to suit the particular wall (masonry, blockwork, dry wall partition etc.) or floor that is being used. The classification of the fire-resisting duct shall meet that of the supporting construction being penetrated by it.

Additional restrictions may be specified for the duct in terms of leakage or insulation.

To demonstrate performance, fire-resisting ducts should been tested to BS EN 1366-1: 2014: *Fire resistance tests for service installations. Ventilation* (BSI, 2014a) and classified to BS EN 13501-3: 2005 + A1: 2009 (BSI, 2005b) or tested as a minimum to BS 476-24: 1987: *Fire tests on building materials and structures. Method for determination of the fire resistance of non-loadbearing element of construction* (BSI, 1987c).

Further protection may be made by the use of fire dampers at the end of fire-resisting duct runs.

Further information on fire-resisting ductwork is available in *Fire Rated and Smoke Outlet Ductwork* ('the ASFP Blue Book') (ASFP, 2000).

Where fire doors are used for ventilation, held open by magnetic catches that release on the receipt of a smoke alarm, it must be checked that the equipment meets the required standards and that all closers are correctly tested and set up. All fire doors, frames and associated ironmongery should be installed using the methods defined by the manufacturer. It is recommended that approved installers are used. It should not be assumed that double-leaf doors have the same fire resistance as single-leaf doors and that the inclusion of glazing has been tested; this should be checked.

Further information of fire doors is available from the British Woodworking Federation (BWF) and the Guild of Architectural Ironmongers (GAI).

Guidance to the building regulations with regard to fire safety is given in Part B of the Building Regulations (NBS, 2013g), supported by BS 9999: 2008: *Code of Practice for fire safety* in *the design, management and use of buildings* (BSI. 2008a). The latter document generally replaces the BS 5588 series. This is supported by CIBSE Guide E: *Fire engineering* (CIBSE, 2010).

Consideration should also be made of the RRFSO (TSO, 2005). This states what is required for a building user to certify their own fire safety. This is generally done by risk assessment, but requires full records of design, selection and maintenance. Supporting this is Part J of the Building Regulations (NBS, 2013f), which requires that all information related to fire safety should be passed on the client/building user. This is represented by, but not limited to, information such as required maintenance schedules, as-built drawings etc. A building regulation is a legal requirement.

Note: It is now required that any fire-resisting products used are subject to third-party certification and are CE marked.

Smoke control

Smoke control is a much broader subject, but it must be noticed that, in the same way as normal ventilation ducts, fire compartments should not be compromised.

Smoke control design requires specialist advice using fire-engineered solutions for the most part. Reference should be made to Approved Document B with supporting documentation being provided from other sources. CIBSE

Guide E: *Fire engineering* (CIBSE, 2010) gives further guidance. A range of other guides are also available from the BRE, ASFP and the Smoke Control Association (SCA).

— BRE Report BR 186: *Design Principles for Smoke Ventilation in Enclosed Shopping Centres* (BRE, 1990).

— BRE Report BR 368: *Design Methodologies for Smoke and Heat Exhaust Ventilation within Atria* (BRE, 1999a).

— BRE Report BR 375: *Natural Ventilation in Atria for Environment and Smoke Control: An Introductory Guide* (BRE, 1999b).

— BRE Project Report 213179: *Smoke Ventilation of Common Access Areas of Flats and Maisonettes (BD2410): Final Factual Report* (BRE, 2005).

— *Fire Rated and Smoke Outlet Ductwork* ('The Blue Book') (ASFP, 2000), European version.

— *Guidance on Smoke Control to Common Escape Routes in Apartment Buildings (Flats and Maisonettes)* (HEVAC, 2012).

— *Design of Smoke Ventilation Systems for Loading Bays and Coach Parks* (HEVAC, 2010).

Any and all equipment used should be checked to confirm compliance with the latest European Standards.

Note: It is now required that any smoke control products used are subject to third-party certification and are CE marked.

Weight of ductwork

The weight of ductwork, including insulation where applied, is normally insignificant in relation to the structural support capability of the structure. In some types of buildings the weight of the ductwork may be important (e.g. lightweight retail, storage and factory structures). Examples of the types of problems are insufficient support centres from which to hang the ductwork and lightweight purlins that are unable to support the weight of the installed ductwork. Sufficient structural support for fans must be provided. Information on the weight of ductwork materials is given in 'Weight of ductwork' in section 2.3.5.2.

Testing, commissioning, cleaning and maintenance

It is essential for duct systems to be commissioned, kept clean and regularly maintained. These issues are considered in relation to HVAC systems in general in section 2.7.1.

Controlling costs

Lower first costs can be achieved by:

— using the minimum number of fittings possible; fittings can be expensive and the resulting pressure loss is far greater than for straight duct sections

— ensuring ductwork is sealed to minimise air leakage; this allows reduction in both equipment and ductwork size

— using round ductwork where space and initial costs allow because it offers the lowest duct friction loss for a given perimeter or given velocity

— when using rectangular ductwork, maintaining the aspect ratio as close as possible to 1:1 to minimise duct friction losses and initial cost; this can also avoid problems with 'difficult' elbows.

2.3.5.3 Design criteria

Introduction

The primary function of a ductwork system is to convey air between specific points. In fulfilling this function, the duct assembly must perform satisfactorily within fundamental performance characteristics. One of the most important performance characteristics is energy efficiency. This aspect is particularly relevant because changes to Part L of the Building Regulations (NBS, 2013a) imposed new performance constraints on air-moving systems and equipment. Early in the process, designers need to ensure that their design can meet the overall performance requirements of Part L. The energy-efficiency standards of Part L should not be regarded as an absolute target. In many situations, an improved level of performance may be beneficial in terms of whole-life cost and/or as a means of providing a trade-off opportunity to offset against another aspect of the design where achieving the required standard of energy efficiency is more difficult or more costly.

Elements of the assembly include an envelope (e.g. sheet metal or other material), reinforcement, seams, joints, support hangers and, possibly, insulation. Performance limits must be established for:

— dimensional stability

— containment of air

— vibration

— noise generation and containment

— exposure to damage, weather, temperature extremes

— support

— emergency conditions, e.g. fire

— heat gain or loss to the airstream

— adherence to duct walls of dirt and contaminants.

Due consideration must be given to the effects of differential pressure across the duct wall, airflow friction pressure losses, dynamic losses and air velocity leakage, as well as the inherent strength characteristics of the duct components. Ductwork installations can account for a significant proportion of the cost of mechanical services. Ducts should be sized and constructed in accordance with recognised sources of data and standards of construction.

Duct air velocities

The velocity of air flowing through a duct can be critical, particularly where it is necessary to limit noise levels. The duct air velocity is not a major factor in the constructional specification of ductwork.

Recommended velocities for particular applications, using the BESA system classifications, are given in Tables 2.16 and 2.17. These figures are a general guide and assume reasonable distances between the fittings (e.g. four times the duct hydraulic diameter). Higher velocities may be

used if additional attenuation is employed. Maximum velocities, as stated in DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a) are given in Table 2.14.

Table 2.18 gives recommended maximum air velocities for rectangular and circular ducts in risers and ceiling spaces. Table 2.19 gives recommended velocities for supply and return air openings.

Legislation

No legislation has been produced that relates specifically to ductwork. The general requirements of the Health and Safety at Work etc. Act (HMSO, 1974) and the Construction (Design and Management) Regulations 2015 (TSO, 2015) will apply during all the stages of design, installation, commissioning, operation, maintenance and finally demolition and disposal. Part L of the Building Regulations (NBS, 2013a) includes limitations on specific fan power. These are described in 'Fan power energy requirements' in section 2.3.5.2. Part B of the Building Regulations (NBS, 2013g) gives full details on fire-safety issues with regard to ductwork and fire dampers. Building Regulation 38 requires that all information on all aspects of fire protection, installation, positioning, maintenance etc. be passed on to the building owner. The latter is the law.

Health and safety

Health considerations will be addressed if a good inspection, maintenance and cleaning regime is applied. Further information on cleaning is provided in section 2.7.2.3.

Three aspects of safety concerning ductwork need to be addressed:

— *During design*: that there are safe and secure means of access to the ductwork and associated plant and equipment (e.g. filter housings) for inspection, maintenance and cleaning.

— *During installation*: by ensuring that the ductwork can be installed safely and securely.

— *During building operation*: that maintenance and fire protection are maintained.

Fibrous materials were often used as duct linings to provide sound absorption. However, they are not now generally used because:

— they can contribute to mould growth

— fibrous materials degrade with time

— fibres can erode from the surface and be carried in the air

— fibrous materials are difficult to clean.

Suitable alternative sound-absorbing proprietary materials such as acoustic foam are now used and have the advantage of not requiring facings or edge treatment.

2.3.5.4 Airflow in ducts

General

Air in ducts follows natural laws of motion. While the detailed prediction of flow behaviour is very difficult, good design should ensure that the air follows the line of the duct with uniform velocities and that excessive turbulence is avoided. Ductwork fittings cause major pressure losses and good design is essential, particularly where higher velocities are used. Bad design in relation to airflow can lead to vibration of flat duct surfaces, increases in duct pressure losses, unpredictable behaviour in branch fittings and terminals, and adverse effects on the performance of

Table 2.16 Recommended maximum duct velocities for low-pressure ductwork systems where noise generation is the controlling factor

Typical applications	Typical noise rating (NR)*	Velocity / m·s^{-1}		
		Main ducts	Branch	Run-outs
Domestic buildings (bedrooms)	25	3.0	2.5	<2.0
Theatres, concert halls	20–25	4.0	2.5	<2.0
Auditoria, lecture halls, cinemas	25–30	4.0	3.5	<2.0
Bedrooms (non-domestic buildings)	20–30	5.0	4.5	2.5
Private offices, libraries	30–35	6.0	5.5	3.0
General offices, restaurants, banks	35–40	7.5	6.0	3.5
Department stores, supermarkets, shops, cafeterias	40–45	9.0	7.0	4.5
Industrial buildings	45–55	10.0	8.0	5.0

* See CIBSE Guide A (2015a), Table 1.16

Table 2.17 Recommended maximum duct velocities for medium and high-pressure systems

Volume flow in duct /m^3·s^{-1}	Velocity / m·s^{-1}	
	Medium-pressure systems	High-pressure systems
<0. 1	8	9
0.1–0.5	9	11
0.5–1.5	11	15
>1.5	15	20

Table 2.18 Guide to maximum duct velocities in risers and ceilings

Duct location	Duct type	Maximum air velocity / m·s^{-1} for stated room type		
		Critical	Normal	Non-critical
Riser or above plasterboard ceiling	Rectangular	5	7.5	10
	Circular	7	10	15
Above suspended ceiling	Rectangular	3	5	6
	Circular	5	7	10

Table 2.19 Maximum velocity for supply and return air openings (grilles and terminals)

Supply or return air	Permitted air velocity / m·s^{-1}		
	Critical	Normal	Uncritical
Supply	1.5	2.5	3
Return	2	3	4

installed plant items such as fans and dehumidifying coils. It is much cheaper to get the design right than to try and correct abnormal flow situations on-site.

Behaviour of air flowing through a duct

In normal circumstances the flow of air in ducts is turbulent with the flow generally in the direction of the duct axis. Eddies and secondary motions will result in energy dissipation due to internal fluid friction. Streamlines will not be parallel to the duct centre-line. In unobstructed straight ducts, eddies give rise to only relatively small transverse components of the duct velocity and the flow velocities are symmetrical about the duct axis.

Disturbance to the flow arising from obstructions, duct fittings or other components has two major effects:

— the eddies can be significantly larger in size and their velocities much higher

— the flow velocities across the duct become asymmetrical, i.e. much higher velocities can occur in part of the duct section, whilst in other parts even reverse flow may occur.

From the point of view of duct design the important aspects of the effects of disturbance to airflow are:

— increased pressure loss due to creation of eddies

— increased pressure loss as high-velocity air mixes with low-velocity air

— noise generated by the interaction on eddies with the inner surfaces of the ducts.

More information on the flow characteristics through duct components and fittings is given in section 2.6.

Heat gains or losses

In a duct system, the air temperature change can be significant, e.g. when passing through an untreated space. This has the effect of reducing the heating or cooling capacity of the air and increasing the energy input to the system. The heat transmission to and from the surrounding space can be reduced by insulation of the ducts. The following notes give guidance on the estimation of temperature changes in ducted air due to heat gains or losses.

The heat gain or loss rate through the walls of a run of air ducts is given by:

$$\Phi = U A_s (t_{ad} - t_{as}) \qquad (2.3)$$

where Φ is the heat exchange (W), U is the overall thermal transmittance ($W \cdot m^{-2} \cdot K^{-1}$), A_s is the surface area of the duct run (m^2), t_{as} is the ambient temperature outside the duct (°C) and t_{ad} is the temperature of the air inside the duct (°C).

The temperature of the air inside the duct is given by:

$$t_{ad} = {}^1/_2 (t_{ad1} + t_{ad2}) \qquad (2.4)$$

where t_{ad1} is the air temperature in the upstream end of the duct run (°C) and t_{ad2} is the air temperature in the downstream end of the duct run (°C).

The duct surface area is given by:

$$A_s = P \times l \qquad (2.5)$$

where A_s is the duct surface area (m^2), P is the perimeter of the duct cross section (m) and l is the length of the duct run (m).

The heat gain or heat loss rate given by equation 2.3 is equal to the heat gain or loss rate from the air in the duct, which is given by:

$$\Phi = c A \circ c_p \Delta t_{ad} \times 10^3 \qquad (2.6)$$

where c is the velocity of the air in the duct ($m \cdot s^{-1}$), A is the cross-sectional area of the duct (m^2), ρ is the density of air in the duct ($kg \cdot m^{-3}$), c_p is the specific heat capacity of air in the duct at constant pressure ($kJ \cdot kg^{-1} \cdot K^{-1}$) and Δt_{ad} is the temperature difference between the ends of the duct run (K).

Δt_{ad} is given by:

$$\Delta t_{ad} = t_{ad1} - t_{ad2} \qquad (2.7)$$

Equating equations 2.2 and 2.5 and rearranging gives:

$$\Delta t_{ad} = \frac{U P (t_{ad} - t_{as}) l}{c A \circ c_p 10^3} \qquad (2.8)$$

or:

$$\Delta t_{ad} = \frac{4 U (t_{ad} - t_{as}) l}{c \circ c_p d_h 10^3} \qquad (2.9)$$

where d_h is the hydraulic mean diameter of the duct (m).

The hydraulic mean diameter is given by:

$$d_h = 4A / P \qquad (2.10)$$

For air at 20 °C, $\rho = 1.2$ $kg \cdot m^{-3}$ and $c_p = 1.02$ $kJ \cdot kg^{-1} \cdot K^{-1}$. Hence, by substituting these values and combining the numerical factors:

$$\Delta t_{ad} = \frac{U (t_{ad} - t_{as}) l}{306 c d_h} \qquad (2.11)$$

Ignoring the thermal resistance of the duct material, the U-value of the insulated duct is given by:

$$U = \frac{1}{(1/h_{si} + l_n/\lambda_n + 1/h_{so})} \quad (2.12)$$

where h_{si} is the heat transfer coefficient of the inside surface of the duct ($W \cdot m^{-2} \cdot K^{-1}$), l_n is the insulation thickness (m), λ_n is the thermal conductivity of the insulation ($W \cdot m^{-1} \cdot K^{-1}$) and h_{so} is the heat transfer coefficient of the outside surface of the duct ($W \cdot m^{-2} \cdot K^{-1}$).

The value of h_{si} is a function of the Reynolds number and an approximate value is given by:

$$h_{si} = 3.5\,(c^{0.8} / d_h^{0.25}) \quad (2.13)$$

For most typical applications, h_{si} may be taken as 37.5 $W \cdot m^2 \cdot K^{-1}$. The value of h_{so} also depends on the conditions surrounding the duct. A typical value for unvented building voids is 10 $W \cdot m^{-2} \cdot K^{-1}$, but this can be influenced by reflective facing materials on the insulation and by draughts. Estimated values of U for insulated ducts with these values of h_{si} and h_{so} are given in Table 2.20.

The temperature change in an insulated duct can be estimated from equation previous 2.11 and Table 2.12. For insulation with thermal conductivity of 0.045 $W \cdot m^{-1} \cdot K^{-1}$ values of $(\Delta t_{ad}/l\,(t_{ad} - t_{as}))$ are given in Figure 2.24. The approximate values for an uninsulated duct are also shown in Figure 2.24, for typical still locations, but these temperature changes could be underestimated by about 20 per cent if the duct is in draughty conditions.

Example 2.1

For a 600 mm × 500 mm duct with 50 mm of thermal insulation (λ_n = 0.045 $W \cdot m^{-1} \cdot K^{-1}$), an air velocity inside the duct of 9.5 $m \cdot s^{-1}$ and an air temperature t_{ad} = 10 °C, passing through surroundings at t_{as} = 30 °C, the change in air temperature per metre run is calculated as follows.

Cross sectional area of duct:

$$A_s = 0.6 \times 0.5 = 0.3\ m^2$$

Perimeter of duct:

$$P = 2\,(0.6 + 0.5) = 2.2\ m$$

Hydraulic diameter of duct:

$$d_h = (4 \times 0.3)/2.2 = 0.55\ m$$

Hence:

$$d_h\,c = 0.55 \times 9.5 = 5.23\ m^2 \cdot s$$

From Figure 2.24:

$$\Delta t_{ad}/l\,(t_{ad} - t_{as}) = 0.0005\ m^{-1}$$

Hence the change in air temperature per metre of duct run is:

$$\Delta t_{ad} = 0.0005 \times 20 = 0.01\ K \cdot m^{-1}$$

For an uninsulated duct, from Table 2.20:

$$\Delta t_{ad}/l\,(t_{ad} - t_{as}) = 0.004\ m^{-1}$$

Therefore:

$$\Delta t_{ad} = 0.004 \times 20 = 0.08\ K \cdot m^{-1}$$

Since this method assumes that Δt_{ad} is small, some error will be introduced if the length of ductwork is considered large, and the smaller the value of $(d_h \times c)$, the larger the error. A maximum length of 10 m is recommended. It may be noted from Figure 2.24 that as the value of $(d_h \times c)$ falls below 1.5, the rate of temperature drop in the ducts with 50 mm or less insulation increases considerably. For small ducts and low air velocities, the insulation thickness should be at least 50 mm. BS 5422: 2009: *Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range –40 °C to +700 °C* (BSI, 2009b) gives guidance on the assessment of the economic thickness of duct insulation. However, in the absence of such assessment, BS 5422: 2009 recommends insulation thicknesses for ducts carrying chilled and warm air as shown in Tables 2.21 and 2.22 respectively. For detailed information on the thermal insulation of ductwork, see BS 5422: 2009 and BS 5970: 2012: *Thermal insulation of pipework, ductwork and other industrial installations in the temperature range –100 °C to +870 °C. Code of practice* (BSI, 2012b).

2.3.5.5 Condensation and vapour barriers

Condensation of water vapour within air occurs whenever the temperature falls below the ambient dew-point. This can occur on the outside of the cold duct when the temperature of the duct air causes the duct itself to have a temperature below the dew-point of the surrounding air. Even when the ductwork is insulated, this can occur due to diffusion through the insulation of the more humid air external to the duct. In turn this can lead to corrosion of the ductwork as well as diminishing the thermal resistance of the insulation, leading to more condensation.

Vapour sealing will be required where the temperature of the air within the duct is at any time low enough to promote condensation on the exterior surface of the duct and cause moisture penetration through the thermal insulation. In this case the most important requirement is to limit penetration of the seal. The vapour barrier must be carefully installed to ensure the seal is continuous with no routes for penetration of humidity.

BS 5970: 2012 (BSI, 2012b) warns of the risk of condensation within the layer of insulation, which is primarily used to avoid condensation on its outside surfaces. With a suitable choice of insulation material and thickness, the surface temperature of the ductwork can be raised sufficiently above the ambient dew-point temperature to avoid surface condensation on the duct.

The extent of any vapour sealing of ductwork thermal insulation and the support method to be used should be clearly specified in advance by the designer.

Table 2.20 Estimated *U*-value for insulated ducts

Thermal conductivity of insulation / $W \cdot m^{-1} \cdot K^{-1}$	*U*-value (/$W \cdot m^{-2} \cdot K^{-1}$) for given thickness of insulation/mm				
	25	38	50	75	100
0.025	0.89	0.61	0.47	0.32	0.24
0.03	1.04	0.72	0.56	0.38	0.29
0.035	1.19	0.82	0.64	0.44	0.34
0.04	1.33	0.93	0.73	0.50	0.38
0.045	1.47	1.03	0.81	0.56	0.43
0.05	1.6	1.13	0.89	0.61	0.47
0.055	1.72	1.22	0.97	0.67	0.51
0.06	1.84	1.32	1.04	0.73	0.56
0.07	2.07	1.49	1.19	0.83	0.64
0.08	2.28	1.66	1.33	0.94	0.73

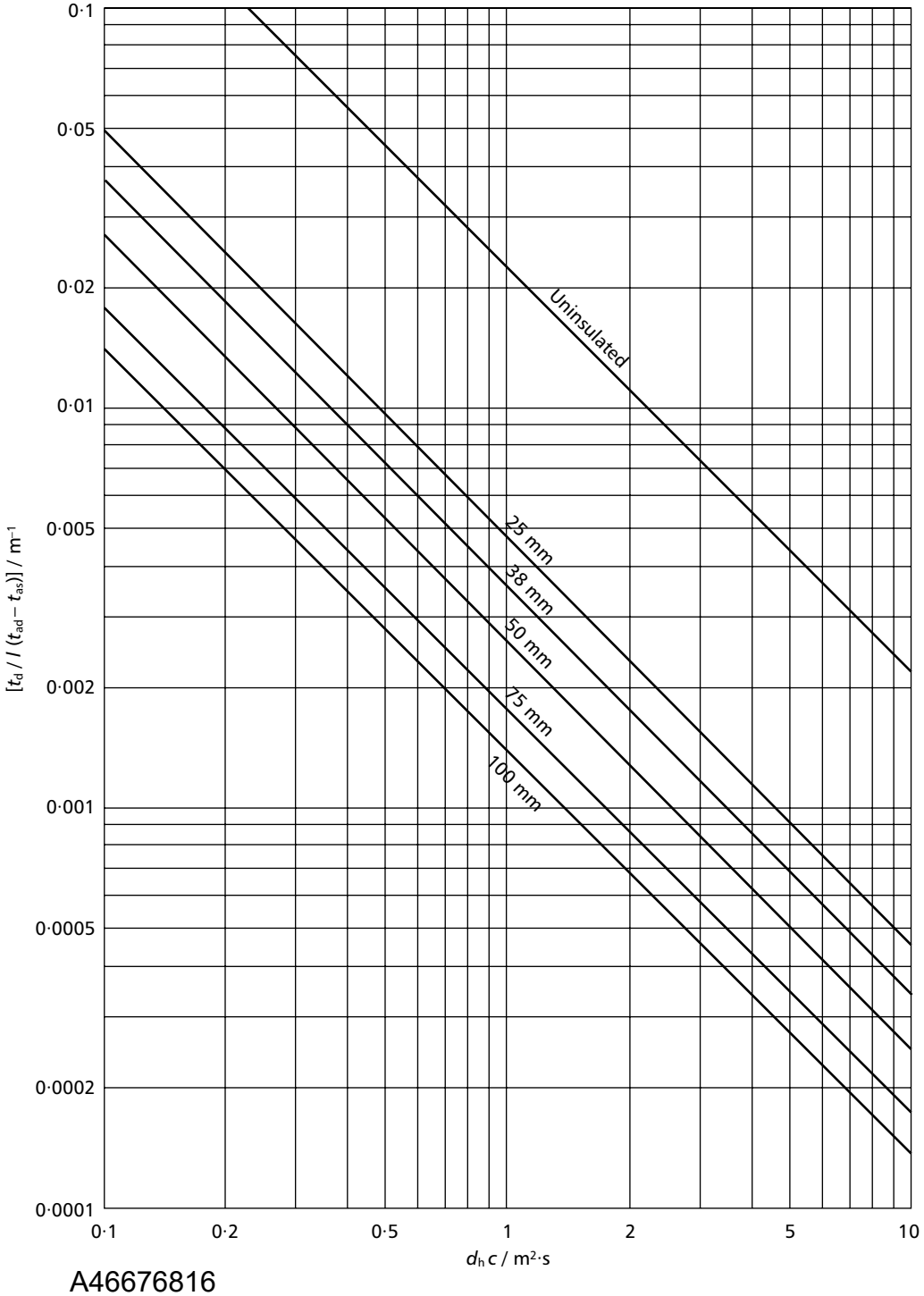


Figure 2.24 Temperature change along insulated ducts for various thicknesses of insulation

Table 2.21 Recommended minimum thickness of insulation on ductwork carrying chilled air (see BS 5422: 2009 (BSI, 2009b))

Minimum air temp. inside duct/°C	Minimum thickness of insulating material (mm) for stated thermal conductivity λ / W·m^{-1}·K^{-1} and external surface emissivity ε											
	$\lambda = 0.02$			$\lambda = 0.025$			$\lambda = 0.03$			$\lambda = 0.035$		
	$\varepsilon = 0.05$	$\varepsilon = 0.44$	$\varepsilon = 0.9$	$\varepsilon = 0.05$	$\varepsilon = 0.44$	$\varepsilon = 0.9$	$\varepsilon = 0.05$	$\varepsilon = 0.44$	$\varepsilon = 0.9$	$\varepsilon = 0.05$	$\varepsilon = 0.44$	$\varepsilon = 0.9$
15	15	8	5	18	9	6	22	11	7	25	13	8
10	26	10	9	32	17	11	39	20	13	45	23	15
5	37	19	12	47	24	15	56	28	18	64	33	21
0	48	25	16	60	31	20	72	37	24	84	43	27
Minimum air temp. inside duct/°C	Minimum thickness of insulating material (mm) for stated thermal conductivity λ (/W·m^{-1}·K^{-1}) and external surface emissivity ε								
	$\lambda = 0.04$			$\lambda = 0.045$			$\lambda = 0.05$		
	$\varepsilon = 0.05$	$\varepsilon = 0.44$	$\varepsilon = 0.9$	$\varepsilon = 0.05$	$\varepsilon = 0.44$	$\varepsilon = 0.9$	$\varepsilon = 0.05$	$\varepsilon = 0.44$	$\varepsilon = 0.9$
15	29	15	10	32	17	11	36	18	12
10	52	26	17	58	29	19	64	33	21
5	75	38	24	83	42	27	92	47	30
0	96	49	31	108	56	35	120	61	39

Notes: (*a*) assumes ambient conditions of 25 °C still air, 80% relative humidity, dew-point temperature 21.3 °C; (*b*) thicknesses calculated in accordance with BS EN ISO 12241: 1998: *Thermal insulation for building equipment and industrial installations* (BSI, 1998) based on 0.6 m vertical flat surface of rectangular duct but are also adequate for horizontal surfaces; (*c*) Thermal conductivity values of insulating materials quoted at mean temperature of 10 °C.

Table 2.22 Indicative thickness of insulation for ductwork carrying warm air to control heat loss (based on BS 5422: 2009: (BSI, 2009b))

Surface emissivity	Thermal conductivity of insulation (mm) for stated thermal conductivity λ (W/·m·K)							Maximum permissible heat loss / W·m^{-2}
	$\lambda = 0.020$	$\lambda = 0.025$	$\lambda = 0.030$	$\lambda = 0.035$	$\lambda = 0.040$	$\lambda = 0.045$	$\lambda = 0.050$	
Low ($\varepsilon = 0.05$)	17	21	25	29	33	38	42	16.34
Medium ($\varepsilon = 0.44$)	21	26	31	36	41	46	51	16.34
High ($\varepsilon = 0.90$)	22	27	33	38	44	49	54	16.34

Notes: (a) heat loss relates to specified thickness and temperature; *(b)* insulation thickness in this table has been calculated according to BS EN ISO 12241: 1998 using standardised assumptions: horizontal duct at 35 °C, with 600 mm vertical sidewall in still air at 15 °C, emissivity of outer surface of insulated system as specified.

The thickness of insulation to prevent surface condensation can be determined from the following approximate equations governing solid state heat transfer:

For rectangular ducts:

$$l_n = \frac{(t_{ds} - t_{ad})\lambda}{(t_{as} - t_{ds})h_{so}} \qquad (2.14)$$

where l_n is the insulation thickness (m), t_{ds} is the ambient dew-point temperature of the air outside the duct (°C), t_{ad} is the temperature of the air inside the duct (°C), λ is the thermal conductivity of the insulation (W·m^{-1}·K^{-1}), t_{as} is the ambient temperature outside the duct (°C) and h_{so} is the heat transfer coefficient of the outside surface of the duct (W·m^{-2}·K^{-1}).

Example 2.2

Calculate the thickness of glass wool ($\lambda = 0.045$ W·m^{-1}·K^{-1}) to prevent surface condensation on a circular duct of diameter 0.8 m, carrying cooled air at 12 °C, exposed in a ceiling void at 35 °C with relative humidity of 85%.

From a psychrometric chart, for a dry bulb temperature of 35 °C and 85% RH:

$$t_{ds} = 32.1\ °C$$

Taking h_{so} as 10 W·m^{-2}·K^{-1}, using equation 2.14, the required thickness is:

$$l_n = \frac{(32.1 - 12) \times 0.045}{(35 - 32.1) \times 10} = 0.030\ \text{m} = 30\ \text{mm}$$

Table 2.21 recommends an insulation thickness of 50 mm. Hence the glass wool thickness required for vapour resistance is less than that recommended for thermal insulation and surface condensation should not arise under these operating conditions.

Vapour barriers

In normal circumstances the insulation thickness for heat resistance is sufficient to prevent surface condensation, but in extreme conditions the insulation thickness for vapour resistance may be larger than that for heat resistance. When cold ducts pass through areas of high dew-point, carefully selected vapour barriers should be applied externally to the

insulation. Well-installed vapour barriers with sealed joints will minimise vapour penetration and combat the risk of internal condensation in the insulation. It is good practice to provide 'nominal' vapour barriers to cold ducts or to use thermal insulation with a low value of permeability, even when the insulation thickness for vapour resistance is less than that which is recommended for thermal resistance. Although polystyrene foam provides a high resistance to vapour transfer, other thermal insulation materials, for example rock wool, have minimal vapour resistance (see Hayden and Parsloe (1996), Table 3.49).

There are three main types of vapour barrier:

— *rigid barriers*: such as reinforced plastics and sheet metal, which are erected by mechanical means with sealed joints and suitable protection to resist impact damage

— *membrane barriers*: such as metal foils, plastic films and coated papers, which are easier to install and are in many cases available as backing material with heat-resisting insulation but are more easily damaged

— *coating barriers*: which are usually available as paints, hot melts, pastes or powders with chemical hardeners.

Vapour barriers need to be effective and continuous. The slightest leak will permit water vapour to diffuse throughout the insulation. It is therefore imperative that cracks in vapour barriers due to poor workmanship or thermal forces are avoided. This is not normally a significant problem because Δt is often small.

A common problem is that accidental damage to barriers caused by maintenance workers is subsequently not rectified.

2.3.5.6 Duct and plenum design

Air terminal devices will only perform as intended if the approach velocity is even. If the duct connections and/or volume flow regulators created eddies at the terminal, the following problems may arise:

— unpredictable throw, spread and drop

— breakdown of Coanda effect

— high noise levels

— balancing is difficult or impossible.

Design procedures for duct and plenum connections to various types of air terminal are given elsewhere (HEVAC, 2000); also see section 2.6.8.

If the ceiling is to be used as an exhaust plenum, it is important to create a uniform negative pressure throughout the whole ceiling void to ensure even exhaust throughout all terminals. This is particularly important where exhaust is by means of air-handling luminaires, the performance of which varies with airflow rate. Ceiling voids should be made as large as possible and, if

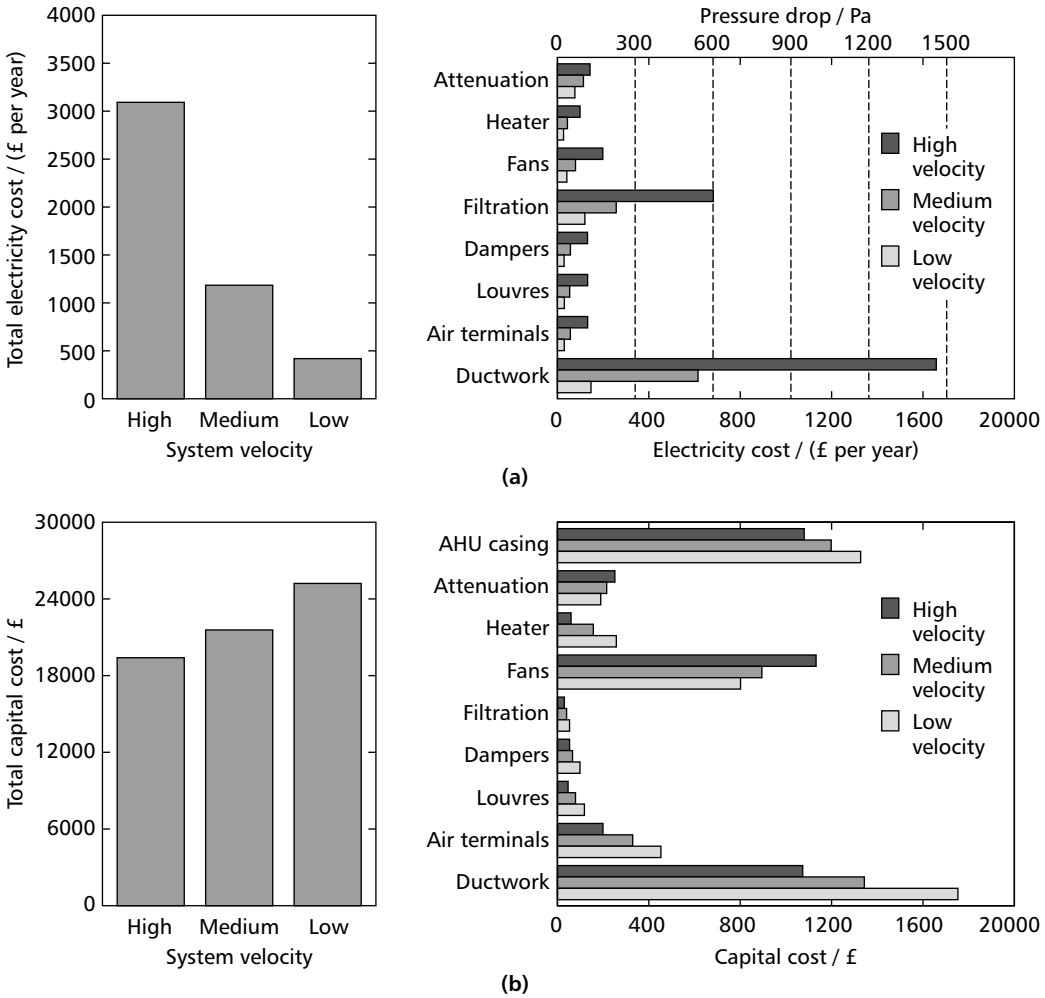


Figure 2.25 Comparison of high, medium and low-velocity systems (Action Energy, 1997); (a) electricity costs (b) capital costs

obstructed by luminaires, ductwork etc., exhaust stub ducts should be provided to ensure even exhaust over the full ceiling area.

2.3.5.7 Ductwork and system velocities

Optimising duct design is essential for achieving energy efficiency. For optimum energy efficiency ductwork should have as large a cross-sectional area as possible to produce low-velocity systems and reduce system pressure drops. Figure 2.25 which is based on Jackman (1990) and Good Practice Guide GPG 257 (Action Energy, 1997) illustrates the running and capital costs for systems having different design air velocities. These figures show how the running costs are reduced for low-velocity systems and how some components become more expensive while others become cheaper. The benefits of the energy-efficient (i.e. low-velocity) system include a reduction in electricity costs of approximately 70 per cent, while the additional capital cost is recovered in under five years.

The basis of the comparison is as follows:

— all systems supplying 2 $m^3 \cdot s^{-1}$ of air

— all systems supplied by a centrifugal fan operating at an efficiency of 70 per cent

— pulley and motor efficiencies of 90 per cent and 80 per cent respectively

— electricity cost: 10 pence per kW·h

— annual run time: 3000 hours

— noise levels less than 40 dBA.

In a low-velocity system, the AHU face velocity would typically be less than 2 $m \cdot s^{-1}$ with the main duct velocity less than 3 $m \cdot s^{-1}$. In a medium-velocity system these figures would become 2–3 $m \cdot s^{-1}$ and 5 $m \cdot s^{-1}$ respectively. In a high-velocity system the AHU velocity would typically be greater than 3 $m \cdot s^{-1}$ with the main duct velocity at 8 $m \cdot s^{-1}$.

Air leakage from ductwork should be minimised to prevent the wastage of fan power. Ductwork should be insulated accordingly and runs through unoccupied spaces should be minimised. Testing of ductwork air tightness should be undertaken (see DW/143: *Guide to Good Practice: Ductwork Air Leakage Testing* (BESA, 2013b)).

Good duct design should achieve airflow that is as uniform as possible throughout the ductwork run to reduce the pressure drop. To achieve this:

— changes to the direction of the flow should be minimised

— where possible 2–3 diameters of ductwork should be allowed either side of components before changing direction

— radius bends should be used in preference to right-angled bends

— Y-junctions should be used in preference to T-junctions

— turning vanes should be used wherever appropriate

— for rectangular ductwork, the aspect ratio should be as close to unity as possible.

Ductwork noise is considered in more detail in sections 2.5.2.3 and 2.6.7 and CIBSE Guide B4 (CIBSE, 2016c).

Noise

Noise should be prevented from getting through to the occupied spaces. Design features in support of this objective, which largely correspond to those required for energy efficiency, include the following:

— a low air velocity in the ductwork

— the use of round ducts

— the use of bends with large internal radii

— smooth transitions and changes in flow direction

— the use of low-noise control vanes

— low air leakage.

2.3.6 Ventilation control systems

2.3.6.1 General

Control systems are essential to maintain air quality, thermal comfort and energy efficiency. Increasingly, a wide variety of controls are becoming available that are appropriate for both mechanical and natural ventilation systems. Controls incorporate a variety of sensors and actuators that enable optimum operating conditions to be maintained.

In designing a control system the following should be taken into account.

— Ensure fairness and consistency of control by avoiding occupants being unduly affected by controls from which they do not benefit.

— Provide rapid acting controls that give feedback to occupants to demonstrate response.

— Make sensible decisions with regards to the choice of manual versus automatic control (manual overrides should be provided where practical); any automatic change in state should happen gradually to avoid feelings of discomfort.

— Remove unnecessary complexity by providing controls that are simple and well labelled.

Further guidance on these issues can be found in Bordass *et al.* (1995, 1999).

2.3.6.2 Sensors

Typical sensors for automatic control may include:

— CO_2 sensors for occupant generated pollutant

— gas sensors to monitor specific gasses that may be present in a space

— humidity sensors

— passive infra red (PIR) sensors to detect the presence of occupants

— temperature sensors to control thermal comfort and natural cooling

— solar gain sensors for feed forward control to increase ventilation when gains are high.

In addition, sensors for natural ventilation include:

— wind-speed sensors to throttle back vent openings at high wind speeds

— rain sensors to indicate potential driving rain problems

— wind direction sensors to optimise vent opening

2.3.6.3 Sensor location

The positioning of sensors to obtain representative readings is very important. Important considerations are outlined below.

CO_2 and gas sensors

These should be placed to provide a representative value of room space conditions. In a well-mixed mechanically ventilated space sensors may be placed at the extract where they can provide direct feedback to the supply air. It is important not to locate the sensor directly in the breathing zone where a distorted reading can be obtained. Typically a CO_2 sensor might be set at about 1000 ppm. Inevitably some flexibility in operating range must be acceptable such that, for example, this threshold is maintained on average but can be allowed to drift, for example, to 1400 or 1500 ppm. The outdoor concentration needs to be checked and allowance made by setting the threshold proportionately higher if the outdoor concentration is above approximately 400 ppm. Typically 400 ppm is the concentration in open country but it could exceed 500 ppm in city centres.

Temperature sensors

Internal temperature sensors should not be too close to windows as incoming fresh air may not have mixed with the room air and the sensed condition may not therefore be representative. Again, for mechanical ventilation control, exhaust air temperature should be included in the control loop. External temperature sensors should not be placed on sunny walls that can absorb solar radiation and elevate the sensor reading throughout the 24-hour cycle.

In view of the vertical temperature gradients associated with displacement ventilation systems (see section 2.8.2), the room air temperature sensor is best placed at about head height in a location free from significant draughts.

Humidity sensors

Humidity sensors and associated controls are typically located in 'wet' zones to control humidity levels and prevent humid air from reaching other parts of a building. They are also used to control humidity levels in air-conditioned buildings where they are linked to humidifiers and dehumidifiers as necessary. This is covered in detail in CIBSE Guide B3 (2016a).

Actuators

Automatically controlled openings could be modulated, open/shut, have intermediate fixed positions or open in sequence where a number of vents serve a common zone. Operation should be a function of prevailing weather conditions as well as the required ventilation rate since these will influence the driving forces. Wind speed override may be required to prevent excessive ventilation under windy conditions.

Manual control is the most common form of control. It provides occupants with increased personal control over the environment in their workspace, a factor often associated with increased occupant satisfaction. Control (Willis *et al.*, 1995) should be:

— territorial, positioned locally and, ideally, affect a single person

— intuitive

— accessible.

2.3.6.4 Control of volume airflow rate

Volume airflow rate control may be achieved by the following means:

— *Damper*: normally of the butterfly or multi-leaf type and capable of controlling the volume. The main distribution dampers are located to fine balance airflows through legs of the ductwork (assuming that the ductwork has been sized on static regain principles). Typically these dampers are required to provide a pressure drop across the damper of between 50 and 100 Pa. If the pressure drop is higher, there will be a tendency to generate excessive noise, which will require the introduction of a downstream silencer. Normally these dampers are supplied as separate components for direct installation in the ductwork and not as part of an air terminal device. With multiple air terminal devices on a duct leg dampers can also be supplied as integral accessories on the rear of the air terminal device to provide a final terminal balance; typically in this application the dampers provide 10 to 40 Pa pressure drop. Due to the energy inefficiency of damper control, dampers should no longer be used as a primary method of fan duty control. In both applications, final adjustment is carried out manually on-site.

— *Pressure regulating valve*: an assembly consisting of one or two rows of shaped blades, the size of which changes when volume adjustment is required. Because of the particular blade shape, the device gives volume adjustment up to pressure drops of about 600 Pa without generating excessive noise, however a downstream silencer may still be required for a low-noise environment. The majority of dampers are set on-site, but they can be controlled from a static pressure-sensing element. Such units are generally supplied as a separate component for direct installation in the ductwork and not as part of a terminal unit.

— *Mechanical volume controller (air terminal unit)*: a unit that is self-actuating and capable of automatically maintaining a constant pre-set volume flow rate through it independent of upstream duct pressure. The minimum pressure drop across the air terminal unit depending on size varies from 100 to 50 Pa and typically up to a maximum of about 500 Pa. As the supply air pressure increases, most devices of this

type tend to close the airway progressively by means of a butterfly, single or multi-blade damper in the airway. As such an air terminal unit achieves volume reduction by reducing the airway, there is a tendency to generate noise, particularly when working at high air pressures. For this reason, the air terminal unit is generally supplied either with additional acoustic cladding and a separate secondary silencer or the air terminal unit has these features integrated into a single factory-supplied unit. It is factory pre-set to pass a specific volume and, when installed, will automatically give a pre-balanced air distribution system up to and including the air terminal unit. It can be adjusted on-site if required. With the addition of a sensing system and an actuator, this type of air terminal unit can be used for variable volume applications where the flow supplied at the dictates of the sensing system is again independent of upstream duct pressure.

2.3.6.5 Control of temperature

This may be achieved by the following means:

— *Blending*: two separate airstreams, one warm and one cool, are supplied to a zone and mixed in a terminal unit to produce a supply air temperature that offsets the zone cooling or heating loads.

— *Reheat*: controlled reheat of a pre-conditioned, low temperature air supply by means of hot water, steam or electric coils, may be used to give a resultant supply air temperature that will satisfy the zone requirement.

2.3.6.6 Control options for natural ventilation openings

Control options for natural ventilation openings should be specified with the needs of the occupants in mind. Control mechanisms for natural ventilation opening include the following.

Window/damper actuators

A number of different actuator types are available for window control. These are electrically driven and include chain, helical cable, piston and rack and pinion type actuators. Because of their linear action, the last two types suffer some disadvantage because they protrude into the space. The actuator will have to cope with the weight of the window and with any wind forces. The use of vertically pivoted windows minimises the effect of the weight of the window but they are less efficient as ventilators. If dampers are used, conventional control mechanisms (pneumatic or electric actuators) can be considered. More details are provided in CIBSE AM10: *Natural ventilation in non-domestic buildings* (2005).

Sensors

Any automatic control system must be regulated in response to signals from appropriate sensors. Equipment to be specified includes the following:

— *Temperature sensors*: room temperature sensors may be sufficient to indicate excessive ventilation rates because of the influence of ventilation on room temperature. However this approach will need to be integrated with heating system controls to avoid the two systems fighting each other. Other control parameters may be required as well as temperature.

— *Wind sensors*: wind speed sensors (anemometers) can be used to reduce window opening as wind speeds increase in order to maintain a nominally constant ventilation rate. They may also be used in conjunction with rain sensors to give an indication of potential ingress of driving rain. Wind direction sensors can be used to shut exhaust vents on the windward side of a building and simultaneously open leeward vents in order to avoid back-draughts.

— *Solar sensors*: solar sensors (pyranometers) can be used to indicate periods of high solar gain. The sensor must integrate the gain over a certain period to avoid hunting during periods of patchy cloud.

— *Rain sensors*: windows and vents may need to be closed during periods of rainfall to prevent ingress of water. Typical sensors include the 'tipping bucket', which collects rainfall and tips over at a certain level. Each tipping action generates a pulse, the frequency of which can be used to determine the intensity of the rainfall. An alternative approach is to use a device whereby the capacitance changes as the area of moisture on its surface increases. The sensor is heated to dry off the surface when the rain stops.

— *Air-quality sensors*: several approaches to measuring air quality have been used. These usually rely on taking a particular pollutant as indicator for the overall air quality. CO_2 and humidity sensors have been most commonly used; the former in commercial buildings and the latter in residential buildings where condensation is a bigger problem.

— *Occupancy sensors*: infrared sensors that detect movement have been used to identify the presence of occupants and adjust ventilation rates (and lighting etc.) accordingly. Further details on the application of these sensors can be found elsewhere (Oughton and Wilson, 2015).

Air conditioned buildings will have quite complex control mechanisms to ensure optimum operation. When various areas to be air conditioned have differing heat gain patterns with respect to time, these can be met from a central plant in which either the temperature or volume (or both) of the air supplied to each area is varied to meet the particular requirements of the area. Such temperature or volume control may be carried out in ductwork serving a number of rooms or zones, or may be carried out in the terminal units feeding individual rooms. Control strategies include the following.

2.3.6.7 Control options for mixed-mode ventilation

In the case of a mixed-mode system, it is also important to remember that the control characteristics of windows differ from the 'designed' characteristic of HVAC dampers and coils. The control authority of a window is low and non-linear or proportional, hence the use of sophisticated control algorithms will not bring greater accuracy. Given the pulsing effect of the wind or natural ventilation,

continuously correcting automatic controls should be avoided and the control's response slowed.

The reactions of the occupants to the control systems must also be allowed for in terms of:

— the provision of intuitive user interfaces and control strategies

— adverse reactions to systems that appear to operate in a capricious manner noticeable by changing noise levels or creating a draught

— giving occupants the ability to override automatic controls manually and the impact on system performance

— providing a rapid response to a requested control action.

Elements of the following control sub-strategies may be included:

— *Normal working day control*: where mechanical cooling is switched on when a predetermined temperature is exceeded.

— *Seasonal control*: where, for example, the building is sealed in peak winter and summer conditions under mechanical operation but runs freely during spring and autumn.

— *Top-up/peak lopping control*: where mechanical cooling is switched on only at times of peak load.

— *Pre/post-occupancy space conditioning*: where selected areas prone to overheating may be cooled outside of working hours to ensure that the space temperature is the minimum acceptable at the start of the working day.

— *Overnight cooling*: where the building thermal mass is utilised either through natural or mechanical means, see section 2.4.2.4.

— *Moisture control*: where exposed direct cooling such as chilled ceilings or chilled beams are used.

— *Ventilation control*: where carbon dioxide (CO_2) sensors are used as a surrogate indicator of occupancy levels to switch on mechanical ventilation when the level exceeds a pre-set value and occupants have not elected to open windows.

2.3.6.8 Control of displacement ventilation systems

The main forms of control are as follows.

— *Constant supply air temperature, constant airflow rate*: in which the supply air temperature is maintained at a constant design value selected to be at least 1 K below the required zone mean air temperature. Variations in heat gain will affect the temperature gradient within the space so that, provided the maximum heat gain does not create a temperature gradient in excess of comfort limits, acceptable conditions will be maintained.

— *Constant supply air temperature, variable airflow rate*: the supply airflow rate may be adjusted to accommodate higher variations in heat load and maintain a substantially constant temperature gradient within the occupied zone. This adjustment can be automatically controlled to maintain a constant difference between the room air temperature and supply air temperature.

— *Variable supply air temperature*: this form of control is not as effective in displacement ventilation systems as it is in mixed-flow systems because the supply air temperature required to maintain an acceptable mean room air temperature is not so directly related to internal heat gains.

Using a control system to maintain substantially constant thermal conditions within a room requires a temperature sensor located in a position that provides a reading that is representative of the occupied zone. In view of the vertical temperature gradients associated with displacement flow, the room air temperature sensor is best placed at about head height in a location free from significant draughts.

2.3.6.9 Energy-efficient control of mechanical ventilation systems

Increased system efficiency, i.e. reduced specific fan power, can be achieved by the following measures.

— Select efficient fans (see section 2.6.1).

— Select appropriate attenuation, filtration and heat-recovery devices to reduce system pressure drops (see sections 2.3.3 and 2.3.4).

— Choose appropriate ductwork and system velocities to reduce system pressure drops (see section 2.3.5.3).

— Vary the volume of air through the system, e.g. through the use of two-speed or variable-speed fans (as covered, for example, by Part L of the Building Regulations (NBS, 2013a) for fans rated above 1100 W. This can be achieved through variable speed drives or inlet guide vanes. (The latter technique is not recommended due to its relative inefficiency.) Further information on variable speed fans is available in GIR 41: *Variable Flow Control* (Action Energy, 1996).

— Ensure local extraction by the appropriate location of plant in order to minimise duct runs and hence fan power.

— Use intelligent zoning to avoid the system operating to suit the needs of one small area.

— Switch off systems when they are not in use or not required. Systems may run for longer than intended for a various reasons, e.g. controls may have been overridden and not reset afterwards; automatic controls (e.g. frost thermostats or hidden hardware or software interlocks) may have switched on systems unnecessarily as a consequence of poor setting, calibration or programming. Suitable fault detection should be incorporated, e.g. by reporting the running hours of devices and systems during periods when they are programmed to be off.

— Appropriate coverage of a building by mechanical ventilation, i.e. using natural systems where applicable (mixed-mode approach) (see section 2.3.2.4).

— Control fan operation according to occupancy in both variable and constant volume systems.

— Log hours of operation of systems to identify if systems are operating unintentionally, particularly outside the occupied period. Anticipatory systems (e.g. for optimum start or night cooling) are prone to such behaviour.

— Take care to avoid parasitic loads that may increase energy consumption. Examples include heat-recovery systems that break down unnoticed (or continue to operate when cooling is required); 'free-cooling' control systems that introduce the wrong proportions of outside air; and unnecessary heating of air intended for night cooling. Ideally, the performance of such systems should be automatically monitored against the design intentions. Alternatively, systems can be designed deliberately to allow such technical problems to become noticed.

— The supply of air to a space can be controlled by a number of manual or automatic means. The most popular options are:

  — *CO_2 sensing*: useful in buildings where there are wide variations in the ventilation requirement, e.g. bingo halls, cinemas, theatres and meeting rooms

  — *temperature sensing*: useful where it may be advantageous to increase the flow of air when conditions are favourable to take advantage of free cooling

  — *humidity sensing*: fresh air rates can be increased when internal humidity levels are too high, an option used for example in areas where moisture is produced, e.g. kitchens and bathrooms

  — *occupancy sensing*: this enables systems to be switched off when rooms are not occupied.

2.3.6.10 Fire damper control systems

There is a variety of additional systems that give control to fire dampers, either as simple systems to close them on alarm or more sophisticated systems that allow smoke and heat exhaust or area pressurisation. These need to be considered as part of the design process and the latter systems need a very clear cause-and-effect schedule to make sure they achieve what they have been designed to do.

2.4 System design

2.4.1 Introduction

This section is not intended to provide step-by-step design guidance but to summarise the key issues and performance targets that need to be addressed during design. The guidance contained in this section should be read in conjunction with CIBSE Guides A (2015a) and F (2012). For details of refrigeration methods, see CIBSE Guide B3 (2016a).

System design starts with decision making, taking into account the needs of the occupier and any planning requirements. Energy and environmental impact also play an important part of the decision-making process. A typical selection approach is presented in Figure 2.26. From this the designer will make a choice between a natural or mechanical system and identify zones that may be suitable for mixed-mode ventilation.

2.4.2 Designing for natural ventilation

In the case of natural ventilation important factors relating to the driving forces and the configuration of openings must be considered. Full guidance is given in CIBSE AM10: *Natural ventilation in non-domestic buildings* (2005).

A key issue to consider is the need to take into account all operational regimes—winter and summer, as well as night ventilation and passive cooling if required. Ventilation strategy should be considered on the basis of the whole building rather than just room by room, although each individual room case needs close attention to ensure the efficiency of the proposed design. Circulation areas such as stairwells or corridors can be used as plenums or supply ducts, although care must be taken to avoid these routes acting as 'short circuits'. Compliance is also needed with fire and smoke regulations as outlined in section 2.5.3.

Consideration must be given to where the fresh air will be brought from (see section 2.6.5), for example it may be beneficial to draw the air from one side of the building to:

— avoid noise and traffic fumes from a busy road

— maximise benefit from wind velocities.

Guidelines for minimising the ingress of external pollution are given in Kukadia and Hall (2011).

The magnitude and pattern of natural air movement through a building depends on the strength and direction of the natural driving forces and the resistance of the flow path as described in section 2.3.2.2.

Fresh air requirements are based on occupant needs (see section 2.2.3) and/or pollutant loads (see section 2.2.2). Airflow rates for cooling will normally be based on a summertime temperature prediction using some form of thermal analysis and also on thermal gains such as from processes and equipment use (see section 2.2.4).

2.4.2.1 The BREEAM requirements for natural ventilation

In addition to the guidelines on natural ventilation, given in section 2.3.2.2, BREEAM (2014) also gives guidance aimed at achieving an excellent environmental rating. A range of supporting guidance documents are being released and the BREEAM website should be consulted. BREEAM is an internationally recognised rating scheme covering the environmental performance of buildings, which sets performance criteria for installed ventilation systems. In the case of the natural ventilation of office-type buildings, the criteria state that: natural ventilation strategy performance must be demonstrated via *either* of the following.

(*a*) The openable window area in each occupied space is equivalent to 5 per cent of the gross internal floor area of that room/floor plate. For room/floor plates 7–15 m in depth, the openable window area is on

opposite sides and evenly distributed across the area to promote adequate cross-ventilation.

(*b*) The design demonstrates (by calculation, using ventilation design tool types recommended by CIBSE AM10: *Natural ventilation in non-domestic buildings*) that the natural ventilation strategy provides adequate cross flow of air to maintain required thermal comfort conditions and ventilation rates.

For a strategy that does not rely on openable windows, or that has occupied spaces with a plan depth greater than 15 m, the design must demonstrate (by calculation in accordance with requirement (*b*) above) that the ventilation strategy can provide adequate cross flow of air to maintain the required thermal comfort conditions and ventilation rates.

2.4.2.2 The design process

The design of a natural ventilation system should take account of the following steps.

— Assess the potential for natural ventilation (see Figure 2.26). Factors include:

  — availability of fresh air

  — minimising problems associated with outdoor noise

  — suitability of building.

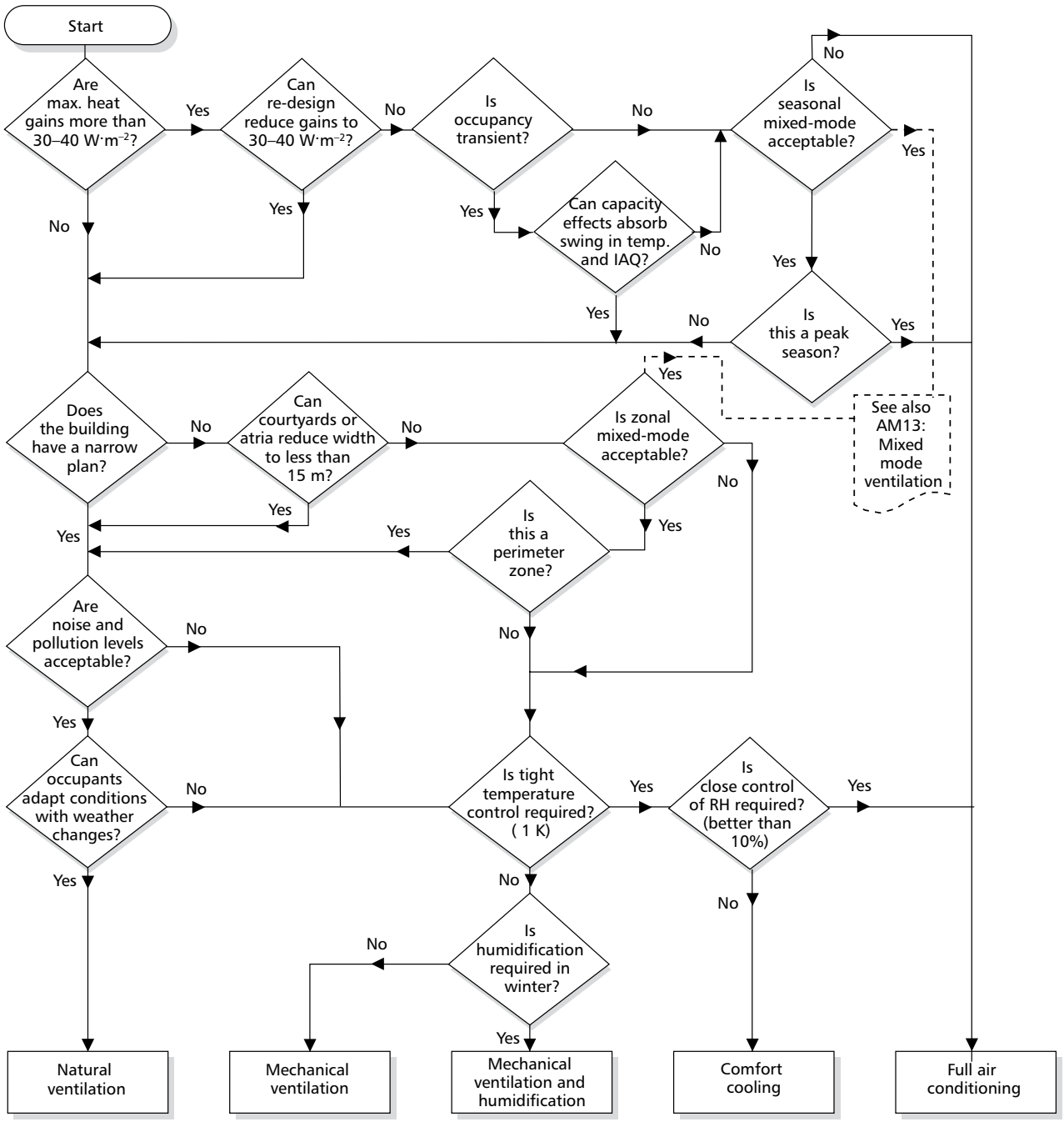


Figure 2.26 Decision-making process (from CIBSE AM10: *Natural ventilation in non-domestic buildings* (2005))

— Determine ventilation rates required for fresh air (see section 2.2.3).

— Determine the requirements for cooling needs (see section 2.2.4).

— Based on local weather data consider the optimum driving forces (wind, stack or combined) for the building.

— From fresh air and cooling need calculate the size and location of openings. Initial estimates can be determined from the calculation equations given in CIBSE Guide A (2015a) and CIBSE AM10: *Natural ventilation in non-domestic buildings* (2005). More detailed analysis using multi-zone, computational fluid dynamics (CFD) modelling or wind tunnel and flume scale modelling may be required for complex buildings (see section 2.4.6).

— Plan the use of windows, vents, passive stacks and wind towers.

— Plan interaction building form, e.g integration with thermal mass (see section 2.4.2.4).

— Identify a control strategy (see section 2.3.6).

— Plan flexibility for future needs including mixed-mode ventilation and mechanical cooling.

2.4.2.3 Meeting thermal comfort and cooling needs

If the internal heat gain rises above approximately 40 W/m^2, natural ventilation on its own may be inadequate and a strategy involving mechanical assistance may be required (BMI, 1999). Table 2.23 illustrates how the design of the building fabric might be adapted to meet this target (BMI, 1999). However, this table is indicative of a scale only and will vary depending on the characteristics of the particular building and on the freedom or otherwise allowed to the designer to maintain thermal comfort within acceptable limits using these design features. If natural ventilation is to be used for comfort cooling, control of heat gains into the occupied space is a prerequisite. Thus measures must be taken to reduce solar and internal heat gains during warm periods in order to maximise periods of thermal comfort. Advantage needs to be taken of adaptive thermal comfort criteria to enable a temperature spread to be applied.

The ability to open windows to provide increased air movement can provide a beneficial cooling effect in summer (see chapter 1 of CIBSE Guide A (2015a)). However, the high ventilation flow rates associated with summer conditions can cause nuisance draughts that may disturb papers etc. This can be reduced by specifying that the openable part of the window to be above desk height.

The minimisation of draughts is a particular issue for natural ventilation systems in winter. The potential problem can be reduced in a number of ways such as:

— providing multiple trickle ventilators (or similar)

— using specially provided ventilation openings positioned so that the air is warmed before reaching the occupied space (e.g. behind a radiator or in a floor void with a suitable convector heater)

— using a separate natural ventilation system that can pre-heat the air such as a combined weather louvre, control insulated damper, heating coil and internal grille system.

Table 2.23 Relationship between design features and heat gains

Design features	Total heat gains*/W·m^{-2} floor area			
	10	20	30	40
	Minimum room height/m			
	2.5	2.7	2.9	3.1
Controllable window opening (to 10 mm)	Essential	Essential	Essential	Essential
Trickle vents for winter	Essential	Essential	Essential	Essential
Control of indoor air quality	May be required	May be required	Essential	Essential
Design for daylight to reduce gains	May be required	Essential	Essential	Essential
Daylight control of electric lighting	May be required	May be required	Essential	Essential
100% shading from direct sun	May be required	Essential	Essential	Essential
Cooling by daytime ventilation only	Essential	Essential	Problem	Problem
Cooling by day and night ventilation	Not necessary	May be required	Essential	Essential
Exposed thermal mass	Not necessary	Not necessary	Essential	Essential

* i.e. people + lights + office equipment + solar gain

It should be recognised that not all parts of a building need to be treated in exactly the same way. Different natural ventilation strategies may be applied to different parts of a building as appropriate.

2.4.2.4 Interaction with building form and fabric

The interaction between building form and ventilation strategy is important. Natural ventilation relies on the building envelope (rather than any mechanical system) to provide the primary environmental control (air quality and thermal comfort). The building form will need to facilitate the airflow strategy. Particular consideration should be given to the following.

— *Building spacing and orientation and their impact on building shading and wind effects*: increasingly this is being analysed by wind tunnel and numerical methods (sections 2.4.6.6 and 2.4.7.8). Some guidance is given in Kukadia and Hall (2011).

— *Planning the width/floor-to-ceiling height ratio to achieve effective ventilation*: as air flows across the zone a sufficiently high 'stratification height' is required to lift heat and contaminants above the downstream occupied space (see CIBSE AM10: *Natural ventilation in non-domestic buildings*).

— *Achieving good solar control by sensible choice of glazing ratios and by shading provision*: buildings with their main façades facing north and south are much easier to protect from excessive solar gain in summer (see CIBSE AM10: *Natural ventilation in non-domestic buildings*). Note that a balance must be achieved in allowing appropriate natural lighting levels.

— *Openings in the external façades to provide airflow paths*: classical single-zone and multi-zone airflow models as well as CFD techniques can assist in optimising opening configurations. These models are discussed in more detail in (section 2.4.6.5 and in CIBSE AM10: *Natural ventilation in non-domestic buildings*). Manufacturers also have a range of programs available to allow review of selection of external, transfer and exhaust units.

— *Use of exposed thermal mass to aid passive and night cooling*: thermal modelling techniques are available to assist design and check with energy performance requirements.

— *Airtightness*: to minimise energy losses and cold draughts in winter and to assist the controllability of natural ventilation.

2.4.2.5 Empirical guidelines for sizing openings and calculating natural ventilation rates

Detailed guidance on calculating driving forces, the size of openings and natural ventilation rates is presented in CIBSE Guide A, chapter 4 (2015a) and CIBSE AM10: *Natural ventilation in non-domestic buildings* (2005).

Some empirical equations for the conditions are available to assist in obtaining approximate guidance on opening sizes. These are taken from BS 5925: 1991: *Code of practice for ventilation principles and designing for natural ventilation* (BSI, 1991). The assumption that ventilation openings can be represented by orifice flow equations (see section 2.4.6) enables the estimation of ventilation rates using standard formulae for simple building layouts. These layouts and associated formulae are shown in Table 2.24 for a simple building with airflow through opposite sides and in Table 2.25 for a situation with openings in one wall only. Both wind-induced and temperature-induced ventilation are given.

The values of area (A) used in the formulae should be taken as the minimum cross-sectional area perpendicular to the direction of the airflow passing through the opening.

The formulae given in Table 2.24 illustrate a number of general characteristics of natural ventilation, as follows.

— The effective area of a number of openings combined in parallel, across which the same pressure difference is applied, can be obtained by simple addition.

— The effective area of a number of openings combined in series (across which the same pressure difference is applied) can be obtained by adding the inverse squares of the individual areas and taking the inverse of the square root of the total (see Table 2.24(b)).

— When wind is the dominating mechanism the ventilation rate is proportional to wind speed and to the square root of the difference in pressure coefficient. Thus, although ΔC_d may range between 0.1 and 1.0, this will result in a ratio of only about 1 to 3 in the predicted ventilation rates for the same wind speed.

— When stack effect is the dominating mechanism the ventilation rate is proportional to the square root of both temperature difference and height between upper and lower openings. When wind and stack effect are of the same order of magnitude, their interaction is complicated. However, for the simple case illustrated, the actual rate, to a first approximation, may be taken as equal to the larger of the rates for the two alternative approaches, considered separately. This is shown in Table 2.24(c).

Measurements (Braham *et al.*, 2001) have shown that, with normally sized windows, the magnitude of the resulting single-sided ventilation, while smaller than cross-ventilation with similar areas of opening under comparable conditions, can be large enough to contribute to natural cooling. Table 2.25 provides formulae that enable ventilation rates to be calculated for wind and stack effect. It is suggested that calculations be carried out using both formulae and the larger value taken. The formula for wind-induced infiltration represents a minimum, which will be enhanced up to threefold for certain wind directions and windows with openings that tend to deflect inwards the impinging wind.

Ducted or under-floor pathways

In order to improve air distribution into deeper spaces, it is possible to use ducted or under-floor ventilation pathways. This can provide ventilation to internal spaces or a perimeter zone local to a pollution source (e.g. a busy road). Because of the low driving pressures with natural ventilation (<10 Pa), it is important to design the supply duct for very low pressure drops. Problems could occur if incoming air is cooled to below the condensation temperature since this will result in condensation in the duct, thus leading to microbiological contamination.

More advanced calculation techniques are available for detailed design and evaluation. These are described in more detail in section 2.4.6 and include:

— zonal models

— CFD

— combined thermal and ventilation models.

A simple design tool and guidance is included in CIBSE AM10: *Natural ventilation in non-domestic buildings* (2005).

2.4.2.6 Other design considerations

Measurement techniques for evaluating natural ventilation systems

For complex buildings it may be necessary to commission laboratory or other measurement studies to understand flow behaviour. Measurement methods are covered in more detail in section 2.4.7.

Minimising problems associated with outside noise

Noise from outside sources can present a major problem to natural ventilation designs. Solutions include sound insulation, acoustic vents and the location of openings away from sound sources. These methods are described in more detail in section 2.5.2.

Table 2.24 Standard formulae for estimating airflow rates for simple building layouts (openings on both sides) (reproduced from CIBSE Guide A)

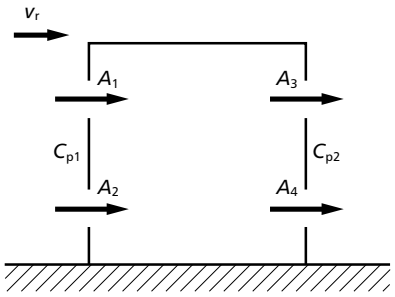
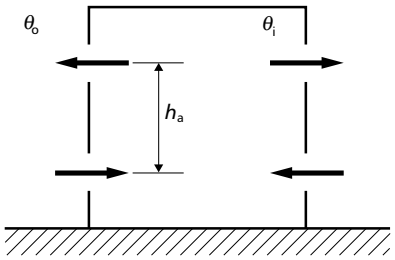
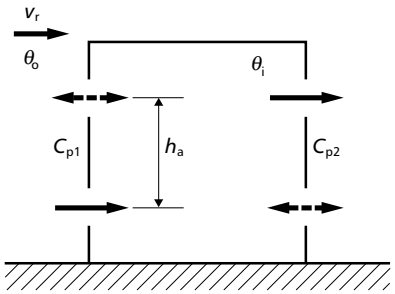
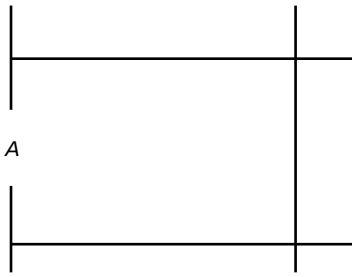
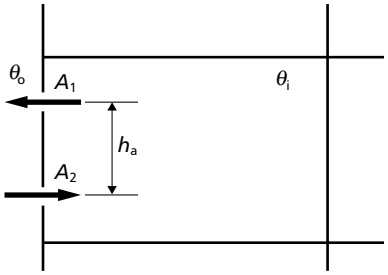
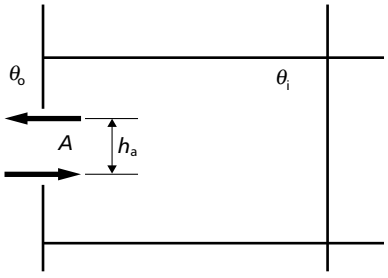
Conditions	Schematic	Equations
(*a*) Wind only		$Q_w = C_d A_w v_r (\Delta C_p)^{0.5}$ $\frac{1}{A_w^2} = \frac{1}{(A_1 + A_2)^2} + \frac{1}{(A_3 + A_4)^2}$
(*b*) Temperature difference only		$Q_b = C_d A_b \left(\frac{2 \Delta\theta h_a g}{\bar{\theta} + 273} \right)^{0.5}$ $\frac{1}{A_b^2} = \frac{1}{(A_1 + A_3)^2} + \frac{1}{(A_2 + A_4)^2}$
(*c*) Wind and temperature difference together		$Q_t = Q_b$ for $(v_r / \sqrt{\Delta t}) < 0.26 (A_b/A_w) (h_a / \Delta C_p)^{0.5}$ $Q_t = Q_w$ for $(v_r / \sqrt{\Delta t}) > 0.26 (A_b/A_w) (h_a / \Delta C_p)^{0.5}$

Table 2.25 Standard formulae for estimating airflow rates for simple building layouts (openings on one side only) (reproduced from CIBSE Guide A)

Conditions	Schematic	Equations
(*a*) Wind only		$Q = 0.025 A V_r$
(*b*) Temperature difference only: two openings		$Q = C_d (A_1 + A_2) \left(\frac{\varepsilon \sqrt{2}}{(1 + \varepsilon)(1 + \varepsilon^2)^{0.5}} \right) \left(\frac{\Delta\theta\ h_a g}{\bar{\theta} + 273} \right)^{0.5}$ where $\varepsilon = (A_1 / A_2)$
(*c*) Temperature difference only: one openings		$Q = C_d (A/3) \left(\frac{\Delta\theta\ h_a g}{\bar{\theta} + 273} \right)^{0.5}$ If opening light is present: $Q = C_d (A f_\phi / 3) \left(\frac{\Delta\theta\ h_a g}{\bar{\theta} + 273} \right)^{0.5}$ where f_ϕ is given by Figure 4.15 in CIBSE Guide A (2015a)

External noise should not normally present a significant problem unless opening windows face busy main roads or are within 100 m of a railway line. A partially open window typically has a weighted sound reduction index of 10–15 dB compared with 35–40 dB for thermally insulating double glazing (BSI, 2014b). Measures to improve acoustic performance include:

— the use of acoustic baffles
— siting the opening windows on a quiet side of a building
— the use of acoustic ventilators (as opposed to windows)
— placing buffer zones (e.g. a circulation space) adjacent to the noise source.

As well as the ingress of external noise, consideration also needs to be given to internal acoustic design issues including:

— conflict between partitioning for acoustic privacy and provision of air paths
— that exposed thermal mass increases the number of hard surfaces (see section 2.4.2.4).

Solutions include perforated sound-absorbing tiles and acoustic baffles. Acoustics is dealt with in detail in section 2.5.2.

Climate variability

In both the long and short term, local climate will vary. It is therefore important that the ventilation design takes this into account. In particular, wind and temperature will vary on an hourly basis thus there could be as many as 8760 combinations of driving force in a year. Although rationalisation is possible by taking into account prevailing winds and typical temperature ranges, extreme conditions also need to be considered. Simple calculation methods are useful for performing multiple calculations but they may not have the accuracy of more time-consuming complex methods. Weather sequences must also take into account climate trends.

Flexibility

Flexibility should be provided to cope with changing occupant requirements over the life of the building. Systems can be designed to be capable of relatively simple upgrading (and downgrading) so that extra cooling systems can be added when and where required. Contingency planning is required at the design stage to provide:

— space for any subsequent installation of additional equipment
— sufficient floor-to-soffit height to enable additional servicing to be routed through floor or ceiling voids
— breakout floor zones that could form future service risers.

Multiple occupied spaces

Problems may arise if a single opening is required to provide ventilation for a group of occupants. This can be minimised if the window unit has high- and low-level openings for independent control by occupants internally and at the perimeter respectively. This may require actuators on the high-level openings operated by a remote controller (that could also be used as part of an automatically controlled night-cooling regime).

Intuitive manual control will not necessarily lead to windows or ventilators being opened at the optimum time of day. The instinctive reaction is to open windows to increase ventilation as indoor temperatures increase later in the day, whereas higher ventilation rates may be more beneficial earlier in the day, when ambient temperatures are lower.

Night cooling

If night cooling is under manual control, windows will either be closed or left open for all the unoccupied hours resulting in either:

— inadequate pre-cooling, with overheating the following afternoon, or
— overcooling, with cold discomfort problems the next day (or a need for heating).

These problems can be avoided by some form of automatic control of window or ventilator opening or by provision of a separate mechanical night ventilation system (see section 2.3.6 on controls).

Security

If a ventilation strategy relies on opening windows (especially if they are left open overnight for night ventilation), particular thought needs to be given to the security implications. Movement of ventilation openings at night and entry of birds through openings can cause problems with movement detection security systems. Stacks and wind-tower configurations, combined with controlled mechanical vents, provide a more satisfactory means for providing night ventilation because they can offer weather and intruder protection and can be kept under a constant control regime

Rain

The large ventilation openings that may be needed to deliver the required airflow should be designed to avoid rain entering the building, taking account of the effects of driving wind, splashing etc.. Particular thought needs to be given to ventilators left unattended during night ventilation.

Fire safety

The ventilation strategy must comply with fire and smoke regulations. More details are presented in section 2.5.3. Solutions include zoning and the use of intumescent vents. See BS 9999: 2008: *Code of practice for fire safety in the design, management and use of buildings* (BSI, 2008a), Part B of the Building Regulations (NBS, 2013g) and RRFSO (TSO, 2005).

2.4.3 Mechanical ventilation design

2.4.3.1 Introduction

Decisions relating to mechanical ventilation must take into account many aspects including:

— system size (fresh air and recirculation capacities)
— system type (displacement and mixing)
— requirements of individual zones
— room air distribution system design
— location of exhaust terminals
— installation configuration (incorporation of ductwork)
— filtration design
— integration with heating and cooling plant.

These design aspects are summarised in this section.

2.4.3.2 System size

Ultimately the system must be sized to meet the fresh air requirements for the intended number of occupants (see section 2.2.3). Also it must be sized (and designed) to ensure that process pollution or pollution from any other sources is maintained at a safe concentration. In a building without mechanical cooling the ventilation system must provide sufficient fresh air ventilation for cooling purposes (see section 2.2.4). Where space heating and cooling is provided by the ventilation system the additional recirculation air also needs to be determined

2.4.3.3 System type

An early decision needs to be made about the type of mechanical system. This includes choosing between displacement and mixing ventilation (section 2.2.8) as well as the choice of heating and cooling system.

2.4.3.4 Requirements of each zone

Individual zones will need to be separately sized to meet requirements. Plans for adaptation are also necessary to cope with any subsequent redesign of the building layout

2.4.3.5 Room air distribution system design

Room air diffusion: criteria for design

Air diffusion is the main interface between the system and the occupants. If the air diffusion is not well designed the system will fail, no matter how accurately building loads have been modelled and how carefully the plant and equipment have been selected.

The effectiveness of all ventilation and air-conditioning systems depends on the method by which supply air is introduced to, and vitiated air removed from, the space. The parameters that influence the quality of the air at any point in the room are:

— air supply velocity
— temperature differential between the room and supply air
— quality of the supply air
— position of the air supply terminals
— room shape and geometry, including projections
— position, size, and shape of all sources and sinks for heat and contaminants
— temperature of any heat sources and sinks
— rates of evolution and sorption of contaminants
— other factors influencing air movement, such as movement of the occupants and machinery, and air infiltration.

As discussed later, if terminal devices are poorly selected or positioned this can result in draughts, stagnation, poor air quality, inappropriate mixing, large temperature gradients and unwanted noise. The terminal type and layout may be affected by architectural or structural considerations, but conversely particular room air diffusion requirements should form part of the integrated/co-ordinated building design and/or structure (e.g. floor supply).

The occupants' perception of the effectiveness of the system will normally be determined by:

— the velocity of air adjacent to any uncovered or lightly covered skin (e.g. neck and ankles)
— temperature of airstream in relation to that of still air adjacent to other parts of the body
— the level of activity taking place
— the occupants' clothing
— the quality of air in the breathing zone
— the individual's susceptibility and acclimatisation
— the appearance and positioning of any ventilation devices or openings
— the noise emitted.

The above are discussed in detail in section 1.4 of CIBSE Guide A (2015a).

BS EN ISO 7730: 2005 (BSI, 2005a) recommends that, during cooling, the mean air velocity should be less than 0.25 $m \cdot s^{-1}$ for moderate thermal environments with light, mainly sedentary, activity and that, in winter, it should be less than 0.15 $m \cdot s^{-1}$. No minimum velocity is suggested, although stagnant zones could result in temperature gradients between the ankle and the neck greater than the 3 K recommended. It is likely that sufficient air movement will be generated by other means.

The occupied zone can be defined as a region, the outer limits of which are described by an envelope 1.8 m from the floor and 0.15 m from the walls. However, in the case of low-level supply terminals, the occupied zone is any region where the occupants are likely to linger for significant periods. In the case of desk terminals, this definition does not apply. For desk terminals, mixing occurs over the desk surface and for seatback terminals, mixing occurs in the regions above and between the seats.

An assessment of predicted percentage dissatisfied (PPD) (BSI, 2005a) for a wide range of activity levels, clothing,

body temperatures and velocities shows that, even at low activity levels, velocities as high as 1.0 m·s^{-1} can be acceptable in offsetting high temperatures. This technique has been applied to the concept of spot cooling in some industrial applications (Hwang *et al.*, 1984) whereby heat stress in the workers is avoided by keeping the local conditions below an agreed value of wet-bulb globe temperature.

Air terminal phenomena

Many studies of jets and their effect on room air movement have been undertaken. A detailed account and review is presented by Awbi (2003). Figure 2.27 shows the predicted airflow patterns for various types and positions of air terminal device (ASHRAE, 2009).

It should be noted that these patterns are based on stylised terminals. For predictions of air movement appropriate to specific air terminals the manufacturers' data must be consulted. For non-standard situations it may be necessary to model room air movement using a mock up. In many cases it will be necessary to allow for on-site adjustment of airflow pattern, either during commissioning or operation by the occupant (e.g. desk-mounted terminals).

Air diffusion terminology

BS EN 12792 (BSI, 2003) gives definitions and standard terminology used in connection with air movement. Some of the more important parameters are listed below.

Throw

A free jet having a given momentum on discharge will establish velocity profiles known as isovels, the shape of which depends on the geometry of the terminal, the temperature of the jet and any other disturbing influences. The velocity decays with increasing distance from the terminal. Throw is defined as the distance from the terminal (measured perpendicular or parallel to the face of the air terminal device depending on the predominant direction of flow) to the 0.5 m·s^{-1} isovel.

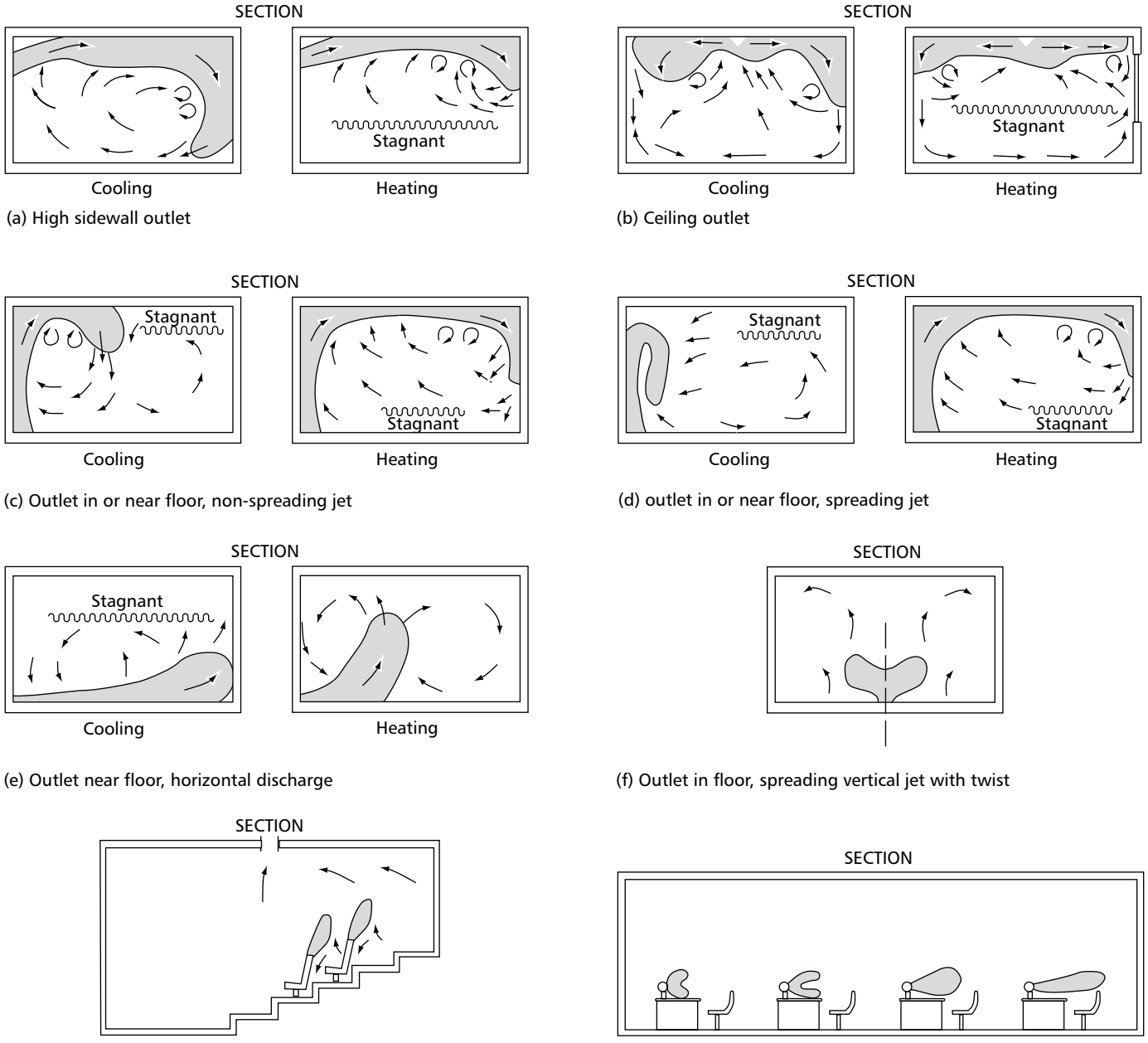


Figure 2.27 Predicted airflow patterns (adapted from ASHRAE, 2009)

Normally lower velocities are required for air entering the occupied zone, typically 0.25 m·s^{-1} for cooling, 0.15 m·s^{-1} for heating. Reference should be made to manufacturers' literature for throw data and recommended mounting distances from solid surfaces and neighbouring terminals.

The maximum throw for an air terminal device depends upon the characteristics of the device, the mounting height and the influence of neighbouring devices.

Spread

The spread of a horizontal jet is defined as the width of the 0.5 m·s^{-1} isovel. Note that most manufacturers give the width of the 0.25 m·s^{-1} isovel, which is generally of more use to the designer.

Drop

The drop is defined as the vertical distance from the centre-line of the terminal to the bottom edge of the 0.25 m·s^{-1} isovel.

Entrainment, mixing and boundaries

Frictional forces cause a momentum transfer to take place between the jet and adjacent room air, which draws the room air in the same direction as the jet. The jet expands with distance from the terminal as it entrains adjacent room air. Hence kinetic energy is expended in creating turbulence, which transfers thermal energy and assists the dilution of contaminants. This process of diffusion may be enhanced by the introduction of a rapidly expanding jet and still further by imparting a swirling motion to the jet.

A jet that is constrained by the walls of a room, such as a full width slot, will entrain less room air and expand more slowly than a free conical jet (Awbi, 2003).

Effect of temperature differential

Figure 2.27 above shows that a jet that is not influenced by the proximity of a solid surface follows a path that is a function both of velocity and temperature. A warm jet tends to rise until it attaches itself to a horizontal surface, whilst a cold jet falls. Care must be taken to ensure that this does not lead to unacceptable temperature gradients in the occupied zone during heating and excessive air velocities during cooling. The terminal must be mounted such that the 0.25 m·s^{-1} isovel does not enter the occupied zone.

The difference in temperature between the supply and return air may be greater than that between the supply air and the occupied zone, particularly with a low-level supply designed to encourage high-level stratification. This temperature difference is related to sensible heat gain and supply air mass flow, as follows:

$$q_s = m\, C_{ph}\, \Delta T \qquad (2.15)$$

where q_s is the total sensible heat gain (kW), m is the mass flow rate of supply air (kg·s^{-1}), C_{ph} is the specific heat of the air and water vapour mixture (kJ·kg^{-1}·K^{-1}) and ΔT is the room air to supply air temperature differential (K).

Therefore the mass flow rate, and hence the cost of air handling, will depend upon the temperature difference chosen by the designer. This decision will also be influenced by the evaporator temperature and the level of control of humidity. For example, a displacement system with low-level input can supply air at 18 °C with a temperature difference of about 10 K. This can be achieved with high evaporator temperatures and correspondingly low compressor power. However, high-level humidity control will suffer unless the supply air is overcooled and reheated, normally an undesirable combination at peak load. Alternatively, a permanent bypass around the cooling coil can be provided and, if motorised dampers are incorporated at the coil face and in the bypass, part load control supply temperature can be achieved by damper modulation.

For comfort applications, air change rates are unlikely to exceed 10 ACH, corresponding to a cooling temperature differential of 8–12 K. A free horizontal jet from a rectangular grille is likely to create down draughts if providing more than 8 ACH with a cooling temperature differential greater than 8 K.

A maximum cooling differential of 10 K can be applied when either:

— the presence of the Coanda effect (see below) is assured, or

— for a free jet, mixing of supply air with room air outside the occupied zone can be assured without promoting discomfort.

Table 2.26 gives general guidance on the maximum air change rates that can be achieved using various air terminal devices supplying air with a cooling temperature differential of 10 K.

If sufficient mixing between terminal and occupants cannot be guaranteed (e.g. with low-level supply) then the minimum supply temperature of 18 °C applies, with a temperature differential in the occupied zone of 4–5 K. However, the cooling temperature differential is ultimately determined by the maximum exhaust air temperature (Sodec, 1984) (see Table 2.27).

The larger temperature differential indicated for high ceilings is possible due to the smaller influence of ceiling temperature on the mean radiant temperature experienced by the occupants.

Downward discharge is generally only satisfactory for very high air change rates, and hence small temperature differentials, or where room convection is not significant (see below). An exception is the specific case of split air-conditioning systems, where temperature differences can be as high as 20 K. Particular care is therefore needed in their specification, see CIBSE Guide B, Chapter 3 on air conditioning.

High-level supply jets must overcome the buoyancy forces in the room air generated by heat emitters, solar gain, occupants etc., whereas low-level input cultivates these forces to assist the supply jet. For this reason, low-level supply is most satisfactory for applications with high room gains and high ceilings. For low ceilings the radiant heating effect of the ceiling itself may be significant. This may also be a problem where the ceiling void is used as an exhaust air plenum, carrying air heated by air-handling luminaires.

Table 2.26 Typical maximum air change rates for air terminal devices

Device	Air change rate / h^{-1}
Side-wall grilles	8
Linear grilles	10
Slot and linear diffusers	15
Rectangular diffusers	15
Perforated diffusers	15
Circular diffusers	20
Swirl diffusers	20-30

Table 2.27 Typical cooling temperature differentials for various applications

Application	Maximum temp. differential / K
High ceiling (large heat gains/ low-level input)	12
Low ceiling (air handling luminaires/low-level input)	10
Low ceiling (downward discharge)	5

Free descending jets are not recommended for normal use, since the low velocity approaching the occupied zone would cause instability. This could result in localised high velocities due to deflection by convective forces elsewhere in the room (see Figure 2.28). An exception is the case of laminar downflow cleanrooms (BS EN ISO 14644 (BSI, 1999–2013)) where an even velocity across the full area of 0.4 $m \cdot s^{-1}$ should be maintained from ceiling to floor. However, even in these circumstances, sources of extremely buoyant upflow should be avoided.

Coanda effect

When a jet is discharged from a terminal device adjacent and parallel to an unobstructed flat surface, the jet entrains air from one side only resulting in deflection of the axis of the jet towards the surface. This phenomenon, known as the Coanda effect, is due to frictional losses between the jet and the surface.

The effect diminishes with distance from the terminals as increasing volumes of air are entrained from the room-side of the jet, resulting in a reduction of jet velocity. However, the Coanda effect is maintained despite temperature differences between the jet and the room air. It is a critical factor influencing the selection and positioning of supply air terminals, particularly for rooms with low ceilings, which have little space above the occupied zone in which mixing can occur.

If the Coanda effect is not present the maximum throw for any terminal is reduced by approximately 33 per cent. The main factors that influence whether or not the Coanda effect will occur are:

— the distance between terminal and surface

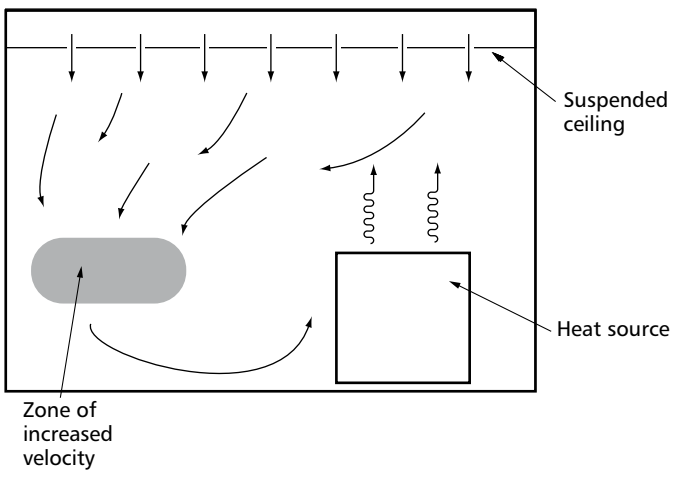


Figure 2.28 Effect of room convection currents

— the width of jet exposed to surface

— the velocity of the jet

— the presence of projections and other disturbing influences.

The importance of these influences for side-wall terminals with various aspect ratios, velocities and temperature differences is discussed elsewhere (Awbi, 2003). The most important factor is temperature difference, i.e. buoyancy effects. For the usual range of temperature differences for cooling of 8–12 K, the opening should be within 300 mm of the surface to guarantee attraction. For systems designed to make use of the Coanda effect, provision should be made for on-site adjustment of the jet.

When a jet adheres to a surface, dust particles will be deposited on the surface leading to staining, hence supply air cleanliness is of paramount importance. Cleanliness of the exhaust air is difficult to control and some staining of surfaces near to exhaust openings is inevitable.

Techniques exist (Awbi, 2003) for predicting the influence of projections, such as downstand beams and surface-mounted luminaires, on a jet flowing across an otherwise smooth surface. An obstruction may cause the jet to separate completely from the surface, hence destroying the Coanda effect, or it may separate and join some distance downstream of the obstruction.

The critical distances at which these phenomena are likely to occur depend on the depth and shape of the obstruction and size of the supply opening. The influence of supply air to room air temperature differential is small but depends upon the extent to which mixing has occurred before the jet meets the obstruction.

Figure 2.29 shows the effect of a horizontal surface on a jet rising close to the vertical surface. The Coanda effect is maintained after the change in direction provided that the velocity is adequate, particularly in the case of cooling jets, and that the temperature differential between supply and room air is not too large. Guidance for selecting optimum supply velocities and temperature is given elsewhere (Awbi, 2003).

Interaction between jets

Figure 2.30(a) shows possible room air velocity patterns for two jets directed towards each other along a 3 m high ceiling. The individual velocities of the two airstreams must not be greater than 0.25 $m \cdot s^{-1}$ at the boundary otherwise discomfort may occur due to excessive down-draughts.

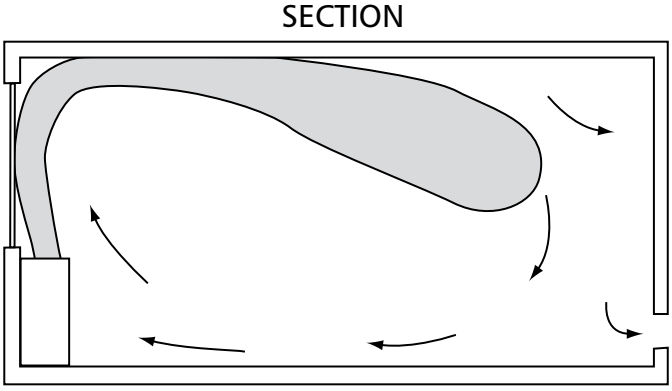


Figure 2.29 Effect of horizontal surface on a jet

The envelopes of two converging jets may also interfere with each other, combining to form a single, wide jet with a maximum velocity at the new axis between the two jets (see Figure 2.30(b)). A similar phenomenon occurs with two jets moving in tandem (see Figure 2.30(c)). The downstream jet entrains and accelerates the decaying upstream jet and forms a wider jet with an axis further from the neighbouring surface. The cumulative effect of a series of single-way jets can result in a deep jet that intrudes into the occupied zone resulting in unacceptably high room velocities.

Figure 2.31 shows examples of possible layouts for ceiling diffusers. The main problems likely to be encountered are those described above. Down-draughts may be encountered in areas marked 'X' and this problem may be eliminated by avoiding terminals with excessive throw, particularly in large spaces where stagnation between terminals is unlikely to occur. The layout shown in Figure 2.30(c) may cause convergence problems with long rooms.

For side-wall applications, the spacing of diffusers should be in accordance with manufacturers' recommendations. However, in the absence of such recommendations, Table 2.28 may be used in conjunction with throw and deflection data to determine the diffuser spacing. For a terminal mounted close to a wall, spacing should be halved to give the minimum distance from the centreline to the wall. Table 2.29 (Sodec, 1984) indicates typical turndown limits for various types of fixed air terminal device.

2.4.3.6 Location of exhaust terminals

The positioning of the opening has little influence on the airflow pattern in the space because the zone of localised high velocities associated with exhaust openings is very close to the opening.

Exhaust terminals may be sited to advantage:

— in a stagnant zone where supply jet influence is limited

— close to a source of unwanted heat and/or contamination, e.g. above a luminaire

— close to an excessively cold surface to increase its surface temperature and thereby reduce radiant losses and cold draughts

— at a point of local low pressure, e.g. the centre of a ceiling diffuser.

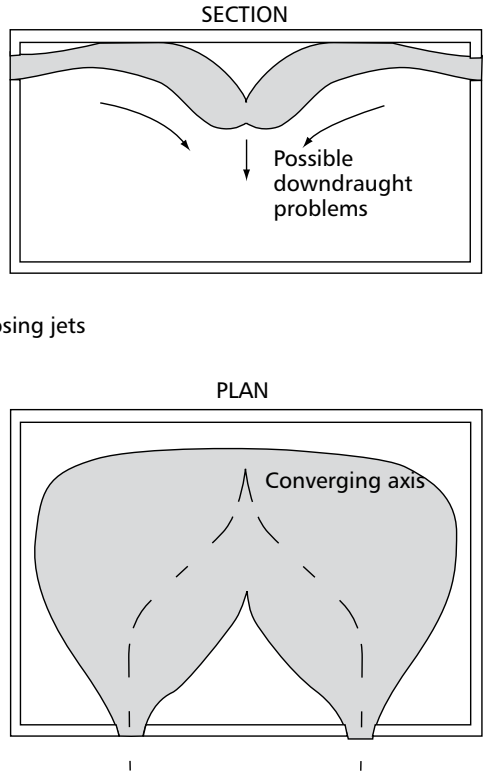


Figure 2.30 Room air velocity patterns; interaction between jets

Positions that should be avoided are:

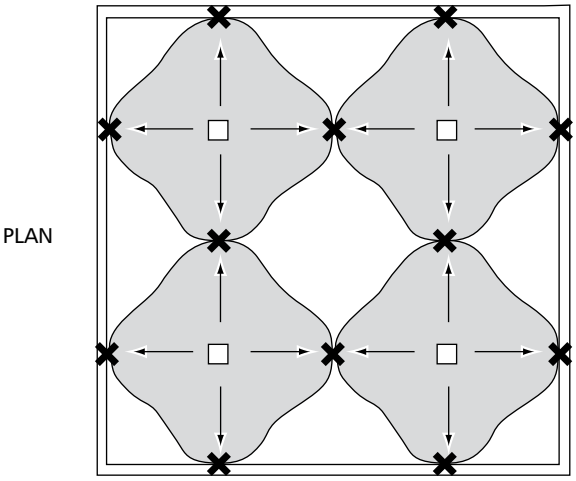
— within the zone of influence of a supply air terminal since this allows conditioned air to pass directly to exhaust without first having exchanged heat with its surroundings; this results in very low ventilation efficiency

— close to a door or aperture that is frequently opened since this leads to the exhaust handling air from outside the conditioned space

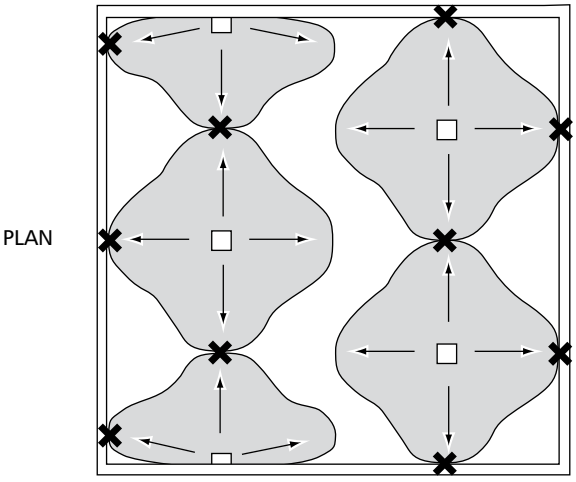
— in a position that causes contaminated room air to be drawn through the occupants' breathing zone.

2.4.3.7 Installation configuration: incorporation of ductwork

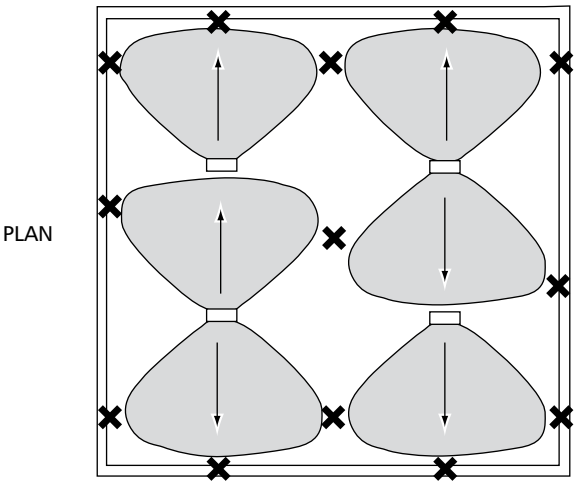
Considerations of layout are discussed in section 2.3.5.2. Ductwork is covered more generally in sections 2.3.5, 2.4.5 and 2.6.7.



(a) Four-way ceiling diffusers, symmetrical layout



(b) Four-way ceiling diffusers, off-set layout



(c) One-and two-way ceiling diffusers, contra-flow layout

Figure 2.31 Supply terminal layouts for open plan spaces

Further information on spatial allowance for ductwork is available from Design and Maintenance Guide 08: *Space requirements for plant access, operation and maintenance* (DEO, 1996), BSRIA TN 10/92: *Spatial Allowances for Building Services Distribution Systems* (1992) and BS 8313: 1997: *Code of practice for accommodation of building services in ducts* (BSI, 1997).

Table 2.28 Data for determining spacing of ceiling diffusers

Deflection / deg.	Spacing / m	
0	0.20 L_x	0.33 L_y
22.5	0.25 L_x	0.50 L_y
45	0.30 L_x	1.0 L_y

Note: L_x = throw (m) where axial velocity has decayed to 0.25 m·s^{-1}; L_y = throw (m) where axial velocity has decayed to 0.5 m·s^{-1}

Table 2.29 Turndown limits for types of fixed air terminal device (Sodec, 1984)

Type of outlet	Maximum turndown/%
Ceiling mounted:	
— not using Coanda effect	50
— using Coanda effect	40
Floor mounted outlets:	
— perforated plate and fixed bar grille	60
— free jet outlets	50
— outlets with swirl	40
Desk outlets:	
— linear type	50
— ball type	50
— outlets with swirl	40

2.4.4 Mixed-mode ventilation design

2.4.4.1 Introduction

Mixed-mode ventilation will incorporate both natural and mechanical design requirements and therefore it is important to refer to the previous two sections. In the case of the mixed-mode approach, however, dominance often falls on natural ventilation with the mechanical systems being as simplified as possible. In the design of a mixed-mode system the issues described in this section also need to be considered.

2.4.4.2 General design issues

The range of circumstances encompassed by the term 'mixed-mode' system is extremely broad. It encompasses, for example, a building that is almost entirely naturally ventilated except for areas of high heat or moisture production served by mechanical systems, to one that is entirely served by air conditioning with the intention that this might in the future be converted to natural ventilation. Hence the guidance provided here must be considered in the light of the specific strategy, or its derivative, as determined in section 2.3.2.4. Furthermore, this section cannot be treated in isolation but read in conjunction with sections 2.4.2, 2.4.3 and CIBSE Guide B3 (CIBSE, 2016a), which consider the principles of the individual operating modes.

Building fabric

Mixed-mode is a term describing servicing systems that combine natural ventilation with any combination of mechanical ventilation, cooling or humidification in a strategic manner. In common with buildings that are solely naturally ventilated, this approach requires that benefit be obtained from the building fabric.

The presence of mechanical systems means that a balance needs to be drawn, using value engineering principles, between investment in the relatively long-lived fabric and expenditure on the shorter-lived (and easier to modify/replace) building services, components of which can subsequently be added when and where necessary.

Although the building services in a mixed-mode system should usually cost less than in a fully mechanically serviced building, some additional investment may be needed to improve their efficiency, responsiveness, control and adaptability. The initial cost of the mechanical services and the openable windows or vents combined can be greater than that for a sealed building.

Obviously, the greatest economies are made if the improvements to the fabric allow the building services system to be completely eliminated from part or all of the building. For example, reducing fabric and internal heat gains may allow mechanical cooling to be avoided. A highly insulated and airtight fabric with low-powered mechanical ventilation (and heat recovery) may allow both mechanical refrigeration and perimeter heating to be avoided. The effective use of external night-time temperature differentials can permit any excess heat built up during the day to be removed at night, using natural and/or mechanical ventilation, thereby reducing or eliminating the need for mechanical cooling during the daytime (see 'Night cooling' in section 2.4.2.6) and see CIBSE Guide B, Chapter 3 on air conditioning.

In the particular case of zoned systems, a consideration may be to introduce 'localised' fabric enhancements to reduce heat gain, e.g. additional treatment of the roof fabric to ameliorate solar heat gains or additional solar shading of selected windows. A further option might be to introduce 'assisted passive' measures before employing full mechanical systems. This might take the form of a fan in selected natural ventilation 'stacks' for use under peak conditions or on days when inadequate external forces are available or possibly simple desk fans.

Combining natural and mechanical systems effectively

Within complementary systems, the balance between the operation of the natural and mechanical system elements needs to be optimised. This requires a 'trade off' between the extent of passive and active features, for example the number and location of the openable windows will depend upon the extent of mechanical ventilation. The processes by which this balance can be achieved are given in CIBSE AM13: *Mixed mode ventilation* (2000a).

In the case of zoned systems, it requires an understanding of the problem areas that will require mechanical assistance. These might include:

— zones facing inferior environmental conditions, such as top floors, corner rooms, internal areas, areas local to non-openable façades, or areas where partitioning inhibits bulk air movements

— toilet areas

— areas where heat- or odour-producing equipment is located such as areas containing photocopiers or drinks machines, tea rooms or cleaners' cupboards

— restaurants or kitchens

— areas with dense occupation or high equipment heat loads that may require comfort cooling or close-control air conditioning such as meeting rooms, electronic data processing rooms, dealer rooms etc.

— atria.

Flexibility

Flexibility is of particular concern with contingency systems where future change is taken into account. This requires the provision of a building fabric with a stated indoor environment control performance and a defined strategy for subsequent adaptation through the addition and omission of either centralised or localised supplementary mechanical systems. The extent to which systems are initially installed, or allowance made for them, will depend upon the context but the decision must be taken in the light of the ease and speed of subsequent installation and the likely extent of upgrades, sub-tenancies, or critical areas.

Plant rooms

It may be possible to include space for plant rooms that can be put to alternate use until it is required for ventilation or cooling purposes, for example as storage or car parking. External flat roof and undercroft locations may also be suitable. Plant room locations should preferably allow mechanical plant containers to be installed. A further option is prefabricated plant rooms that can be obtained on hire and 'plugged in' with minimum site disruption. These can subsequently be disconnected for reuse elsewhere when a tenancy terminates.

Distribution routes

The availability of space for routing services to and around individual rooms often determines the overall level of flexibility. The recommended heights of exposed ceiling soffit slabs to facilitate natural ventilation can often provide adequate space for a future suspended ceiling void or bulkhead, capable of accommodating a wide range of HVAC systems. A suspended floor may also allow direct expansion, chilled water and condensate pipes to be routed to any potential 'hotspot'. With appropriate initial sizing the floor void also has the potential to become a floor supply plenum, from which rooms or larger areas can be supplied with air.

It is important to ensure continuity of the routes between the various parts of the system. A clear route without constrictions is needed from the spaces designated for main plant, via the risers, to the tertiary run-outs. Care should be taken to avoid inadequate space for connection between risers and the floors they are to serve.

Room must be given for the installation of fire dampers at compartment boundaries. This should also allow for access for maintenance. See notes on fire safety in 'Fire issues' in section 2.3.5.2 if fire doors are to be used as part of the route.

Choice of HVAC system

The choice of HVAC system will depend upon the client's functional requirements (see section 2.2.1). In the case of

zoned or contingency systems the choice between freestanding or centralised systems is dependent upon:

— the size and distribution of the zones to be treated

— planning restrictions on the use of the façade

— the availability of space for logical horizontal and vertical distribution routes.

2.4.4.3 Energy-efficient operation of mixed-mode systems

The principles for achieving energy-efficient operation in mixed-mode systems are a combination of those applied to buildings operating in either natural or mechanical ventilation modes. Prioritisation of these principles depends upon the extent to which mechanical systems for ventilation, cooling or humidification have been installed.

Additionally, consideration needs to be given to the following points.

— Mechanical systems should be used only when and where required. The specific fan power increases with air change rate. Furthermore, as the air change rate increases, the occupants are more likely to notice the difference between when the system is operating and when it is not. This may reinforce the tendency for it to be left running unnecessarily. The use of zoned mixed-mode systems helps to overcome the need for whole systems having to operate in order to service small demands.

— Natural and mechanical systems should not conflict in their operation, e.g. mechanical systems competing with air coming in through the windows, or simultaneous humidification and dehumidification. Such situations can be reduced through making users aware of the rationale behind the operation of the system and having suitable trigger points for changeover operation. The state and performance of the system should be monitored and system conflicts reported.

— Systems should not default to a non-optimal state, e.g. switched on when they could be switched off or, at least, operating at reduced output. This risk can be minimised by avoiding over-complex design.

2.4.4.4 Control

The control strategy for mixed-mode systems is context dependent, but aims overall for energy-efficient operation, maximum staff satisfaction and ease of building management. This is achieved through:

— maximisation of the natural operating mode

— integration of natural and mechanical systems to avoid system conflicts, wasteful operation and discomfort

— simple and effective control for occupants that is non-presumptive

— simple and effective controls for the building management that are easy to commission and operate on occupation of the building.

The general principles of a good control strategy are given in section 2.3.6.

2.4.4.5 Performance assessment

Some aspects of mixed-mode design may be difficult to resolve or to optimise using normal calculation methods and rules of thumb. More detailed simulation may be desirable in:

— appraising options

— developing new concepts and testing their robustness under all foreseeable conditions

— demonstrating the capabilities of an option to clients

— refining a chosen approach.

Appendix 2.A6 considers the techniques of dynamic thermal simulation and air movement analysis. In applying them specifically to mixed-mode systems the designer must consider:

— the full variety of potential (often overlapping) operational modes and control variables

— the trigger points for each control strategy element

— the potential actions of occupants

— uncertainty concerning the actual operation of the building compared with the intent and the consequent robustness of the solution

— possible differences between parts of the building and areas of particularly demanding localised conditions that place particular demands on the ventilation system

— possible adverse interactions between adjacent zones in different operating modes

— possible adverse effects of facilities designed for one mode and operating in another, e.g. facilities designed for summertime ventilation and cooling may not work well in cold weather, possibly leading to draughts or excessive heat losses.

The selection of appropriate weather data and treatment of heavyweight buildings within thermal models is discussed in Appendix 2.A6.

2.4.5 Ductwork principles of design

2.4.5.1 General

General background information on this topic is provided in section 2.3.5.2. Design is concerned with duct layout, sizing minimising pressure loss and fire safety. For further fire safety information see section 2.5.3.3.

2.4.5.2 Duct layout

In most installations, the constraints imposed by the building or other structures (e.g. single or multiple plant rooms, split systems based on tenancy arrangements etc.), and the siting of fans, plant items and terminals, can lead to the adoption of an overall duct layout that is not ideal. Room must be given for the installation of fire dampers at compartment boundaries. This should also allow for access for maintenance

Considerations of duct layout design are discussed in detail section 3.5.2.

2.4.5.3 Spatial requirements

Provision of sufficient space for ductwork is essential and must be addressed at an early stage in the design process of the building.

Laying out the space required for ductwork is, to an extent, an amalgam of experience, skill and three-dimensional visualisation. Adequate space must be provided for installation and maintenance of the ductwork and associated equipment such as fire dampers at compartment boundaries. The designer should ensure that ductwork is co-ordinated with the other engineering services to be accommodated in the same space, particularly in false ceiling voids and riser spaces where there may be several distribution systems vying for restricted space. Developments in building information modelling (BIM) (ASHRAE, 2013) should be considered for this type of task.

Branches from vertical risers to serve horizontal distribution routes should be considered with care, as this is likely to be the most congested area of the service core. If the service core is enclosed on three sides (e.g. by a lift shaft and an external wall) the horizontal distribution from the core will be extremely difficult, with little space for installation and maintenance.

The area served by a single riser will dictate the size of the horizontal branch duct. The depth selected for a branch duct will have a significant influence on the false ceiling or raised floor depth. It will also affect the overall floor-to-floor heights and hence have significant influence on building costs.

The depth of the horizontal element is a function of the number of vertical risers, generally:

— maximum number of vertical risers equates to minimum horizontal element depth

— minimum number of vertical risers equates to maximum horizontal element depth.

Adequate space must be allowed around ducts for fitting of insulation, hangers and supports during installation and for access during subsequent maintenance. Access will also be dependent on the clearance from adjacent objects such as structural items and the type of jointing method.

Suitable allowances are given in Appendix 2.A2, which also shows examples of common problems associated with ductwork access.

Ductwork clearances can be reduced with care, providing jointing, insulation and maintenance of any vapour barrier is achieved. Consideration should also be given to how the ductwork will be tested and how it will eventually be replaced.

Adequate space shall be allowed at compartment boundaries for the installation of fire dampers using a tested installation method. The fire damper installation method to be used should be clearly defined as part of the ductwork/supporting construction design, so that it meets the fire classification of the boundary.

Further information on spatial allowance for ductwork is available from Design and Maintenance Guide 08: *Space requirements for plant access, operation and maintenance* (DEO, 1996), BSRIA TN 10/92: *Spatial Allowances for Building Services Distribution Systems* (1992) and BS 8313: 1997: *Code of practice for accommodation of building services in ducts* (BSI, 1997).

2.4.5.4 Interaction with structure and building form

Because ductwork is likely to be the most space-intensive service provided, it is important that the ductwork design is fully co-ordinated with the design of the building structure to minimise the number of bends and other fittings, each of which will increase the resistance to airflow. This is particularly important for new installations where requirements apply to maximum fan power levels. The structural design may have reached beyond an outline design and shape by the time that ductwork design commences.

Provided they are allowed for early in the design, it is usually possible to accommodate vertical ducts of any desired size without great difficulty from both structural and planning viewpoints. Horizontal ducts present more problems; if they are located between floors, headroom will be restricted and there will be limits on the floor area that a horizontal duct can serve. Early checks should be carried out to ensure that the vertical main ducts enable horizontal distribution without compromising the performance of the installation or the available headroom and that structural members allow branch ducts to leave the main ducts.

Distribution of the engineering services within a building are likely to follow a pattern associated with the main building circulation route that represents the main functional pattern of the building. This may not be the most efficient route for the ductwork. The large space requirements for ductwork mean that it can be desirable to locate plant close to the areas they serve.

This should include space to fit fire dampers that are suitable to any supporting construction used. The requirements of Part B of the Building Regulations (NBS, 2013g) should be followed. Details of fire damper installation methods are given in DW/145: *Guide to Good Practice for the Installation of Fire and Smoke Dampers* (BESA, 2010) and *Fire Dampers (European Standards)* ('the ASFP Grey Book') (ASFP, 2010).

Sufficient space needs to be provided for ease of fitting the ductwork. Providing access for maintenance is also important since it will be expensive to install retrospectively, whether ducts are horizontal or vertical. Space should also be allowed for additions and alterations.

Co-ordination of the engineering services should ensure that the area for removal of access panels and covers and entry into the ductwork is free of services and readily accessible without obstructions.

2.4.5.5 Duct sizing

Background

Duct sizing and pressure loss calculations are normally carried out as a combined exercise to quantify the ductwork dimensions and provide data for specifying the fan duty. The duct sizing process and pressure loss calculations require the specification of system requirements, including:

— system type, i.e. low, medium, high pressure or industrial

— volume flow rates in all parts of the ductwork

— positions of fans, other plant items, supply-and-extract terminals

— special operating requirements, e.g. minimum conveying velocities in extract systems

— ductwork type, i.e. circular, rectangular, flat oval

— layout of the duct runs, including fittings, dampers and plant items

— duct material.

The purpose of duct sizing is (*i*) to determine the cross-sectional dimensions of the various parts of the duct system, and (*ii*) to ensure a balanced system that delivers design conditions. Furthermore the system, fans and other plant items should be:

— economical in installed and operating costs

— compatible with the space limitations imposed by the structure and other services

— sufficiently quiet in operation

— easily regulated after installation to achieve the design airflow at each terminal.

In practice, duct sizing seeks to obtain an economical and practical solution to these objectives by either simplified manual procedures or computer programs. The computer programs can vary in complexity from computerisation of manual procedures to overall design including optimisation, damper settings and noise assessment.

Before commencing duct sizing, a schematic of the air distribution system must be prepared. This should indicate the airflow directions and contain the following information:

— system identification for each section

— air volume flow rates in each section

— the length of all straight sections

— descriptions of fittings, dampers, plant items and terminals.

An example schematic is shown in Figure 2.32.

Approximate sizing

Because ductwork can be large, it will often be necessary to assess the size of individual ductwork in critical locations, particularly where horizontal branches leave the main vertical risers. It is often possible to adjust the size of the vertical space well into the detailed design. Horizontal branches, however, cannot encroach on the necessary headroom.

To make a preliminary estimate of a branch size, calculate the airflow rate required in the area served by multiplying the zone volume by the number of air changes per hour and divide by 3600 to obtain the zone flow rate in $m^3 \cdot s^{-1}$. Two air changes an hour may be appropriate for offices with a separate heating system for fabric losses. Where the air is used for heating, four air changes an hour may be required or six air changes or more for an air-conditioned space. Dividing this flow rate by the velocity given in Tables 2.16 and 2.17 gives the duct cross-sectional area required. For conventional systems, the aspect ratio (long side to short side) of rectangular ducting should not exceed 3:1.

Manual duct sizing method

Simple design methods include:

— velocity method

— constant pressure drop (or equal friction loss) method

— static regain method.

The most common method is based on delivering constant pressure drop per unit length for a duct run, with maximum duct velocities as set out in Tables 2.16 and 2.17 for low-, medium- and high-pressure systems.

These methods are simple procedures that use ductwork data charts to determine duct dimensions. The overall cost effectiveness, ease of system regulation and noise can be taken into account by imposing limits on some of the design parameters. It is recommended that the calculated duct size is rounded to the nearest recommended duct size (see Appendix 2.A1) before the pressure drop calculations are carried out. A brief description of these methods is given below.

Velocity method

This method is based on the selection of duct velocities by the designer using limiting noise generation and/or pressure drop. In a typical system the velocity at the fan connection is chosen and velocities are also chosen for subsequent duct runs with the aim of progressively reducing velocities from the fan to the terminals. Tables 2.16 and 2.17 give some guidance on suitable maximum air velocities. In practice, this is only used on simple layouts or sections of systems, as the procedure depends on experienced but subjective judgements. It is difficult to produce a coherent selection of sizes for a complex layout on this basis. In industrial systems where minimum transport velocities are required this method may be employed more frequently.

Constant pressure drop (equal friction loss) method

The basis for this method is to select a constant pressure loss per unit length for the duct runs and then to size the ducts at this rate using Figure 2.33 below. This method is used for sizing very simple low-pressure supply-and-extract systems, some medium-pressure systems and also for VAV systems. For low-pressure systems, typical values used for the constant pressure loss rate are in the range 0.8–1.2 $Pa \cdot m^{-1}$ with duct velocities not exceeding 10 $m \cdot s^{-1}$. At large volume

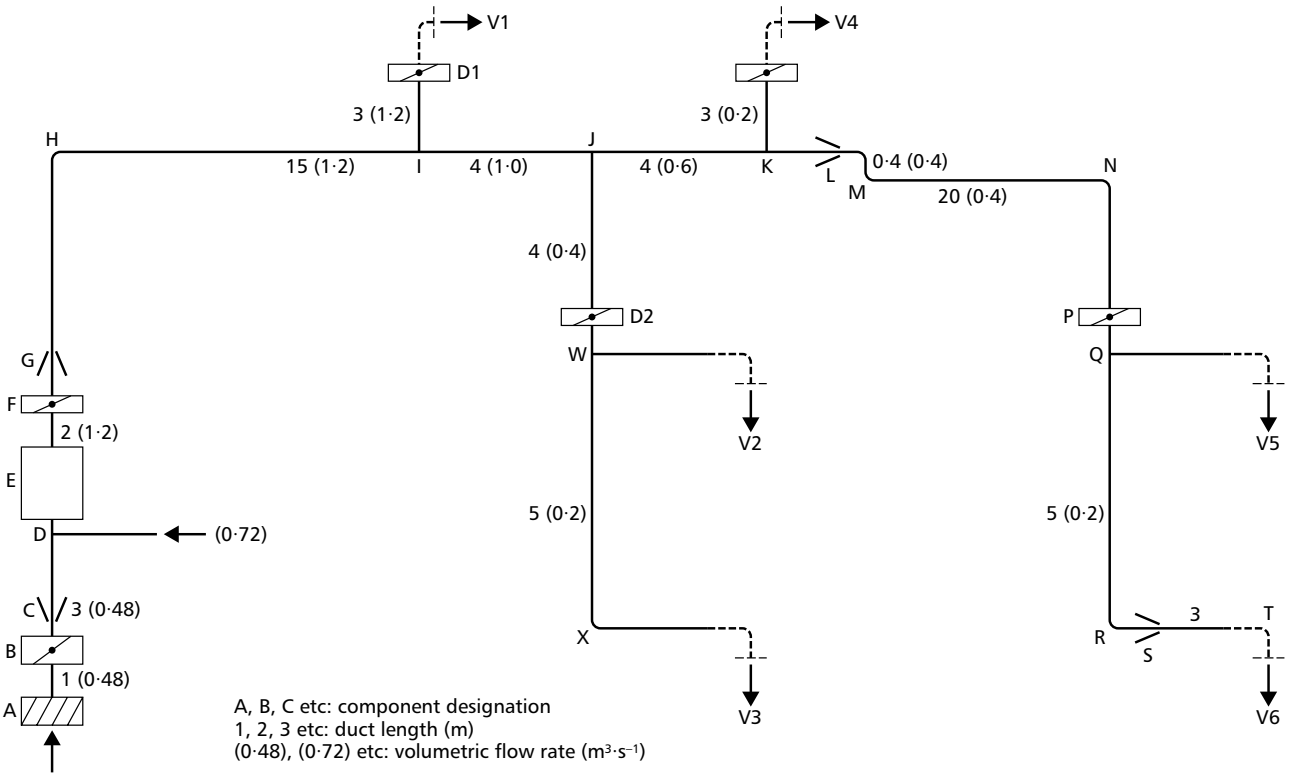


Figure 2.32 Example schematic of ductwork layout, showing lengths (m) and flow rates ($m^3 \cdot s^{-1}$) (see Appendix 2.A5 for calculation procedure)

flow rates in low-pressure systems the 10 $m \cdot s^{-1}$ duct velocity limit should override the constant pressure loss rate chosen, leading to somewhat lower pressure loss rates in the large ducts.

The sizing process involves:

— the selection and use of a vertical constant pressure loss line in Figure 2.33, appropriate to the design requirement

— reading off the circular duct diameter for the actual volume flow rate

— if a rectangular or flat oval duct is required, taking the dimensions from Tables 2.A1.1 or 2.A1.2 (see Appendix 2.A1), as appropriate, for the equivalent circular diameter.

The friction loss method gives a reducing velocity from the fan to the terminals. Adopting different pressure loss rates for the individual branches of a system can be used to produce a more nearly equal resistance to each duct run and so assist balancing the system. This modification can be introduced during the pressure loss calculation.

Initially, all parts of the system should be sized to the same pressure loss rate and the adjustments to individual branch sizes only carried out after the pressure losses in the initial system design have been computed. These adjustments are most quickly and conveniently carried out by computer.

Static regain method

When the velocity in a duct is reduced without excessive losses occurring, the static pressure increases. In high-pressure systems, this increase can be significant and is the basis for the static regain duct-sizing method. The principle is to size ducts between branch take-offs so that the recovery in static pressure after one branch take-off due to reduction in velocity is equal to the static pressure loss due to friction and fittings in the subsequent duct run. The method seeks to equalise the static pressures at the branch take-offs, and where these take-offs serve high-pressure terminals an inherently balanced system can be achieved.

The static regain method is used primarily for those parts of a high-pressure system where the initial duct velocity pressure is sufficient to give static pressure regain without unnecessarily low duct velocities at the end of the run. In practice, only the duct mains serving multiple terminal branches are sized by this method, while the smaller branches to terminals are sized by the equal friction method (see 'Constant pressure drop (equal friction loss) method' above) to minimise their size and cost. High-pressure terminals on the same system normally all have roughly the same pressure loss. If this value is high compared with the branch duct pressure loss, then variations in the latter between different branches arising from the use of the equal friction sizing method will not significantly unbalance the system. The static regain method uses duct static pressure losses rather than total pressure losses in the sizing procedure.

The static regain is due to the drop in velocity pressure. However it must be emphasised that there is still a drop in total pressure Δp_t, due to friction. For the branch shown in Figure 2.34, subscript 'c' denotes 'combined' flow, subscript 'b' denotes 'branch' flow and subscript 's' denotes 'straight' flow.

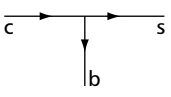


Figure 2.34 Schematic of duct branch

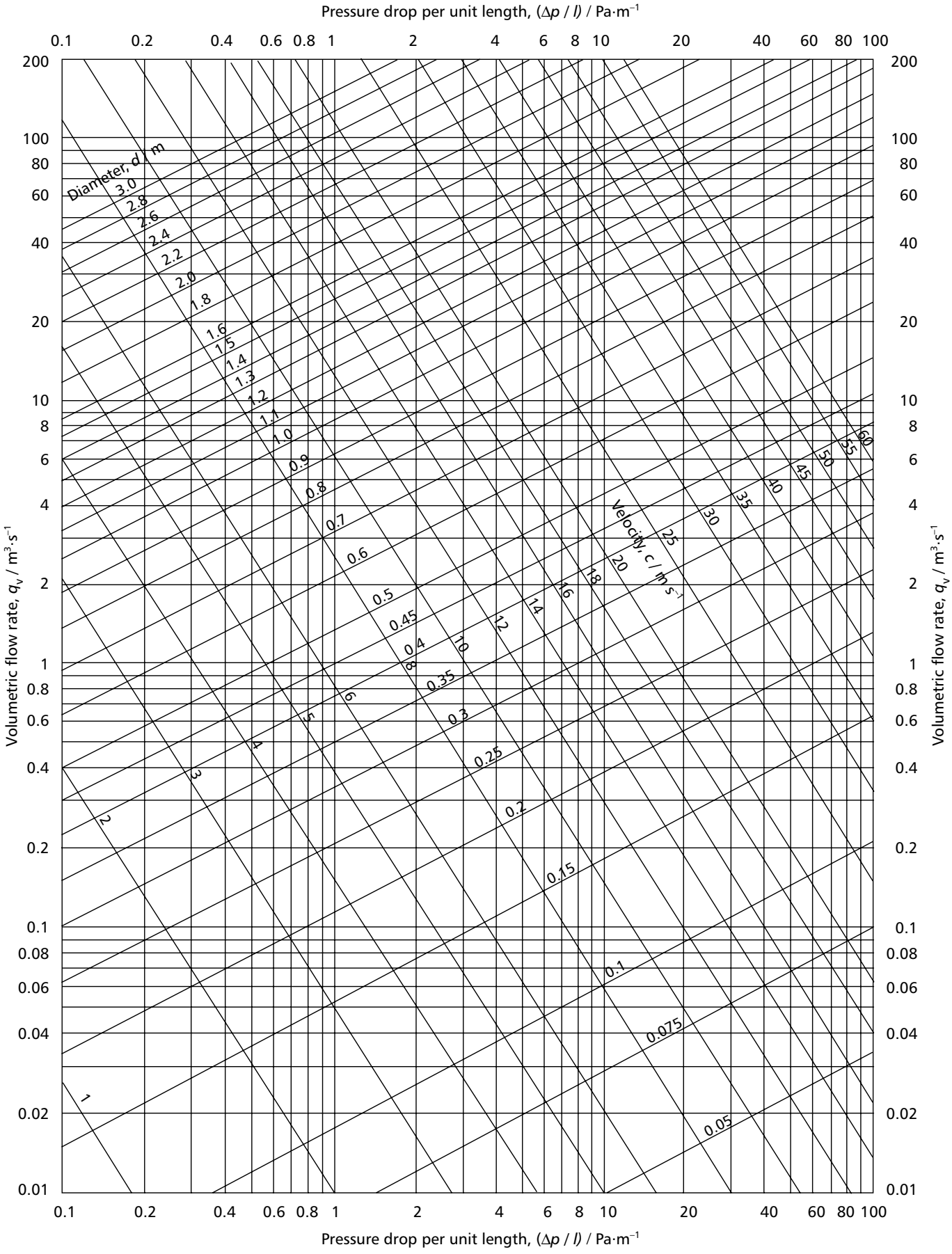


Figure 2.33 Pressure drop for air in galvanised circular ducts (ρ = 1.2 kg·m^{-3}; T = 293 K)

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Pressure drop across the branch is given by:

$$\Delta p_t = p_{tc} - p_{ts} = {}^{\circ}_{c-s}\,{}^{1}/_{2}\,\rho\, c_c^2 \qquad (2.16)$$

where Δp_t is the loss of total pressure across the branch (Pa), p_{tc} is the total pressure on the upstream side of the branch (Pa), p_{ts} is the total pressure on the downstream side of the branch (Pa), ζ_{c-s} is the pressure loss factor for the branch, ρ is the density of air (kg·m^{-3}) and c_c is the air velocity on the upstream side of the branch (m·s^{-1}).

Static regain is given by:

$$p_s - p_c = {}^{1}/_{2}\,\rho\,(c_c^2 - c_s^2) \qquad (2.17)$$

The air velocities are given by:

$$c_c = q_c / A_c \qquad (2.18)$$

$$c_s = q_s / A_s \qquad (2.19)$$

where q_c and q_s are the flow rates on the upstream and downstream sides of the branch respectively (kg·s^{-1}), A_c and A_s are the cross-sectional areas of the inlet to and outlet (straight flow) from the branch respectively (m^2).

(In general, $A_c = A_s$, but the cross-sectional area could increase between inlet and outlet if required.)

It must be emphasised that the fan must produce a rise in *total pressure* equal to the drop in *total pressure* of the ductwork system. The deliberate use of 'static regain' does not directly influence this, except that the downstream duct sizes are larger than might otherwise have been the case.

The value of air pressure in the duct ('static pressure', p) is only of consequence in duct air leakage calculations, and for ensuring approximately equal pressures behind any air outlets immediately on the duct itself. Sizing ductwork by the static regain method is normally carried out using a computer program.

Choice of duct sizing method

Use of the static regain method on low- and medium-pressure systems is limited, and its worth depends on the equivalent length of the index run; the shorter the index run, the more favourable the case for the static regain method. This is because in a low-pressure system the loss of velocity pressure is small and in a large installation its recovery is not significant in comparison with the friction loss in the system.

The equal friction loss method is easier to use in design and results in smaller duct sizes. Ducts sized using this method can cost up to 8 per cent less than those sized by the static regain method. However, the savings will be at least partly offset by higher commissioning costs, especially where the index run is relatively short but with numerous branches and outlets. This reduction in duct size may not be an option under Part L of the Building Regulations (NBS, 2010a), which limits specific fan power to 2 W/l·s^{-1}.

Similar considerations apply for high-pressure systems but, because of the higher potential loss of velocity pressure and the greater need to equalise static pressures at terminals (to avoid generation of noise at terminal dampers), there will be more occasions when the static regain method is worthwhile. The additional cost of ductwork will probably be less than 1 per cent.

Calculation of system pressure loss

The pressure loss in a ductwork system is made up of the pressure losses at plant items and terminal equipment, the friction loss in the straight ducts plus the losses due to duct fittings.

The losses due to both straight duct and fittings are directly related to the duct sizes, so that the determination of the system pressure loss follows the duct sizing process. The calculation as described, using data given in section 4.10 of CIBSE Guide C (2007), gives the 'total pressure' loss and this can be used to assess the required fan total pressure for the system. The total pressure loss of plant items and fittings is related to the static pressure loss as follows:

$$\Delta p_t = \Delta p + p_{vi} - p_{vo} \qquad (2.20)$$

where Δp_t is the total pressure loss (Pa), Δp is the static pressure loss (Pa), p_{vi} is the inlet velocity pressure (Pa) and p_{vo} is the outlet velocity pressure (Pa).

In the case of plant items and fittings where the inlet and outlet connection areas and flow rates are equal, then $p_{vi} = p_{vo}$ and the total and static pressures are identical. The advantage of using total pressure losses is that the friction and fitting losses are such that the total pressure always decreases in the direction of airflow so that the losses can simply be added. The total pressure loss of the terminals must be included in the overall total system pressure loss.

The calculation of pressure loss is essential in identifying the fan total pressure, as well as for balancing the system. It is very important to note that the total pressure loss along each duct run will always be the same. A system will always naturally balance itself so that the total losses in each run are the same. The duct sizing procedures outlined above will not normally deliver a balanced system, that is, the total pressure loss along each duct run will not normally be equal following the design process. Thus, it is crucial that the pressure loss along each run is equalised in order to deliver the design conditions, and this is normally achieved by adding dampers to balance the system.

The required fan total pressure for the system is then equal to the total pressure loss along one of the runs (which is, of course, the same as the total pressure loss along all the other runs) but it is prudent to allow a margin on the calculated total pressure loss to take account of:

— differences between the design concept and the actual installation

— the effect of system leakage on the fan duty.

Suitable air leakage margins are given in Table 2.15.

The second step is to compute the index run total pressure loss. This calculation should (for a supply system) typically include pressure losses at the following items:

— *entry*: intake opening, louvres, bird screens

— *suction duct*: straight duct sections, duct fittings, control and fire dampers, mixing chambers

— *plant*: filters (dirty condition), heaters, cooling coils, humidifiers, eliminators, attenuators

— *fan*: inlet vanes, inlet duct connection, outlet duct connection, flexible connections

— *supply duct*: straight duct sections, attenuators, duct fittings, balancing and fire dampers, zone plant items, control boxes, flexible ducting, terminals.

Extract systems will probably include many of the same items, but in a different order. Where the connections to equipment are different in size, or where multiple connections occur, the manufacturer's pressure loss data should be checked to ensure that they are the total pressure losses.

The next step in the manual calculation of the total pressure loss in a system is to identify the 'index' duct run. This is the duct run that has the greatest total pressure loss when using the duct sizing method described above: the duct sizing calculations will normally deliver a different total pressure loss for each run and the index run is the largest of these calculated pressure losses. Normally the index run will be that which links the fan and the most distant terminal. However, this is not automatically true because it is possible for shorter runs to have higher pressure losses if they contain plant items, high-pressure loss terminals or a high proportion of duct fittings.

The final step is to balance the system and here it is necessary to put in dampers to equalise the total pressure losses along each duct run, alternatively it may be necessary to consider resizing the duct to take out excess pressure. This ensures that the diameters chosen in the duct sizing process deliver the required design conditions; if dampers are not added the system will self balance and the flow rates in the ducts will depart from those originally chosen.

Ductwork sizing process

Duct sizing is an iterative process following identification of the duct runs. It requires the determining of the airflow requirements in the main ducts and subsidiary branches to assess the size of each. These then need to be checked against the original design parameters. A balance needs to be obtained between the duct sizes required to achieve the design outputs and the space allocated for the ductwork system. Within an overall ductwork installation, there may be different ductwork standards, resulting in a mixture of high-, medium- and low-pressure systems. Proper sealing of ductwork will mean reduced air leakage and therefore reduced ductwork size.

Materials, equipment, fittings and construction methods need to be chosen with respect to whole-life costs, not just the initial or installation cost. It can be beneficial and cost effective to standardise the types and sizes of the ducts and fittings used in the installation.

The areas served by the risers are likely to dictate the size of the horizontal branches. The depth of horizontal ductwork will also have a significant influence on the depth of false ceilings or floors and the overall floor-to-floor height.

The depth of the horizontal element is a function of the number of the vertical risers:

— maximum number of, or space in, vertical risers equates to the minimum horizontal element depth

— minimum number of, or space in, vertical risers equates to the maximum horizontal element depth.

It is essential that ductwork is sized correctly for air velocity, particularly to avoid noise. Where noise is likely to be a problem, providing two smaller ducts in parallel (rather than a single large duct) will reduce the air velocity and hence the noise. However, energy can be wasted by reducing the duct size since this will result in increased fan power. A worked example of the duct sizing process is provided in Appendix 2.A5.

Computer-based sizing methods

Computer programs have been produced that cover one or more of the following design aspects:

— duct sizing

— pressure losses in ductwork systems

— total fan pressure

— duct heat losses or gains and terminal temperatures

— acoustic analysis, with attenuation calculations from fan to terminals

— leakage analysis.

Users of computer-based sizing methods are advised to ensure that the reference data and equations used by the computer program are data provided in CIBSE Guide C (2007).

2.4.6 Ventilation design calculation techniques

2.4.6.1 Summary and introduction

Reliable calculations are essential for good design. Ventilation and airflow calculation methods are increasingly needed to evaluate the performance of ventilation design. To some extent they are able to replace expensive and time-consuming field tests and provide a comprehensive range of test conditions. Often, calculation methods can lead to an improved understanding of flow behaviour and provide confidence in design. They are especially important for making preliminary evaluations of complex ventilation and airflow strategies.

There are many calculation techniques available to predict ventilation and related airflow parameters in buildings. The main difficulties concern ease of use and providing suitable input data. Many advances have developed in the commercial field, especially in the areas of user-friendly access and embedded databases. As these developments continue, the ease with which calculation techniques may be applied is steadily improving.

In general, the designer is faced with a set of fixed conditions relating to the environment in which the building is located. These include climate, pollutant sources (e.g. from traffic and adjacent buildings etc.) terrain characteristics and the shielding presented by surrounding buildings.

Calculation techniques form part of the process of matching design variables (e.g. building layout, approach to ventilation etc.) with the various design constraints to achieve an optimum ventilation. Reliable results are dependent on a good working knowledge of techniques and data. More detailed calculation guidance is presented in CIBSE Guide A (2015a). CIBSE AM11: *Building performance modelling* (2015c) also provides important guidance on the integration of energy and environmental modelling for buildings.

2.4.6.2 Applications

Typical applications for which numerical methods are needed include:

— estimating air change rate induced by air infiltration and ventilation

— calculating the influence of parameters such as climate and building airtightness on air change rate

— determining the rate and direction of flow through purpose-provided and air infiltration openings

— calculating the rate of airflow between rooms

— calculating the pattern of airflow within individual zones or rooms (ventilation efficiency parameters).

Subsidiary calculations, based on knowledge of airflow and ventilation prediction, include:

— determining the energy impact of ventilation

— predicting pollutant concentration (indoor air quality analysis and pollutant removal effectiveness)

— estimating the transfer of pollutants between zones or between the outside and inside of a building

— calculating room and building pressures for back-draughting or cross-contamination assessment

— the sizing of ventilation openings (to optimise ventilation performance)

— cost and energy performance analysis (e.g. to compare alternative ventilation strategies)

— thermal comfort analysis (temperature and draught risk).

Further methods are necessary to evaluate the strength of natural driving forces. These include:

— wind pressure calculation

— stack pressure calculation.

A summary of calculation methods and applications is presented in Table 2.30.

The rate and pattern of airflow throughout a building is uniquely defined by:

— the distribution and airflow characteristics of all flow paths (openings) that penetrate the building envelope and that link individual rooms; these paths include constructional cracks and gaps, intentionally provided air vents and any open windows or doors

— the pressure difference acting across each opening; this is developed by the combined effect of naturally and mechanically induced driving forces.

Additionally, the pattern of air movement within any individual space is further influenced by the:

— locations of all sources of incoming air

— temperature, velocity and turbulence of incoming air at each source

— location and flow rate of all sources of outgoing air

— distribution of flow obstructions (e.g. partitioning, furnishings and fittings)

— distribution and strength of all thermal sources and sinks

— thermal characteristics of all surfaces.

These extra needs can make the prediction of airflow patterns in enclosed spaces an extremely complex exercise.

In reality, it would be a formidable task to identify the flow characteristics, driving forces, size and location of every opening. Instead it is necessary to introduce a number of simplifying assumptions that allow the main physical concepts of airflow to be represented without compromising results. It is the degree to which the flow mechanics are simplified that identifies the type of model, the detail of data needed and the range of applicability of results. Generic forms of calculation method used for the prediction of ventilation and airflow patterns in buildings include:

— estimation from building airtightness data

Table 2.30 Summary of calculation techniques and applications

Application	Calculation type			
	Empirical/look-up tables	Single-zone models	Multi-zone models	Computational fluid dynamics
Initial design average infiltration rate	*			
Hourly infiltration and whole-building ventilation rate and contaminant concentration		*		
Hourly room airflow rate and contaminant concentration			*	
Airflow and contaminant flow between rooms			*	
Airflow distribution within rooms				*
Room ventilation efficiency				*

— 'simplified' theoretical methods

— network (zonal) models

— computational fluid dynamics (CFD).

2.4.6.3 Estimation from building airtightness data: estimation of average air infiltration rate for basic loading design

The simplest method for estimating air infiltration rate is by inferring it from airtightness data. For small buildings such as dwellings, the wholly empirical rule of thumb has been to divide the air change at 50 Pa (see 'Building airtightness' in section 2.4.7.2) by 20 to obtain the average annual infiltration rate. This however is very sensitive to building size. The method is further developed in section 4.6 of CIBSE Guide A (2015a) to take account of building size through a series of design tables and figures such as that illustrated in Figure 2.35.

Advantages

— It is easy to apply using both measured or design data.

Limitations

— It is only a very approximate solution for preliminary design purposes only. Final losses will usually need to be determined as part of a whole-building thermal analysis.

— This approach largely ignores the driving forces that vary considerably over time, so time varying changes to air change are also ignored. Therefore this is not suitable for short-term use, since the instantaneous rate of ventilation can differ considerably from the 'average' value.

2.4.6.4 Simplified theoretical models

A much improved approach that incorporates the effects of airtightness and natural and mechanical driving forces has been developed (Sherman and Grimsrud, 1980). This adds to airtightness data by including the driving forces of ventilation (both natural and mechanical) as well as local shielding conditions that can affect wind pressure. It can thus be used for calculating hourly air change rates. The method is based on making a basic assessment of the leakage distribution and using simplified wind and stack pressure equations to determine the driving forces. The result is an estimate of total air change rate for the space.

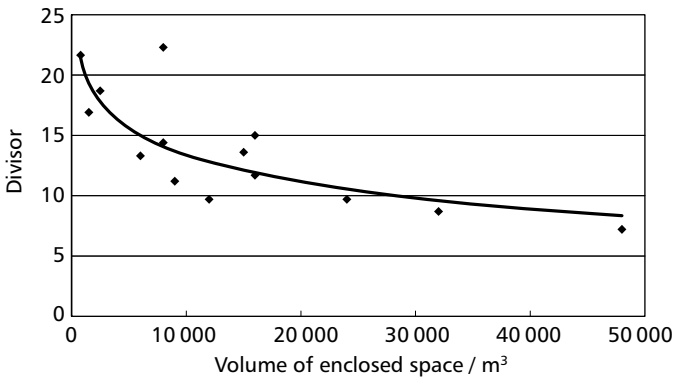


Figure 2.35 Approximate ACH at 50 Pa; divisor to obtain average annual air infiltration rate

Advantages

— It is a fairly simple spreadsheet calculation procedure.

— It can be used for hourly ventilation calculations taking into account airtightness, local shielding and ambient driving forces.

Disadvantages

— The building is treated as a single zone only.

— It calculates an air change rate only; there is no information about inflow and outflow directions through openings.

2.4.6.5 Network (zonal) models

A network model is one in which a building is represented by a series of 'zones' or 'cells' interconnected by flow paths. Each 'zone' typically represents an individual room, while flow paths represent individual or amalgamated flow openings. These models thus provide a more rigorous incorporation of flow theory and can be used to estimate the flow rate and flow direction through defined openings in the building fabric. They can also incorporate air leakage data, specific natural ventilation openings and flow rates induced by mechanical ventilation systems. Wind and stack (buoyancy forces) are taken into account as well as wind shielding.

The pressure due to wind, stack and mechanical driving forces is calculated for each opening in the flow network. The corresponding flow rate through each opening is determined by applying a standard power law or quadratic law flow equation (see CIBSE Guide A (2015a)). The average pressure inside each zone is then iteratively adjusted until a flow balance between incoming and outgoing airflow is achieved. Zonal models can also be used to calculate steady-state contaminant concentrations within zones for given concentration sources.

There are two configurations of these models: single zone and multi zone, discussed below.

Single zone

This treats the building as a single open zone of uniform indoor pressure. Calculation of flow balance is relatively easy and an algorithm listing is given in Appendix 4.A3 of CIBSE Guide A (2015a).

Multi zone

Each room in a space is treated as a separate zone, thus the flow rate into each room can be determined. This involves a much more complex solution procedure since the flow rate into each zone as well as the whole building itself must be balanced. A popular open source algorithm is CONTAM (NIST, 2010) developed at NIST in the US. An alternative program is COMIS (AIVC, 1990).

Advantages

— Network methods are used to calculate the rate of airflow through individual openings. Thus, this technique represents some of the closest of approximations to the true system of ventilation and infiltration airflow.

— By calculating the rate and direction of flow through each flow path, it is possible to evaluate virtually every ventilation-related parameter. Applications include the calculation of:

  — air change rate as a function of climate and building air leakage

  — ventilation and air infiltration rate (mechanical and natural)

  — the rate and direction of airflow through individual openings

  — the pattern of airflow between zones

  — internal room pressures

  — pollutant concentration

  — pollutant flow between zones and between the inside and outside of the building

  — back-draughting and cross-contamination risks.

Limitations

— The driving forces need to be quantified and all openings in the structure of the building need to be accurately accounted for.

— It assumes that air and pollutant in each zone is uniformly mixed.

— As with the preceding methods, this approach does not provide information on pollutant distribution within the individual zones.

— It does not handle wind-driven single-sided flow.

2.4.6.6 Computational fluid dynamics (CFD)

Often, knowledge is needed about the pattern of airflow and the distribution of air temperature and pollutants within an enclosed space. This may be especially important to check the performance of a ventilation system, to verify comfort conditions or to predict thermal transport and smoke and fire spread prediction. In the past, design has been based on scale-model analysis and measurements of airflow patterns in full-size buildings. More recently, the application of CFD mathematical models representing the flow field has become increasingly popular. These are numerical methods that approximate the enclosure by a series of 'control' volumes or elements. Airflow in each element must follow the fundamental laws of physics covering motion, energy transport and conservation of mass.

Specific applications include the simulation and prediction of:

— room airflow

— airflow in large enclosures (atria, shopping malls, airports, exhibition centres etc.), air change efficiency

— pollutant removal effectiveness

— temperature distribution

— air-velocity distribution (for comfort, draughts etc.)

— turbulence distribution

— pressure distribution

— fire and smoke movement

— airflow around buildings (for wind-pressure distribution).

Simulation approach

The space to be simulated is 'discretised' into a set of control volumes or elements. Typically, the enclosure may be divided into 500 000–2 000 000 control volumes or more; therefore each element represents only a fraction of the total enclosure volume. The system of discretisation can be non-uniform so that clusters of elements can be located at areas of greatest interest. Flow, energy propagation and contaminant spread are represented in each of the control volumes by a series of discretised transport equations. In structure, these equations are fundamentally identical but each one represents a different physical parameter. Direct solution techniques are not available, so iteration is applied. Parameters are initially given arbitrary values from which the iteration can commence. These values are then adjusted until each of the transport equations balances. The process of reaching a balance is referred to as 'convergence'. Considerable computational effort is normally necessary, with the result that processing times can be lengthy, sometimes taking many hours.

Key parameters

Key parameters calculated as part of a CFD analysis include:

— *Pressure distribution*: airflow is driven by the pressure distribution, therefore the pressure field is fundamental to the whole flow process. Pressure is maintained by a combination of driven air or forced convection and by buoyancy forces or natural convection. Forced convection is driven by mechanical ventilation or the natural flow of air through openings. Free convection is driven by buoyancy forces created by imbalance in temperature difference.

— *Velocity field*: air movement is a vector having components in both speed and direction. To determine the air velocity distribution, airflow must usually be represented by three transport equations.

— *Temperature field*: the temperature field is sustained by thermal sources and sinks distributed about the enclosure. Sources can include heat emitters, solar gain and surfaces warmed by radiation. Sinks can include chilled ceilings and cold surfaces such as windows or uninsulated walls. Buoyancy forces and free convection currents are generated by the temperature field. Temperature is a scalar quantity acting only on the vertical component of velocity field through a gravitational term.

— *Turbulence*: turbulence is the random fluctuation of the airstream from its mean flow direction. It contributes to the rapid mixing of air and pollutants

in the space and thus has a major impact on the flow field and pollutant distribution. The representation of the turbulence of room air currently presents a challenge to the credibility of CFD techniques. Turbulence must be accurately represented but the representation of turbulence is usually highly empirical. This is because the scale length of turbulence is usually much smaller than the grid size that can practicably be used in a CFD simulation. Modelling turbulence has, therefore, become an important area of research and is an area that is most likely to lead to erroneous results. Modern techniques are increasingly adopting a large eddy simulation (LES). In this method the most significant scale of turbulence is represented by grid size. However considerable computing capacity is needed.

— *Boundary layer flow*: airflow close to surfaces is subjected to boundary layer effects in which the rate of flow is influenced by surface friction. This further adds to the complexity of flow modelling.

Advantages

— It can be used to calculate steady-state and transient airflow patterns within a space.

— It can also be used to calculate associated pollution distribution and ventilation effectiveness parameters.

Disadvantages

— It is often difficult to validate results.

— Complex calculation techniques require meticulous setting up.

— Turbulence can be difficult to represent, thus risking erroneous results.

2.4.7 Ventilation design measurement techniques

2.4.7.1 Introduction

Measurement methods for airflow and related parameters are essential for commissioning, diagnostic analysis, design and research. Many techniques have been developed with each having a specific purpose. The intention of this section is to present a summary of measurement methods, principally for design, and to provide guidance on the selection of techniques according to application. Comprehensive information on measurement techniques is published by Charlesworth (1988) and Roulet (1991). In addition, a simplified discussion is presented in *AIVC Guide to Energy Efficient Ventilation* (Liddament, 1996) on which the following discussion is based. Typical measurement requirements cover:

— building airtightness

— duct airtightness

— ventilation rate

— ventilation effectiveness

— airflow characteristics and air movement

— airflow through terminal units and ducts

— pressure distribution and airflow around buildings.

Figure 2.36 Airtightness testing: (*a*) blower door and (*b*) trailer fan (reproduced courtesy of BSRIA Compliance)

2.4.7.2 Measuring airtightness

The main objectives of an airtightness test are to:

— determine the leakage rate of air through a building component or duct at a specified test pressure

— determine the relationship between air leakage and pressure over a typical operating pressure range.

Building airtightness

In the UK airtightness requirements for building are covered by Part L of the Building Regulations (NBS, 2013a). Testing usually requires a whole-building pressurisation test to determine the air leakage at a reference pressure of 50 Pa. This is the average pressure between the inside and outside of the building. The conduction of the test is covered by a protocol as described in CIBSE TM23: *Testing buildings for air leakage* (2000c). The 50 Pa reference pressure is selected on the basis that results will not be adversely affected by wind and stack pressures under calm conditions but is not sufficiently high for the generated pressure itself to distort leakage openings physically (either by opening or closing them). Despite this there is invariably a difference in results between pressurising and depressurising a building as a consequence of the behaviour of leaks.

Measurements are made using a 'blower door' (Figure 2.36(a)) or, in the case of very large buildings, a 'trailer fan' (Figure 2.36(b)) to create incremental pressure differences between the inside and outside of a building in the ±100 Pa pressure range. For each pressure increment, the corresponding airflow rate through the fan is measured. The relationship between induced pressure and flow rate is then plotted. From this, the air leakage rate at 50 Pa is determined by interpolation as well as the pressure flow characteristics. The flow characteristics are commonly described by the power law equation as described in CIBSE Guide A (2015a).

By carrying out multiple pressure tests between zones, the airtightness of individual rooms and leakage across party walls can be determined.

Duct airtightness

In the UK it is recommended as good practice that all significant installations (e.g. those with a fan capacity greater than 1 $m^3 \cdot s^{-1}$) should be tested in accordance with DW/143: *Guide to Good Practice: Ductwork Air Leakage Testing* (BESA, 2013b). Duct testing is also a requirement of Part L of the Building Regulations (NBS, 2013a) in England (and related requirements for Scotland, Wales and Northern Ireland).

2.4.7.3 Leak detection

Simple leak detection methods are necessary to track design faults and poor workmanship. Suitable methods are outlined below.

Smoke methods

Leaks may be detected by fan pressurising a building or an individual room within a building and observing the movement of smoke emitted from a smoke stick or puffer. This approach is very effective and easy to undertake. The smoke source is gently moved in the vicinity of potential sources of leaks during the course of the test. Sometimes leak locating and sealing may be undertaken while conducting a routine pressurisation test. Ideally, the building or room should be pressurised at positive pressure so that the flow of smoke, from inside to outside, can be clearly identified.

Thermography

Leaks may also be located by thermography. Testing may be undertaken from either the inside or outside of the building. For indoor testing, the building or room is depressurised to permit the ingress of cold outdoor air. An interior thermographic scan will indicate the location of fabric leaks.

Alternatively, scanning can be undertaken externally, in which case the building is pressurised and the sources of exfiltrating hot air are located. This may be undertaken on a cold night when it is possible to locate air leaks and location of excessive fabric heat loss arising from inadequate or poorly installed insulation.

Limitations

— Leak detection does not quantify the infiltration loss but only identifies the source of leaks.

— Infrared thermography is costly and experience is needed to interpret results.

2.4.7.4 Measuring ventilation rate

The tracer gas technique

Fresh air ventilation rate is commonly determined using the 'tracer gas' technique. This tends to be a specialist task rather than routine and therefore requires specialist contractors. A tracer gas is ideally an inert gas that is non-toxic, measurable at low concentrations and not normally present in the atmosphere. In the past, nitrous oxide and sulphur hexafluoride were commonly used. However, neither of these would probably now be acceptable where occupants are present. Also SF_6 is a substantial greenhouse gas and its general use has largely been banned. The remaining choice is carbon dioxide, which is generated by people (metabolic CO_2—see section 2.2.2.4) or is otherwise readily available and is perfectly safe at transient concentrations up to 5000 ppm.

To make a measurement, tracer gas is emitted into the space to be tested and is well mixed using mixing fans. These fans are then switched off and concentration behaviour under normal room conditions is observed. Various emission configurations are possible including:

— Concentration decay: the tracer gas injection is switched off and the decay in concentration over time is monitored. For a uniform ventilation rate, the decay is logarithmic with respect to time and the air change rate is proportional to the log gradient.

— Constant concentration: gas is injected at a sufficient rate to maintain a constant concentration.

The ventilation rate is proportional to the gas injection rate. This test requires sensitive feedback controls and actuators, thus adding to complexity.

— Constant emission: the tracer gas is discharged at a constant rate. Air change rate can be determined from the corresponding time varying room concentration. Eventually a steady state may be reached, at which point this test corresponds to a constant concentration test. At all times the concentration of tracer gas must be carefully monitored to ensure that the safe concentration of tracer gas is not exceeded.

In all cases, tracer gas blends with incoming air that is not treated with tracer gas. This could be fresh outdoor air or it could be infiltrating air from adjacent rooms. To determine the fresh air ventilation rate into a space the following options must be considered.

— The entire enclosure must be tested as a single entity.

— The constant concentration method is used in which all adjacent rooms are held at the same concentration as the test room. The injection rate in the test room will therefore be proportional to the unseeded outdoor air.

Airflow between rooms can be determined by using multiple tracers.

'Passive' tracer gas techniques

A variation on the tracer gas technique is the 'passive' tracer gas method. This technique is used to estimate the average air change rate into a building over an extended period of time. It is a method that was pioneered by Dietz and Cote (1982). It is based on the use of volatile perfluorocarbon tracers (PFTs), which may be detected in the air in minute concentrations within the parts per trillion range. The tracer gas is gradually emitted over a period of time within the test space. An exposed sample tube is used to adsorb the gas over the same time period. Air change rate is calculated from the amount of gas emitted and collected by the emission and sample tubes respectively. Analysis of the sample tubes is undertaken in a laboratory using gas chromatograph and electron capture detection. Recent developments are described by Upton and Kukadia (2011).

The concentration of tracer is so small that it is regarded as having no toxic impact. It may therefore be used in occupied dwellings, offices or other buildings. Test periods can vary from a few hours to several months. By using more than one test gas, it is also possible to use this method to analyse airflow between zones. This method is inexpensive and unobtrusive. It may easily be applied to occupied spaces and may be conducted by relatively unskilled operators.

There are various limitations to this approach, including the following.

— This method is only accurate if air change remains reasonably constant over the measurement time.

— This approach provides insufficient weighting to peaks in air change, such as those associated with airing, door opening or transient high infiltration driving forces, i.e. transient changes in conditions are not 'seen'.

Arguably, if the objective of the measurement is to estimate the average pollutant dose received by occupants in a space resulting from a constant emitting pollutant source (e.g. furnishings and fittings), this method provides a reliable result. However, it can ignore the benefit of ventilation for transient pollutant emissions (e.g. airing for washing and cooking) and underestimate ventilation-related thermal losses (especially through open windows).

2.4.7.5 Measuring ventilation effectiveness

Ventilation effectiveness is a measure of how well air is mixed in a space (see section 2.2.8). This can be measured using the tracer gas technique. Gas is discharged in the occupied zone and the concentration is measured at key points including the extract grille and occupant workstations. Key characteristics are as follows.

— A similar concentration in the occupied zone and extract grille indicates perfect mixing.

— A lower concentration in the extract grille than the occupied space indicates short circuiting, i.e. the supply air reaches the extract grille before mixing in the space.

— A higher concentration in the extract grille than at individual occupant workstations indicates successful displacement ventilation. The lower the workstation concentration, relative to the extract grille concentration, the better the displacement flow.

2.4.7.6 Airflow distribution in a space

Monitoring of airflow in a space may be necessary to evaluate a system of identify faults. Primarily this is a research and development tool. It may also be used in conjunction with CFD analysis (see section 2.4.6.6).

Applications include the:

— measurement of flow velocity and air turbulence throughout a space

— evaluation of diffuser performance

— response to thermal parameters and flow obstruction to airflow patterns.

Methods are based on qualitative visualisation approaches and quantitative anemometric techniques as outlined below.

Visualisation techniques

A qualitative assessment of airflow pattern and turbulence can be made by applying a number of visualisation techniques. These are based on developing a two-dimensional sheet of bright light, which is directed across a section of room. Smoke or small bubbles are used to highlight the flow pattern. These may be photographed or recorded using a video camera.

Limitations

— Qualitative methods are fairly easy to perform but provide only visual information.

Anemometry (hot wire)

Anemometry is used to give quantitative evaluation of spatial air velocity and turbulence distribution. Anemometers must be very sensitive and are usually based on 'hot wire' techniques. A resistance wire (the anemometer element) is heated while the current through the wire is monitored. Air speed fluctuations rapidly change the temperature and, therefore, the resistance of the wire. The resultant current change provides a measure of instantaneous air speed (turbulence). Hot wire anemometers are used in 'test' chamber studies where 'traverses' are made across sections of the chamber to build up a complete pattern of airflow information.

Limitations

— Quantitative (anemometric) techniques are complex and time consuming and therefore tend to be restricted to research or product (diffuser) development applications.

— Measurements give snapshot results only. In reality, the pattern of airflow will vary depending on the location of obstructions and the balance between forced and free convection forces.

— Small changes to conditions can vastly influence airflow pattern.

Flow distribution: flume models

Flume models provide a method by which air movement, pollutant transport and temperature distribution can be predicted using scale models inserted in a water flume. They have been used to assist in the design of a variety of buildings and to predict the transient pattern of airflow. Specific applications include:

— predicting the role and pattern of airflow and pollutant transport through defined openings

— predicting flow patterns through a building

— predicting flow and pollutant distribution in individual rooms.

A 1:20 to 1:100 scale model of the building is constructed using transparent Perspex. This model is necessarily simplified but the essential features controlling the ventilation process, including envelope openings and openings between individual rooms, are retained. This model is completely immersed in a glass-sided water channel such that the pattern of flow can be observed using a video camera. Buoyancy-induced flow (density stratification) is represented by sources of dense salt solution to which a tracer dye is added. The model and video camera are inverted so that the salt solution appears to rise. Cooling is similarly simulated using a less dense alcohol water mixture. Quantitative measurements of flow velocities are made by measuring samples of salt solution taken from within the model. Automated image processing of the video film allows the measurement of dye intensities to give the instantaneous temperature distribution throughout the building, while flow velocities can be measured by particle tracking. Mixing and diffusion processes may also be quantified.

Limitations

— Flume models require considerable laboratory space, thus restricting this approach to the laboratory.

— Primarily this method provides an aid to assessing the impact of stack-induced airflow. The wind regime is more difficult to predict, since it is not usually possible to incorporate surrounding obstructions.

— It is not really practicable to represent infiltration or other openings resulting from construction technique or poor site practice.

2.4.7.7 Airflow through terminal units and ducts

Flow measurements through individual ventilation openings are needed to ensure that the airflow rate and flow direction conform to design requirements. They are also needed to balance ventilation systems as part of servicing or commissioning. Examples include:

— monitoring the flow through passive ventilation stacks

— monitoring the performance of mechanical ventilation systems

— measuring naturally or mechanically driven airflow through air inlets and outlets.

Basic anemometry systems are straightforward to use but might not be as accurate as more complex methods.

Techniques are based on standard airflow measuring instrumentation and include those listed below.

Orifice plates and nozzles

These are calibrated devices that are fitted in series with ductwork and have a known relationship between airflow rate and pressure drop relationship. The flow rate is determined by measuring the pressure drop across the device. Long, straight lengths of duct are needed both upstream and downstream of the system while the constriction imposed by the orifice or nozzle can impede flow.

Pitot-static traverses

Air velocity at a specific location is commonly measured using a pitot-static tube. Duct airflow can be measured by inserting the tube into a prepared opening and measuring the air speed at several depths across the cross-section of the tube. The total flow rate is determined by integrating the results.

Several types of anemometer are used to measure the flow rate through ducts and openings; these include vane anemometers and hot wire anemometers. The vane anemometer is the most likely device for use in servicing and commissioning since it is robust and is satisfactory for measuring relatively high airflow velocities. Hot wire anemometers are delicate, precision devices for measuring very low flow rates and turbulent fluctuations (see 'Anemometry (hot wire)' in section 2.4.7.6).

Figure 2.37 Flow hood (reproduced courtesy of BSRIA Compliance)

Flow hoods

Anemometers can disrupt or impede the flow of air through an opening, thus introducing error, especially if the flow rate is low. One device specifically designed to overcome this problem and to monitor the direction and rate of airflow through an opening is the flow hood. Developed in conjunction with the Netherlands Organisation for Applied Scientific Research (TNO) (Phaff, 1988), it is an active device containing its own calibrated fan, which is operable over a flow range of between 0 and 225 $m^3 \cdot h^{-1}$. The funnel opening of the flow hood is placed over the opening through which the flow rate is to be measured, forming an airtight seal. The internal fan speed is adjusted until there is zero pressure difference across the opening. The resultant flow rate through the device is equivalent to the undisturbed flow rate through the opening. The impact of the measurement system on the rate of flow is therefore substantially minimised. An example of a flow hood is shown in Figure 2.37.

Tracer gas injection

Sometimes, tracer gas injection is used to measure airflow rate. Tracer gas is injected into the duct at a constant known rate. The flow rate of air through the duct is proportional to the tracer concentration measured in the duct.

2.4.7.8 Pressure distribution and airflow around buildings

The wind pressure distribution is needed to calculate the flow rate through building envelope openings. Accurate design requires knowledge relating to a particular building shape and location. The following method may be used.

Wind tunnel testing provides detailed information on spatial pressure distribution. It can also be used to assess airflow patterns around buildings and air intake contaminant ingress risks.

A scale model of the building and immediate surroundings is produced that can fit within the working section of a boundary layer wind tunnel. Pressure taps connected via plastic tubing are placed on each face of the model so that the pressure distribution can be determined. The model needs to be placed on a turntable so that pressure can be analysed for the complete spectrum of wind direction. Wind speed is determined with respect to a specific datum height, normally corresponding to the height of the building. Upwind roughness is normally developed using an array of cubic blocks. Smoke combined with photography is often used to provide visualisation of the flow regime.

An 'environmental or boundary layer' wind tunnel that can accurately represent the lower levels of the Earth's turbulent boundary layer and accommodate reasonably sized scale models of the building and surrounding environs is necessary. These are restricted to laboratory applications on scale models. A typical minimum scale for analysis of wind pressure distribution is 1:50. Models must also incorporate an accurate representation of the surrounding environment.

CFD is also used to assess wind pressures on buildings with several commercial models being available. In all instances care needs to be taken to ensure proper validation in order to obtain accurate results. Typical problems relate to the choice of turbulence model and selection of the correct grid size and layout.

2.5 Other design considerations

2.5.1 Introduction

In developing ventilation strategies there are other important design considerations that need to be addressed. These are covered in this section and include:

— noise

— fire and smoke protection

— air leakage.

Energy and carbon performance considerations are discussed in 2.1.4.

2.5.2 Noise

Both natural and mechanical systems can present noise problems. General guidance on acceptable noise levels can be found in CIBSE Guide A (2015a). The following provides information on noise sources and abatement. More detailed information is covered in CIBSE Guide B4 (2016c).

2.5.2.1 Outdoor noise

Local noise sources can be continuous, such traffic, industrial processing and low-flying aircraft; other sources might be regular, such as playgrounds or entertainment

and sports venues; while other sources might be random, such as construction sites and road maintenance or noise from adjacent buildings. In each case, noise levels should be assessed and incorporated in the ventilation design. External noise can be a particular problem in the case of natural ventilation when windows face busy main roads or are within 100 m of a railway line. A partially open window typically has a weighted sound reduction index of 10–15 dB compared with 35–40 dB for thermally insulating double glazing (BSI, 2014b). Measures to improve acoustic performance include:

— the use of acoustic baffles

— siting the opening windows on a quiet side of a building

— the use of acoustic ventilators (as opposed to windows)

— placing buffer zones (e.g. a circulation space) adjacent to the noise source.

Outside noise is of particular concern in schools. *Acoustic Design of Schools* (EFA, 2004) contains detailed design guidance on minimising noise impact).

2.5.2.2 Indoor noise sources

As well as the ingress of external noise, and noise generated from mechanical systems, consideration also needs to be given to internal acoustic design issues including:

— conflict between partitioning for acoustic privacy and provision of air paths

— that exposed thermal mass increases the number of hard surfaces (see section 2.4.2.4).

Indoor noise can be generated by:

— occupants

— equipment

— mechanical ventilation systems.

2.5.2.3 Noise from ductwork and HVAC plant

Noise generation increases rapidly with increases in velocity at grilles, bends and other fittings where the flow separates from the walls, leaving turbulent eddies in its wake. The noise generated at grilles and terminals is of particular importance. High-velocity systems require noise

Table 2.31 Noise-reduction methods for various noise sources and transmission paths

Path	Description	Noise-reduction measures
(*a*)	Direct sound radiated from sound source to ear	Direct sound can be controlled only by selecting quiet equipment.
	Reflected sound from walls, ceiling, and walls	Reflected sound is controlled by adding sound absorption to room and to location of equipment.
(*b*)	Air- and structure-borne sound radiated from casings and through walls of ducts and plenums is transmitted through walls and ceiling into room	Design ducts and fittings for low turbulence; locate high velocity ducts in non-critical areas; isolate ducts and sound plenums from structure with neoprene or spring hangers.
(*c*)	Airborne sound radiated through supply and return air ducts to diffusers in room and then to listener by path (*a*)	Select fans for minimum sound power; use ducts lined with sound absorbing material; use duct silencers or sound plenums in supply and return air ducts.
(*d*)	Noise is transmitted through plant/equipment room walls and floors to adjacent rooms	Locate equipment rooms away from critical areas; use masonry blocks or concrete for equipment room walls and floor.
(*e*)	Building structure transmits vibration to adjacent walls and ceilings from which it is radiated as noise into room by path (*a*)	Mount all machines on properly designed vibration isolators; design equipment room for mechanical dynamic loads; balance rotating and reciprocating equipment.
(*f*)	Vibration transmission along pipe and duct walls	Isolate pipe and ducts from structure with neoprene or spring hangers; install flexible connectors between pipes, ducts, and vibrating machines.
(*g*)	Noise radiated to outside enters room windows	Locate equipment away from critical areas; use barriers and covers to interrupt noise paths; select quiet equipment.
(*h*)	Inside noise follows path (*a*)	Select quiet equipment.
(*i*)	Noise transmitted to diffuser in a room into ducts and out through an air diffuser in another room	Design and install duct attenuation to match transmission loss of wall between rooms.
(*j*)	Sound transmission through, over and around room partitions	Extend partition to ceiling slab and tightly seal all around; seal all pipe, conduit, and duct penetrations.

Noise source	Transmission paths
Circulating fans; grilles; diffusers; registers; unitary equipment in room	(*a*)
Induction coil and fan-powered mixing units	(*a*), (*b*)
Unitary equipment located outside of room served; remotely located air handling equipment, such as fans and blowers, dampers, duct fittings and air washers	(*b*), (*c*)
Compressors and pumps	(*d*), (*e*), (*f*)
Cooling towers; air-cooled condensers	(*d*), (*e*), (*f*), (*g*)
Exhaust fans; window air conditioners	(*g*), (*h*)
Sound transmission between rooms	(*i*), (*j*)

control by using sound-absorbent units between the duct system and the room outlets and inlets.

Noise in ductwork can be contentious, particularly where the system or components (e.g. intake, exhaust, AHU etc.) produce a noise nuisance to the building occupants, neighbours or passers-by. Noise is generated where eddies are formed as flow separates from a surface.

The generated noise level is particularly sensitive to the velocity (see CIBSE Guide B4 (2016c)).

The velocity of air flowing through a duct can be critical, particularly where it is necessary to limit noise levels. Recommended velocities for particular applications, using the BESA system classifications to control noise, are given in Table 2.16.

Table 2.31 lists noise-transmission paths for a variety of sound sources and suggests appropriate methods of noise reduction (SMACNA, 2006).

2.5.3 Fire and smoke protection

2.5.3.1 General

Building Regulations in the UK require that buildings be subdivided, with fire-resisting construction depending on size and use, to inhibit the spread of fire within the building. Advice on the degree of compartmentation and fire-resisting periods are given in Part B of the Building Regulations (NBS, 2013g).

In addition, Part J of the Building Regulations (NBS, 2013f) has specific legal requirements:

> **38.—(1) This regulation** applies where building work—
> (a) consists of or includes the erection or extension of a relevant building; or
> (b) is carried out in connection with a relevant change of use of a building,
> and Part B of Schedule 1 imposes a requirement in relation to the work.
> (2) The person carrying out the work shall give fire safety information to the responsible person not later than the date of completion of the work, or the date of occupation of the building or extension, whichever is the earlier.
> (3) In this regulation—
> (a)"fire safety information" means information relating to the design and construction of the building or extension, and the services, fittings and equipment provided in or in connection with the building or extension which will assist the responsible person to operate and maintain the building or extension with reasonable safety;
> (b)a "relevant building" is a building to which the Regulatory Reform (Fire Safety) Order 2005 [RRFSO, 2005] applies, or will apply after the completion of building work;
> (c)a "relevant change of use" is a material change of use where, after the change of use takes place, the Regulatory Reform (Fire Safety) Order 2005 will apply, or continue to apply, to the building; and
> (d)"responsible person" has the meaning given by article 3 of the Regulatory Reform (Fire Safety) Order 2005.

The RRFSO (TSO, 2005) makes each building user, via a responsible person, liable for all fire safety within a building. However, in passing over the information, liability is not devolved from a designer, installer or manufacturer and remains in place.

See also CIBSE Guide E: *Fire engineering* (2010) for general guidance on fire protection.

Information on fire-resisting and smoke-control ductwork is given in the *Fire Rated and Smoke Outlet Ductwork* ('the ASFP Blue Book') (ASFP, 2000). Fire-resisting ductwork is tested to BS EN 1363-1: 2012: *Fire resistance tests. General requirements* (BSI, 2012c) and classified to BS EN 13501-3: 2005 + A1: 2009: *Fire classification of construction products and building elements. Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers* (BSI, 2005b). Fire-resisting ductwork may also be tested under BS 476-24: 1987: *Fire tests on building materials and structures. Method for determination of the fire resistance of ventilation ducts* (BSI, 1987c) but this does not allow classification to BS EN 13501-3 (BSI, 2005b). Smoke control ductwork may be tested under BS EN 1366-8: 2004: *Fire resistance tests for service installations. Smoke extract ducts* (BSI, 2004) and BS EN 1366-9: 2008: *Fire resistance tests for service installations. Single compartment smoke extraction ducts* (BSI, 2008b) for single and multiple compartment applications respectively, for classification to BS EN 13501-4: 2007 + A1: 2009 (BSI, 2007c). CE marking is now mandatory.

Information on fire dampers is given in *Fire Dampers (European Standards)* ('the ASFP Grey Book') (ASFP, 2010) and DW/145: *Guide to Good Practice for the Installation of Fire and Smoke Dampers* (BESA, 2010). Fire dampers are tested to BS EN 1366-2: 2015: *Fire resistance tests for service installations. Fire dampers* (BSI, 2015a) and classified to BS EN 13501-3 + A1: 2009: (BSI, 2005b). There is a product standard and this is BS EN 15650: 2010: *Ventilation for buildings. Fire dampers* (BSI, 2010b). CE marking is now mandatory.

In some cases fire dampers may be tested to BS 476-20: 1987/BS 476-22: 1987 (BSI, 1987a/b) should all the fans be turned off in the event of a fire alarm. This does not allow classification to BS EN 13501-3: 2005 + A1: 2009 (BSI, 2005b).

Fire dampers protecting escape routes and in most cases areas with sleeping risk must have an ES classification to BS EN 13501-3 + A1: 2009 (BSI, 2005b) and this is not possible for a fire damper tested to BS 476-20: 1987/BS 476-22: 1987 (BSI, 1987a/b) alone.

In all cases fire-resisting products should be installed as tested, otherwise fire-resistance performance is not guaranteed. This does mean separate fire test reports for different wall and floor constructions. Some assessment may be available, but this is rare for dampers tested to BS EN 1366-2: 2015: *Fire resistance tests for service installations* (BSI, 2015a).

The following notes summarise the main fire precautions issues relating to the design and installation of ductwork systems. Advice on fire-protection systems is laid down in Approved Document B and supplemented in BS 9999: 2008: *Code of practice for fire safety in the design, management and use of buildings* (BSI, 2008a).

Fire and smoke containment and hazards are factors that influence the design and installation of ductwork systems.

A design that is required to perform a particular action as part of a fire strategy is likely to combine electrical,

mechanical and builders' work components, which would be influenced by the normal day-to-day operation requirements. Some of the more common components are:

— ductwork

— fire dampers

— smoke extract fans.

Ductwork is often required to transmit heat and smoke from the fire zone to the outside. The layout, jointing and potential expansion in the ductwork must be designed to withstand the calculated temperatures while maintaining integrity (to ensure containment of smoke and possibly heat) and insulation (to prevent spread of fire by radiation at high temperatures). The need for fire protection should be based on compartmentation requirements and calculated smoke temperatures. Where the fire-resistant ductwork passes through a wall or floor, a penetration seal must be provided that has been tested and/or assessed with the fire-resisting ductwork to the same fire rating as the compartment wall through which the fire-resisting ductwork passes. Where the fire-resisting ductwork passes through the fire compartment wall or floor, the ductwork itself must be stiffened to prevent deformation of the duct in a fire to:

— maintain the cross-sectional area of the duct

— ensure that the fire-rated penetration seal around the duct is not compromised.

Fire dampers are provided in ductwork for fire containment by preventing flow when a predetermined temperature is reached. The operation is usually activated by a fusible link that releases the damper at 72 °C. Generally they are required where ducts penetrate walls or floors that form fire compartments. The damper assembly should have a fire-resistance rating equal to that of the fire barrier it penetrates. It should be fire tested as detailed above.

Fire dampers would not normally be specified in ductwork used for smoke transport, although they may be required as part of the overall fire strategy in other ductwork. These would become smoke control dampers. Various types of fire damper are available: simple E classified integrity only units and ES classified fire dampers with reduced leakage for fire and smoke control. Details are given in DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a) and DW/145: *Guide to Good Practice for the Installation of Fire and Smoke Dampers* (BESA, 2010).

Electrically controlled dampers are required in some circumstances to control the flows, depending on the location of the fire and the control system logic as determined by the requirements of the fire strategy. Fire dampers responding to smoke alarms are required to protect escape routes and areas with sleeping risk (BSI, 2008a).

Smoke extract fans must be selected to ensure reliability at the design temperature and length of exposure as predicted by the fire engineering calculations. These should reflect performances as detailed in BS EN 12101-3: 2015: *Smoke and heat control systems. Specification for powered smoke and heat control ventilators (Fans)* (BSI, 2015b).

Natural smoke ventilators should reflect the requirements of BS EN 12101-2: 2003: *Smoke and heat control systems. Specification for natural smoke and heat exhaust ventilators* (BSI, 2003b).

2.5.3.2 Main areas within a building where ductwork should be fire protected

Agreement for these areas should be sought from the building control officer responsible for the building. Reference should also be made to the current Building Regulations.

Smoke extract systems

If the ductwork incorporated in a smoke extract system is wholly contained within the fire compartment, it must be capable of resisting the anticipated temperatures generated through the development of a fire. This may be demonstrated by testing to BS EN 1366-8: 2004 (BSI, 2004) and BS EN 1366-9: 2008 (BSI, 2008b) or BS 476-20: 1987 (BSI, 1987a). BS 476-24: 1987 (BSI, 1987c) also requires that ductwork that is intended as a smoke extract must retain at least 75 per cent of its cross-sectional area within the fire compartment. If the ductwork penetrates a fire-resisting barrier, it must also be capable of providing the same period of fire resistance as the barrier.

Escape routes covering stairways, lobbies and corridors

All escape routes must be designed so that the building occupants can evacuate the building safely in the case of fire. Ductwork that passes through a protected escape route must have a minimum of 30 minutes' fire resistance and be at least equal to the fire compartment through which the ductwork passes, either by the use of fire dampers or fire-resisting ductwork. Any fire dampers used should have an ES classification to BS EN 13501-3: 2005 + A1: 2009 (BSI, 2005b). The performance of the penetrated partition must also be maintained.

Non-domestic kitchen extract systems

Where there is no immediate discharge to atmosphere, i.e. the ductwork passes to atmosphere via another compartment, fire-resistant ductwork must be used. Kitchen extract ductwork presents a particular hazard, as combustible deposits such as grease are likely to accumulate on internal surfaces; therefore, all internal surfaces of the ductwork must be smooth. A fire in an adjacent compartment through which the ductwork passes could lead to ignition of the grease deposits, which may continue through the ductwork system possibly prejudicing the safety of the kitchen occupants. For this reason consideration must be given to the stability, integrity and insulation performance of the kitchen extract duct which should be specially tested to BS EN 1366-9 (BSI, 2008b) or BS 476-24: 1987 (BSI, 1987c) for a kitchen rating.

Particular points to note are as follows:

— Access doors for cleaning must be provided at distances not exceeding 3 m.

— Fire dampers must not be used.

— Use of volume control dampers and turning vanes are not recommended.

Further information on kitchen extract systems is contained in DW/172: *Specification for Kitchen Ventilation Systems* (BESA, 2005).

Enclosed car parks that are mechanically ventilated

Car parks must have separate and independent extract systems, designed to run in two parts, each extracting 50 per cent of the design load. Fans are required to be rated at 300 °C for a typical period of two hours and the ductwork and fixings constructed from materials with a melting point not less than 800 °C. Full details of the requirements are given in Part B of the Building Regulations (NBS, 2013g).

Due to the fire risks associated with car parks, these systems should be treated as smoke extract systems and therefore maintain a minimum of 75 per cent cross-sectional area under fire conditions in accordance with BS EN 1366-8: 2004: *Fire resistance tests for service installations* (BSI, 2004) or BS 476-24: 1987: *Fire tests on building materials and structures* (BSI, 1987c). Fire dampers must not be installed in extract ductwork serving car parks.

Basements

Ductwork from basements must be fire rated except for car parks as above. If basements are compartmented, each separate compartment must have a separate outlet and have access to ventilation without having to gain access (i.e. open a door to another compartment). Basements with natural ventilation should have permanent openings, not less than 2.5 per cent of the floor area and be arranged to provide a through draft with separate fire ducts for each compartment. See Part B of the Building Regulations (NBS, 2013g) for full details.

Pressurisation systems

Pressurisation is a method of restricting the penetration of smoke into certain critical areas of a building by maintaining the air at higher pressures than those in adjacent areas. It applies particularly to protected stairways, lobbies, corridors and fire-fighting shafts serving deep basements, as smoke penetration to these would inhibit escape. As the air supply providing pressurisation must be maintained for the duration of a fire, fire dampers cannot be used in the ductwork to prevent spread of fire. Any ductwork penetrating fire-resisting barriers must be capable of providing the same period of fire resistance.

Good practice in such systems requires the following.

— *Holes in compartment walls and floors*: all builders' work openings through the compartment walls and floors surrounding the pressurised space (e.g. penetrations for building services) must be made good and sealed.

— *Builders' shafts*: if constructed of brick or blockwork, the inside surfaces of shafts used as part of the system should have a smooth rendered finish to ensure low resistance to airflow and provide a good seal against leakage. The shafts must be pressure tested and be proven to have a leakage factor of less than 10 per cent.

— *Correctly sized shafts and ducts*: since most systems use a very basic shaft layout with simple spigot connections to discharge grilles, it is important to size the shafts and ducts for relatively low air velocity to ensure that correct air distribution is achieved at each grille.

— *Ductwork arrangements*: good working practice must be employed in the layout of the ductwork system. The system must be designed for correct operation of the pressurisation system, not simply to fit the building constraints.

— *Position of air intake*: if at roof level, the intake should be positioned so that it is unlikely to be affected by smoke and should be lower than any shaft or duct that may discharge smoke in the event of a fire. Changes to plant layout during construction should not compromise the air intake position.

— *Position of discharge*: for buildings over three stories in height there should be a discharge grille for every three floors.

Hazardous areas

There are other areas within the building where the building control officer could state a requirement for fire-resisting ductwork, for example areas of high fire risk, boiler houses, plant rooms, transformer rooms.

2.5.3.3 Methods of fire protection of ductwork

There are three methods of fire protection related to ductwork systems as given in Approved Document B supported by BS 9999: 2008: *Code of practice for fire safety in the design, management and use of buildings* (BSI, 2008a). These are described in Appendix 2.A4.

Fire resistance and BESA DW/144

It should be noted that ductwork constructed to DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a) has no tested fire resistance. General purpose ventilation/air-conditioning ductwork and its ancillary items do not have a fire rating and cannot be either utilised in or converted into a fire-rated ductwork system unless the construction materials of the whole system (including supports and penetration seals) are proven by test and assessment in accordance with BS EN 1366-1: 2014 (BSI, 2014a) or BS 476-24: 1987 (BSI, 1987c).

In the case where galvanised sheet steel ductwork is clad by the application of protective materials, the ductwork construction must be type tested and comply with the protective material manufacturers' recommendations, for example gauge of ductwork, frequency of stiffeners and non-use of low melting point fasteners or rivets. Sealants, gaskets and flexible joints should be as tested at the same time and certified in accordance with BS EN 1366-1: 2014 (BSI, 2014a) or BS 476-24: 1987 (BSI, 1987c) and comply with the manufacturers' recommendations.

Methods of fire protection for galvanised steel ductwork are given in Appendix 2.A4.

Design considerations

Where ducting penetrates a fire wall or barrier, it is usual to install a fire damper that has the same fire rating as the wall itself. An alternative in some circumstances is to use fire-rated ducting provided this does not link two different fire zones. For example, it is not permitted to install fire

dampers in kitchen extract ducting and, once the ducting has left the kitchen area, it will have to be fire rated up to the point of discharge from the building. No openings into the duct will be permitted nor connections to other areas, not even another kitchen.

In instances where ducting links an escape route to an adjacent area, a fusible link fire damper will not be sufficient. There will be the possibility that 'cool' smoke will fail to melt the fusible link and thereby enter the escape route and render it unusable. In these instances an additional mechanism will be required that will close the damper on a signal from the building fire detection system. The dampers may be reopened manually or mechanically. Where the damper is not within easy reach, or where there are a significant number of them, motors will be used. In planning the design, adequate space for the installation and maintenance of these items must be allowed.

It is usual to route ducting along corridors with branches into the treated area, as this has advantages from the point of view of maintenance access, potentially deeper ceiling void, proximity to risers etc. However, where there is a need for a large number of dampers that are released by the fire alarm system, the designer may consider it better to run the ductwork through the treated area in order to reduce the complication and cost of numerous dampers on several branch ducts.

Fire-resisting stability

Where ductwork is required to be fire resisting, it is classified according to stability, integrity and insulation. Stability is the ability of a duct to stay in place for the specified period of time when exposed to a fire. Ductwork supports must match the stability of the ductwork. This can be achieved by oversizing them or by applying a protective covering. In all cases, fire-resisting ducts and any associated supports shall be installed as tested. Integrity is the ability of the duct to prevent the passage of fire either into or out of the duct. Insulation is usually called for if the building control officer believes that a duct carrying hot smoke may become sufficiently hot to compromise an escape route.

Fire-resisting ductwork can be either single or double skin. Double-skin ducting is used to encase insulation where this is required, though the more usual alternative is to add insulation to a fire-resisting duct. It is important that adequate space is allowed if a duct is to be insulated. Site modifications to fire-resisting ducts are much more difficult than to normal ducting, as the duct and fittings are often manufactured off-site and site changes may well compromise the classification. Any alterations being made to existing ductwork should be installed as tested, with special care being given to any strengthening at compartment boundaries. Any holes needed for pitot tube measuring instruments need to be cut at the manufacturing stage as site drilling is not allowed.

2.5.4 Air leakage

2.5.4.1 General

Air leakage in buildings and ductwork has a critical impact on ventilation and energy performance. Part L of the Building Regulations (NBS, 2013a) now imposes air-tightness requirements for buildings in order to reduce unwanted air infiltration and reduce energy consumption. Once airtightness is increased much more emphasis is needed on the development and durability of ventilation systems to ensure that air quality is not compromised.

2.5.4.2 Duct leakage

Leakage from ducted air distribution systems is an important consideration in the design and operation of ventilation and air-conditioning systems. A ductwork system having air leakage within defined limits will ensure that the design characteristics of the system can be maintained. It will also ensure that energy and operational costs are not greater than necessary.

Leakage from sheet metal air ducts occurs at the seams and joints and is therefore proportional to the total surface area of the ductwork in the system. The level of leakage is similarly related to the air pressure in the duct system and, whilst there is no precise formula for calculating the level of air loss, it is generally accepted that leakage will increase in proportion to pressure to the power of 0.65.

The effect of air leakage from high-pressure ductwork is critical in terms of system performance, energy consumption and the risk of high frequency noise associated with leakage. These problems are less critical with medium-pressure systems, but should be considered. Low-pressure ducts present the lowest risk in terms of the effect of leakage on the effective operation of the system.

It is important that ductwork should be made as airtight as possible. Conventional sheet metal ductwork is formed by seaming sheets and jointing sections; these seams and joints, penetrations made by damper spindles, control sensors, test holes, access doors etc., all give rise to air leakage. The designer should accept that some leakage will occur in conventional ductwork and make an assessment of the acceptable level in a given system. In some cases it may not be important, for example for a general extract system where the ducting is all in the space being served. In others it may be very important, for example where obnoxious or hazardous contamination is being handled. In the latter case, a completely airtight system may be necessary, where fully welded ducting with air-tight enclosures at all penetrations could be the basis of a special specification, outside the scope of DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a).

For most ventilating and air-conditioning applications, compliance with the construction and sealing requirements of DW/144 (BESA, 2013a) will ensure acceptably low leakage rates. For sheet metal ductwork, the specification requires sealant to be applied to all longitudinal seams (except spirally wound, machine-made seams) and cross-joints; for plastic and resin bonded glass fibre ductwork, similar sealing requirements are specified. The sheet metal specification also gives details of an air leakage test procedure. Recommended acceptable leakage rates in $l \cdot s^{-1}/m^2$ of surface area are given in Table 2.32.

Appendix 2.A3 shows these limits for a range of duct static pressure differentials. These rates are in accordance with the comparable classes in BS EN 12237: 2003: *Ventilation for buildings. Ductwork. Strength and leakage of circular sheet metal ducts* (BSI, 2003a) and BS EN 1507: 2006: *Ventilation*

for buildings. Sheet metal air ducts with rectangular section. Requirements for strength and leakage (BSI, 2006a) but these European Standards do not cover the full range of high-pressure ductwork.

Whilst leakage occurs at seams, joints and penetrations, the purpose of giving acceptable leakage rates in terms of surface area of ductwork is to require that the airtightness is of a consistent standard for air leakage test systems. It does not follow that the total leakage of a system that meets specified leakage requirements will always be a set percentage of the total flow rate; the percentage leakage from short runs can be substantially less than that from long runs. The design therefore plays a very important part in the likely total leakage loss from ductwork systems, since long runs not only provide more crackage and penetration, but also require higher working pressures to operate. Where limitation of air leakage is important, the designer should first ensure that the duct runs are as short as possible, that the operating pressure is as low as possible, that the number of seams, joints and penetrations is kept to a minimum and that there is adequate room around the ducts for site-made joints to be effectively sealed.

Items of equipment and plant installed in ductwork systems can also leak, and particular attention should be paid to the sealing of these items. Where leakage testing is required, the designer should ensure that suppliers of these items can demonstrate that their equipment meets the required airtightness standards. The designer should make adequate allowance in the fan selection for some air leakage so that the completed installation can meet its intended purpose without subsequent adjustments to the fan(s) and motor(s). Table 2.15 gives some recommendations for margins that should be included for complete installations (i.e. ductwork and equipment).

System leakage loss

There is no direct relationship between the volume of air conveyed and the surface area of the ductwork system. It is therefore difficult to express air leakage as a percentage of total air volume. Operating pressure will vary throughout the system and, since leakage is related to pressure, the calculations are complex. However, it is generally accepted that, in typical good-quality systems, the leakage from each class of duct under operating conditions will be in the region of:

— low pressure (Class A): 6 per cent

— medium pressure (Class B): 3 per cent

— high pressure (Class C): 2 per cent.

Table 2.32 Ductwork air leakage limits

Ductwork pressure class	Air leakage limits / $l \cdot s^{-1}$ per m^2 of duct surface area
Low pressure (Class A)	$0.027 \times p^{0.65}$
Medium pressure (Class B)	$0.009 \times p^{0.65}$
High pressure (Class C)	$0.003 \times p^{0.65}$
High pressure (Class D)	$0.001 \times p^{0.65}$

Note: p = differential pressure / Pa

Designer's calculations

The designer can calculate with reasonable accuracy the predicted total loss from a system by:

(*a*) calculating the operating pressure in each section of the system

(*b*) calculating the surface area of the ductwork in each corresponding pressure section

(*c*) calculating the allowable loss at the operating pressure for each section of the system (see above for indicative leakage figures).

This is illustrated in the duct sizing example shown in Appendix 2.A5.

Variable pressures in systems

Designers can achieve significant cost savings by matching operating pressures throughout the system to constructional standards and appropriate air leakage testing. The practice of specifying construction standards for whole duct systems based on fan discharge pressures may incur unnecessary costs on a project.

For example, some large systems could well be classified for leakage limits as follows:

— plant room risers: Class C

— main floor distribution: Class B

— low-pressure outlets: Class A.

2.5.4.3 Duct air leakage testing

General

It is normal practice for leak testing to be a requirement for all or part of high-pressure ductwork installations, but it is not a regular practice for medium- or low-pressure ductwork installations. It is recommended as good practice that all ductwork installations of significant size (e.g. with a fan capacity greater than 1 $m^3 \cdot s^{-1}$) should be leak tested in accordance with DW/143: *Guide to Good Practice: Ductwork Air Leakage Testing* (BESA, 2013b). It should be noted that air leakage testing of low- and medium-pressure ductwork is not obligatory under DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a); this will therefore be an individual contractual matter. However, in the case of low- and medium-pressure ductwork, the relevant country's Building Regulations should be checked for additional requirements.

Factors that should be taken into account in deciding whether leak testing of all or part of a ductwork installation is necessary are:

— whether adequate supervision of the installation can be provided and whether a final detailed examination of the system is feasible

— whether some sections need to be checked, because access will be impracticable after the installation is complete

— safety hazards that may arise from leakage of contaminated air

— whether special circumstances make necessary more stringent control of leakage than is given in the existing specification

— the cost to the client of the leakage testing and the delays caused to the completion of the installation.

The need for leak testing and the extent to which it is carried out should be assessed and, if judged to be necessary, this requirement and its extent should be included in the designer's ductwork specification.

Where it is decided that leak testing is required as part of the commissioning process, the ductwork designer should specify which sections of the ductwork system should be tested and the test pressures and leakage criteria for those sections. DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a) describes an appropriate leak testing procedure and gives test pressures and leakage criteria appropriate to high-, medium- and low-pressure ductwork. These leakage rates are given in Appendix 2.A3.

To ensure that the ductwork is sufficiently airtight for the needs of the design, it is recommended that:

— ductwork is sealed in accordance with the design and construction specification

— a visual check is made during erection, with particular attention to site-made joints

— where leakage testing is required, the ductwork is tested in sections as the work proceeds, and the measured air leakage rate for each section checked against the leakage criterion (the sections so chosen should be sufficiently large that the maximum permitted leakage from the sections can be accurately measured with the test equipment)

— joints between test sections that need to be remade can be visually checked

— non-ductwork items (such as attenuators, coils, fire dampers) should be visually inspected, as the leakage from these is not covered by the relevant BESA specification.

Ductwork constructed and installed in accordance with DW/144 (BESA, 2013a) should provide a level of air leakage that is appropriate to the operating static air pressure in the system. However, the environment in which systems are installed is not always conducive to achieving a predictable level of air leakage; it is therefore accepted that designers may require the systems to be tested in part or in total.

It should be recognised that the testing of duct systems adds a significant cost to the installation and incurs some extra time within the programme.

Duct pressure

Ductwork constructed to DW/144 (BESA, 2013a) will be manufactured to a structural standard that is compatible with the system operating pressure, i.e. Classes A, B, C and D.

Specifying air leakage testing

As previously stated, it is recommended as good practice (and now required by UK Part L legislation) that all significant installations (e.g. with a fan capacity greater than 1 $m^3 \cdot s^{-1}$) should be tested in accordance with DW/143: *Guide to Good Practice: Ductwork Air Leakage Testing* (BESA, 2013b).

Respecting both the cost and programme implications associated with testing ducts for leakage, the designer may, for example, indicate that a particular system is tested as follows:

— high-pressure ducts: all ductwork to be tested.

— medium-pressure ducts: 10 per cent of the ductwork to be selected at random and tested

— low-pressure: ductwork does not need to be tested.

In the case where a random test is selected for medium-pressure ducts, the following clause from DW/144 (BESA, 2013a) is suggested for inclusion by the designer:

> **The designer** shall select at random a maximum of 10 per cent of the duct system to be tested for air leakage. The duct shall be tested at the pressure recommended in Table 22 of DW/144 for the classification for the section of the ductwork that is to be tested.
>
> **The tests** shall be carried out as the work proceeds and prior to the application of thermal insulation. In the event of test failure of the randomly selected section, the system designer shall have the right to select two further sections at random for testing. Where successive failures are identified there shall be a right to require the contractor to apply remedial attention to the complete ductwork system.
>
> **The ductwork** contractor shall provide documented evidence of the calculations used to arrive at the allowable loss for the section to be tested and the client, or his agent, shall witness and sign the results of the test.

Special cases

There may be situations where special consideration needs to be given to containing air losses, for example a long run of ductwork may incur a disproportionate level of air loss. In such cases the designer can specify an improved standard of airtightness, for example 80 per cent of allowable loss for Class B ducts. The designer should not specify a Class C test at Class C pressure for a Class B duct. For more information refer to section A6 of DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a).

Testing of plant items

Items of in-line plant will not normally be included in an air leakage test. The ductwork installation contractor may include such items in the test if the equipment has a certificate of conformity for the pressure class and air leakage classification for the system under test.

2.5.4.4 Building and component leakage

Introduction

Airtightness requirements for building are covered by Building Regulations. Testing usually requires a whole-building pressurisation test to determine the air leakage at a reference pressure of 50 Pa. This is the average pressure between the inside and outside of the building. The conduction of the test is covered by a protocol as described

in CIBSE TM23: *Testing buildings for air leakage* (2000c) and by the Air Tightness Testing and Measurement Association (ATTMA, 2010). The 50 Pa reference pressure is selected on the basis that results will not be adversely affected by wind and stack pressures under calm conditions but it is not sufficiently high for the generated pressure itself to distort leakage openings physically (either by opening or closing them). Despite this, there is invariably a difference in results between pressurising and depressurising a building as a consequence of the behaviour of leaks.

Whole-building leakage testing by fan pressurisation

Measurements are made using a 'blower door' (see Figure 2.36(a)) or, in the case of very large buildings, a 'trailer fan' (Figure 2.36(b)) to create incremental pressure differences between the inside and outside of a building in the ±100 Pa pressure range. For each pressure increment, the corresponding airflow rate through the fan is measured. The relationship between induced pressure and flow rate is then plotted. From this the air leakage rate at 50 Pa is determined by interpolation as well as the pressure flow characteristics. The flow characteristics are commonly described by the power law equation, as described in CIBSE Guide A (2015a).

By carrying out multiple pressure tests between zones, the airtightness of individual rooms and leakage across party walls can be determined.

Whole-building leakage testing using building HVAC system

Testing has sometimes been conducted using the building's own HVAC system. In this case the building is pressurised using the building supply fans. Return air and extract fans are switched off and all dampers are closed.

Component airtightness testing

The air leakage of individual components may also be measured by pressurisation. Sometimes this is undertaken by the manufacturer to check compliance for rain penetration. In this case the component is installed in a test rig such that the pressure difference can be created across the component and the leakage versus airflow rate measured. Components can also be tested in situ by constructing a pressure chamber across the component.

2.6 Equipment

2.6.1 Fans

2.6.1.1 General

Fans consume a large proportion of the total energy in mechanically ventilated buildings. A high priority should therefore be given to achieving energy-efficient fan operation. To achieve this there is a wide selection of fan types, each of which is designed to perform specific functions. Fan selection is critical for ensuring the correct performance of mechanical ventilation systems. Consideration must be given to optimum fan flow volume rates and the minimisation of pressure drops as outlined in section 2.3.2.3 and in CIBSE Guide F (2012). Fan types and characteristics are considered in this section.

2.6.1.2 Fan types and components

Table 2.33 provides a summary of fan types.

The following definitions should be used in relation to fans.

— *Casing*: those stationary parts of the fan that guide air to and from the impeller.

— *Guide vanes*: a set of stationary vanes, usually radial, on the inlet or discharge side of the impeller, covering the swept annulus of the impeller blades (or wings). Their purpose is to improve the recovery of the energy contained in the helical whirl of the airstream and thus raise the performance and efficiency of the fan. Inlet guide vanes are intended to pre-rotate the air entering the impeller and therefore alter the performance of the fan.

— *Impeller*: that part of a fan that, by its rotation, imparts movement to the air.

Important fan types

(*a*) Axial-flow fans

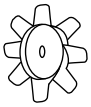
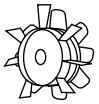
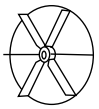
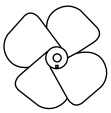
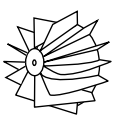
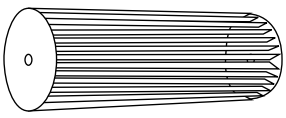
Axial-flow fans comprise an impeller with a number of blades, usually of aerofoil cross section, operating in a cylindrical casing. The fineness of the tip clearance between impeller blades and casing has a marked effect on the pressure development of the fan and, in turn, its output and efficiency. The blades may also have 'twist', i.e. the pitch angle increases from tip to root to equalise the work done along the blade length. As the pitch angle is increased, flow rate and impeller power demand increase. The tendency for flow separation from the blade surface (stall condition) also increases, limiting the maximum operating pressure. The hub is used to support the blades, generally incorporates a means of adjusting the blade angle and acts as a fairing for the motor. Large hubs and short blades characterise a high pressure-to-volume ratio and vice versa. Refinements include guide vanes to correct whirl at inlet or discharge and fairings and expanders to recover a greater proportion of the velocity head in the blade swept annulus.

Axial-flow fans are of high efficiency and have limiting power characteristics, but as the highest pressure single-stage axial-flow fans develop only about one fifth of the pressure produced by a forward-curved (multi-vane) fan, they are best suited for high-volume/pressure ratios. However, axial-flow fans may be staged or placed in series and when fitted with guide vanes the aggregate pressure developed is proportional to the number of stages for a given volume. A two-stage fan can be contra-rotating, and without the use of guide vanes the pressure developed may be up to 2.75 times greater than that of a single stage.

(*b*) Centrifugal fans

Centrifugal fans comprise an impeller that may (depending on type and application) rotate in a diffusing casing that has an expanding radial dimension (referred to as a volute or scroll casing). The air flows into the impeller axially, turns through a right angle within it and is discharged radially by centrifugal force. The scroll acts as a collector

Table 2.33 Summary of fan types

Fan type	Efficiency / %		Advantages	Disadvantages	Applications
	Static	Total			
1. Axial-flow (without guide vanes) 	50–65	50–75	Very compact, straight-through flow. Suitable for installing in any position in run of ducting.	High tip speed. Relatively high noise level comparable with type 5. Low-pressure development.	All low-pressure atmospheric air applications.
2. Axial-flow (with guide vanes) 	65–75	65–85	Straight-through flow. Suitable for vertical axis.	Same as type 1 but to lesser extent.	As for type 1, and large ventilation schemes such as tunnel ventilation.
3. Forward-curved or multivane centrifugal 	45–60	45–70	Operates with low peripheral speed. Quiet and compact.	Severely rising power characteristic requires large motor margin.	All low- and medium-pressure atmospheric air and ventilation plants.
4. Straight or paddle-bladed centrifugal 	45–55	45–70 60 (non-shrouded)	Strong, simple impeller. Least likely to clog. Easily cleaned and repaired.	Low efficiency. Rising power characteristic.	Material transport systems and any application where dust burden is high.
5. Backwards-curved or backwards-inclined blade centrifugal 	65–75	65–85	Good efficiency. Non-overloading power characteristic.	High tip speed. Relatively high noise level compared with type 3.	Medium- and high-pressure applications such as high-velocity ventilation schemes.
6. Aerofoil-bladed centrifugal 	80–85	80–90	Highest efficiency of all fan types. Non-overloading fan characteristic	Same as type 5.	Same as type 5 but higher efficiency justifies use for higher power applications.
7. Propeller 	<40	<40	Low first cost and ease of installation.	Low efficiency and very low pressure development.	Mainly non-ducted low-pressure atmospheric air applications. Pressure development can be increased by diaphragm mounting.
8. Mixed-flow 	45–70	45–70	Straight-through flow. Suitable for installing in any position in run of ducting. Can be used for higher pressure duties than type 2. Lower blade speeds than types 1 or 2, hence lower noise.	Stator vanes are generally highly loaded due to higher pressure ratios. Maximum casing diameter is greater than either inlet or outlet diameters.	Large ventilation schemes where the higher pressures developed and lower noise levels give an advantage over type 2.
9. Cross-flow or tangential-flow 	—	40–50	Straight across flow. Long, narrow discharge.	Low efficiency. Very low pressure development.	Fan coil units. Room conditioners. Domestic heaters.

that permits vortex flow to the casing outlet and converts some of the high velocity pressure at the blade tips into static pressure. There are several variations of the basic form (see below) and the impellers may be arranged as single-inlet types or double-inlet, double-width types (DIDW), essentially two single inlet impellers running back to back in parallel.

— *Forward-curved or multi-vane*: the impeller has a relatively large number of short, forward-curved blades. The air is impelled forward in the direction of rotation at a speed greater than the impeller tip speed. For a given duty, this type of fan is the smallest and least noisy of the centrifugal types. It operates with the lowest tip speed and is often referred to as a low-speed fan. As the velocity of the air does not decrease within the blade passages, the efficiency is not high (although it is generally equivalent to other types at low operating pressures) and the motor can easily be overloaded if the system resistance is overestimated (i.e. the fan power increases as system resistance is decreased). This type can only be used within a scroll housing.

— *Straight-radial or paddle-blade*: the impeller has a few (typically six) straight blades, which may be fixed by the roots to a spider or may have a back-plate and shroud-plate. This is the simplest, and least efficient of fan types but is well suited to applications where airborne material is present, as the blades are unlikely to clog. The impeller is of high mechanical strength and is cheap to refurbish. Renewable blades or wear plates are often fitted.

— *Backwards-curved blade*: the air leaves the impeller at a speed less than the impeller tip speed and the rotational speed for a given duty is relatively high. The impeller has from 10 to 16 blades of curved or straight form, inclined away from the direction of rotation. Because the blades are deep, good expansion within the blade passages takes place and this, coupled with a relatively low air speed leaving the impeller, ensures high efficiency and a non-limiting power characteristic. This fan type may be operated without a scroll diffuser and has become popular for AHU applications as a 'plug' fan, where its compact axial dimensions are beneficial.

— *Aerofoil blade*: a refinement of the backwards-curved fan in which the impeller blades are of aerofoil contour with a venturi throat inlet and fine running clearance between inlet and impeller. The casing is compact and the volumetric output is high. It has the highest static efficiency but is a relatively high-speed fan due to the low-pressure development.

(*c*) Propeller fans

Propeller fans comprise an impeller of two or more blades of constant thickness, usually of sheet steel, fixed to a centre boss and are designed for orifice or diaphragm mounting. They have high volumetric capacity at free delivery but very low-pressure development. However, this may be increased by fitting the fan in a diaphragm, which in turn may be installed in a circular or rectangular duct of area greater than the blade-swept area. The conventional efficiency of propeller fans is low, but in their typical application of moving air across a partition, their specific fan power may be acceptable.

(*d*) Cross-flow or tangential fans

These resemble a forward-curved centrifugal type impeller but with greatly increased blade length and the conventional inlets blocked off. The impeller runs in a half casing with conventional discharge but no inlet. Air is scooped inwards through the blade passages on the free side, but at the opposite side of the impeller, due to the influence of the casing, the air obeys the normal centrifugal force and flows out of the impeller and through the fan discharge.

The principle of operation relies on the setting up of a long cylindrical vortex stabilised within the impeller, which, being much smaller in diameter than the impeller, rotates at high angular velocity. This in turn drives the main airstream past the blades of the fan with higher velocity than the peripheral speed of the blades themselves. In effect the air flows 'across' the impeller, almost at right angles to the axis. Because this fan is so different from other types, direct comparisons are not valid. A serious disadvantage of this type is that it cannot be operated at shaft speeds widely different from that for which it has been designed. Consequently it obeys the fan laws only within narrow limits of speed change. It operates with a high discharge velocity and an expander is desirable when connected to ductwork, especially as the efficiency (which is rather less than that for the multi-vane fan) peaks at near-free delivery conditions. The discharge opening is characteristically narrow so the fan is not easily applicable to ducting but is well suited to fan coil units and electric space heaters.

(*e*) Mixed-flow in-line fans

Mixed-flow fans comprise an impeller with a number of blades, often of aerofoil section, similar to the axial flow fan. The hub is of conical shape such that the passage of air through the impeller has both axial and radial components, hence the term 'mixed flow'. Mixed-flow fans are of high efficiency and can be designed for higher pressure duties than axial flow fans. To remove the swirl generated by the passage of air through the impeller, stator guide vanes are fitted downstream. These vanes are generally highly loaded due to the high-pressure ratios. If the inlet and outlet flanges are to be of the same diameter, a change in casing profile is necessary in the region of the guide vanes. Separation of airflow can occur if the conditions for which the fan was designed are not maintained in practice.

(*f*) Bifurcated fans

Bifurcated fans handle atmospheres normally detrimental to the life of the fan motor, including saturated and dust-laden atmospheres, heated air, hot gases and corrosive fumes. They are normally direct drive with the motor isolated from the system airstream. These fans are generally of the axial flow type, but similar 'motor out of airstream' concepts are well established for centrifugal types.

2.6.1.3 Fan performance

Definition of terms

Fan performance is expressed in terms of fan size, air delivery, pressure, speed and power input at a given air density. Efficiency will be implied or specifically expressed. The size of a fan depends on the individual manufacturer's coding but is generally expressed as, or is a function of,

either the inlet diameter or the impeller diameter. Other terms are defined in BS EN ISO 5801: 2008: *Industrial fans. Performance testing using standardized airways* (BSI, 2008c) and BS EN ISO 13349: 2010: *Fans. Vocabulary and definitions of categories* (BSI, 2010c).

— *Standard air*: for the purposes of rating fan performance, reference air is taken as having a density of 1.200 kg·m^{-3}; this value corresponds to atmospheric air at a temperature of 293.15 K, a pressure of 101.325 kPa, relative humidity of 40 per cent and a gas constant (R_w) of 288 J/kg·K (section 12.1 of BS EN ISO 5801: 2008 (BSI, 2008c)).

— *Fan inlet area* (A_1): the surface plane bounded by the upstream extremity of the air-moving device. *Note*: fan inlet area is, by convention, taken as the gross area in the inlet plane inside the casing.

— *Fan outlet area* (A_2): the surface plane bounded by the downstream extremity of the air-moving device. *Note*: fan outlet area is, by convention, taken as the gross area in the outlet plane inside the casing

— *Fan pressure* (p_f): the difference between the stagnation pressure at the fan outlet (p_{sg2}) and the stagnation pressure at the fan inlet (p_{sg1}) given by the equation:

$$p_f = p_{sg2} - p_{sg1} \tag{2.21}$$

Note: when the Mach number is less than 0.15, it is possible to use the relationship:

$$p_f = p_{tf} = p_{t2} - p_{t1} \tag{2.22}$$

where p_{tf} is the fan total pressure.

Note: it is possible to refer the fan pressure to the installation category A, B, C or D (see below).

— *Stagnation pressure at a point* (p_{sg}): pressure that would be measured at a point in a flowing gas if it were brought to rest via an isentropic process.

Note: *Ma* is the Mach number at this point; for Mach numbers less than 0.122 obtained for standard air with duct velocities less than 40 m·s^{-1}, the stagnation pressure is virtually the same as the total pressure.

— *Dynamic pressure at the fan outlet* (p_{d2}): conventional dynamic pressure at the fan outlet calculated from the mass flow rate (q_m), the average gas density at the outlet and the fan outlet area:

$$p_{d2} = \rho_2 \frac{v_{m2}^2}{2} = \frac{1}{2\rho_2}\left(\frac{q_m}{A_2}\right)^2 \tag{2.23}$$

— *Fan static pressure* (p_{sf}): this is defined as the fan pressure minus the fan dynamic pressure corrected by the Mach factor (f_{M2}) as given by the following equation:

$$p_{sf} = p_{sg2} - p_{d2} f_{M2} - p_{sg1} = p_2 - p_{sg1} \tag{2.24}$$

Note: it is possible to refer the fan static pressure to the installation category A, B, C or D (see below).

— *Inlet volume flow rate*: the methods of flow measurement in this International Standard lead to a determination of the mass flow rate (q_m). In the absence of leakage, q_m is constant throughout the airway system. The inlet volume flow rate can be expressed as the volume flow rate under inlet stagnation conditions, i.e:

$$q_{Vsg1} = \frac{q_m}{\rho_{sg1}} \tag{2.25}$$

where:

$$\rho_{sg1} = \frac{p_{sg1}}{R_w \Theta_{sg1}} \tag{2.26}$$

where Θ is absolute temperature.

— *Fan air power* (P_u): the product of the inlet volume flow rate (q_{Vsg1}), the compressibility coefficient (k_p) and the fan pressure (p_f) given by the following equation:

$$P_u = q_m W_m = q_{Vsg1} p_f k_p \tag{2.27}$$

where W_m is fan (static) work per unit mass.

Note: it is possible to refer the fan air power to the installation category A, B, C or D (see below); fan air power is expressed in watts when q_m is in kg·s^{-1} and W_m is in J·kg^{-1}; fan air power is expressed in watts when q_{Vsg1} is in m^3·s^{-1} and p_f is in Pa.

— *Fan static air power* (P_{us}): the product of the inlet volume flow rate (q_{Vsg1}), the compressibility coefficient (k_{ps}) and the fan static pressure (p_{sf}); k_{ps} is calculated using $r = p_2/p_{sg1}$:

$$P_{us} = q_m W_m = q_{Vsg1} k_{ps} p_s \tag{2.28}$$

Note: it is possible to refer the fan static air power to the installation category A, B, C or D (see below); the fan static air power is expressed in watts when q_m is in kg·s^{-1} and W_m is in J·kg^{-1}.

— *Impeller power* (P_r): the mechanical power supplied to the fan impeller, expressed in watts.

— *Fan shaft power* (P_a): the mechanical power supplied to the fan shaft, expressed in watts.

— *Motor output power* (P_o): the shaft power output of the motor or other prime mover, expressed in watts.

— *Motor input power* (P_e): the electrical power supplied at the terminals of an electric motor drive, expressed in watts.

— *Fan impeller efficiency* (η_r): this is defined as fan air power (P_u) divided by the impeller power (P_r) as follows:

$$\eta_r = \frac{P_u}{P_r} \tag{2.29}$$

Note: it is possible to refer the fan impeller efficiency to the installation category A, B, C or D (see below); fan impeller efficiency may be expressed either as a proportion of unity or as a percentage.

— *Fan impeller static efficiency* (η_{sr}): this is defined as the fan static power divided by the impeller power, given by the equation:

$$\eta_{sr} = \frac{P_{us}}{P_r} \quad (2.30)$$

Note: it is possible to refer the fan impeller static efficiency to the installation category A, B, C or D (see below); fan impeller static efficiency may be expressed as a proportion of unity or as a percentage.

— *Fan shaft efficiency* (η_a): this is defined as the fan air power divided by the fan shaft power given by the equation:

$$\eta_a = \frac{P_u}{P_a} \quad (2.31)$$

Note: fan shaft power includes bearing losses, while fan impeller power does not; it is possible to refer the fan shaft efficiency to the installation category A, B, C or D (see below); fan shaft efficiency may be expressed as a proportion of unity or as a percentage.

— *Fan motor shaft efficiency* (η_o): this is defined as the fan air power P_u divided by the motor output power P_o as given by the equation:

$$\eta_o = \frac{P_u}{P_o} \quad (2.32)$$

Note: it is possible to refer the fan motor shaft efficiency to the installation category A, B, C or D (see below); fan motor shaft efficiency may be expressed as a proportion of unity or as a percentage.

2.6.1.4 Fan installation category

According to BS EN ISO 5801: 2008: *Industrial fans. Performance testing using standardized airways* (BSI, 2008c), fans should be tested using a method that is to some extent representative of their intended installation type. The standard contains extensive definitions of the various test ductwork arrangements, and the difference in performance levels achieved can be considerable, and should be included in any assessment of fan suitability.

The four categories of installation are as follows:

— *category A:* free inlet, free outlet

— *category B:* free inlet, ducted outlet

— *category C:* ducted inlet, free outlet

— *category D:* ducted inlet, ducted outlet.

In the above classification, the terms should be taken to have the following meanings. Free inlet or outlet signifies that the air enters or leaves the fan directly from or into the unobstructed free atmosphere. Ducted inlet or outlet signifies that the air enters or leaves the fan through a duct directly connected to the fan inlet or outlet respectively.

2.6.1.5 Fan efficiency

The various definitions of impeller efficiency given in the section on terminology (section 2.6.1.3), demonstrate that it is always important to identify the precise scope of the term being considered. This has become a pertinent issue, as the need to identity, quantify and verify products in terms of their energy efficiency has become very important. The Ecodesign of Energy-using Products (EuP) Directive 2005/32/EC (EC, 2005) was recast as the ErP (Ecodesign of Energy-related Products) Directive 2009/125/EC (EC, 2009), expanding its scope from products that require energy to perform their primary function to include products that influence energy use. The European government has sought to apply energy-labelling schemes (Energy Labelling Directive 92/75/EEC (EC, 1992)) to a wider variety of products, and fans are now included in this exercise.

Because of the wide variety of fan types and their specific operating characteristics, there has been a great deal of work necessary to establish fan product groups and then to determine appropriate efficiency measures and levels for each type. The approach that has been adopted is to consider each fan type when operating at its peak efficiency point. (On a fan performance curve, there is one operating point that corresponds to the intended design conditions — for all other duty points the fan efficiency levels are not optimised.)

There are also issues of physical scale to be considered, as impeller details such as blade thickness and running clearances do necessarily scale with the principal dimensions of the impeller. This generally means that larger impellers are more efficient.

The result of this exercise has been to establish a range of fan/motor efficiency grades (FMEG) appropriate to each fan type, which are related to the fan input power (BSI, 2015c). The grades are applicable to fans with input powers in the range 0.125 kW to 500 kW. The minimum efficiency target when plotted against fan input power is constructed such that two curves are defined for the ranges 0.125–10 kW and >10–500 kW. Depending on the fan type and the appropriate installation category, efficiency grades may be based on static or total pressures. The FMEG came into effect in the EU from 2013.

An example efficiency curve set is illustrated in Figure 2.38.

The work has led to the publication of BS EN ISO 12759: 2015: *Fans. Efficiency classification for fans* (BSI, 2015c), which specifies:

> 'requirements for classification of fan efficiency for all fan types driven by motors with an electrical input power range from 0.125 kW to 500 kW. It is applicable to (bare shaft and driven) fans, as well as fans integrated into products. Fans integrated into products can be measured as stand-alone fans.'

2.6.1.6 The fan laws

For a given system in which *the total pressure loss is proportional to the square of the volume flow*, the performance of a given fan at any changed speed is obtained by applying the following three rules (the air density is considered unchanged throughout).

— *Rule 1*: The inlet volume varies directly as the fan speed.

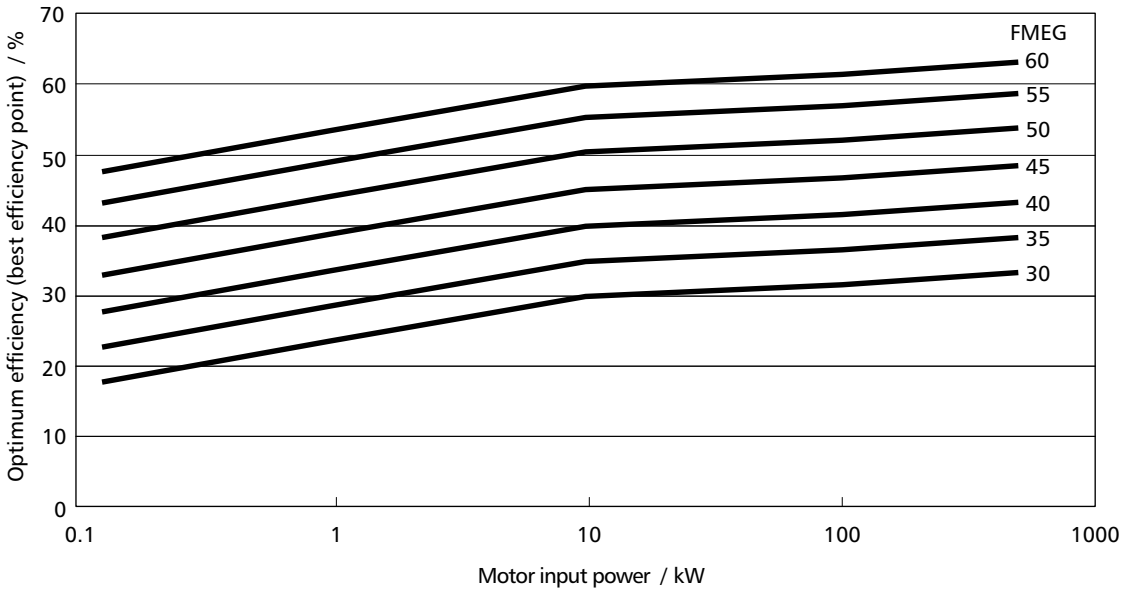


Figure 2.38 Efficiency curves for different fan/motor efficiency grades

— *Rule 2:* The fan total pressure and the fan static pressure vary as the square of the fan speed.

— *Rule 3*: The air power (total or static) and impeller power vary as the cube of the fan speed.

It should be noted that the pressure loss characteristics of several common system element types (e.g. filters, heat exchangers) do not conform to this pattern. Where such elements represent a significant proportion of the overall system resistance, use of these calculations can lead to inaccurate results.

For changes in density the following rule is applied.

— *Rule 4*: The fan total pressure, the fan static pressure and the fan power all vary directly as the mass per unit volume of the air, which in turn varies directly as the barometric pressure and inversely as the absolute temperature.

For geometrically similar airways and fans operating at constant speed and efficiency the performance is obtained by applying the following three rules (the air density is considered unchanged throughout).

— *Rule 5*: The inlet flow rate varies as the cube of the fan size.

— *Rule 6*: The fan total pressure and the fan static pressure vary as the square of the fan size.

— *Rule 7*: The air power (total or static) and impeller power vary as the fifth power of the fan size.

2.6.2 Air control units

2.6.2.1 General

Fans consume a large proportion of the total energy in mechanically ventilated buildings. A high priority should therefore be given to achieving energy-efficient fan operation. Fan volumes and pressure drops should be minimised by good design. Benchmarks for fan volumes and pressure drops are provided in CIBSE Guide F (2012).

The two approaches used to regulate the amount of energy used by fans (within the EU), have their basis in the Energy Performance in Buildings Directive (2002/91/EC) (EC, 2002) and the EuP Directive 2009/125/EC (EC, 2009).

The specific fan power (SFP) is a measure of ventilation system performance that unifies the various elements of system design and has been widely adopted in regulations. It integrates the effects of active components such as fans and AHUs, and the passive (in airflow terms) elements such as filters and ducting.

The calculation methods and uses of SFP in ventilation system design and validation are extensively covered in European standards, for example BS EN 13779: 2007: *Ventilation for non-residential buildings. Performance requirements for ventilation and room-conditioning systems* (BSI, 2007a).

In its simplest form, the SFP is the result of dividing the total input power to the ventilation system (i.e. including the loads due to controls and ancillary items) by the delivered air volume flow rate and may be considered at the unit, zone or building level.

Consideration should be given to over-sizing parts of the system to reduce pressure drops, for example by increasing the AHU cross-sectional area, as components such as heat recovery devices, filters and cooling coils are likely to be responsible for the majority of the losses.

Equipment and ductwork dimensional selections may be optimised for both whole-life cost and minimum energy use, with the resulting designs differing principally in terms of capital costs. Selection should favour the more efficient fan types and try to ensure that the fans will be operating at peak efficiency.

In ventilation systems for spaces where occupancy levels or type of use varies, efficient means of volume flow rate control should be incorporated to meet varying levels of demand. This may be at the dictates of temperature, pressure or air-quality sensors. Flow control may be achieved by a number of means including:

— on/off, multi-speed or variable speed operation

— varying the blade pitch (during operation) for axial fans

— inlet guide vanes.

These types of demand-controlled ventilation can have a very significant effect on the energy required to operate the system — in terms of both fan power and the heating and/or cooling loads. There are additional benefits in terms of reduction in system noise levels, maintenance requirements and improvements in overall system longevity.

Control is particularly needed when various areas to be air conditioned have differing heat gain patterns with respect to time; these can be met from a central plant in which either the temperature or volume (or both) of the air supplied to each area is varied to meet the particular requirements of the area. Such temperature or volume control may be carried out in ductwork serving a number of rooms or zones, or it may be carried out in the terminal units feeding individual rooms.

2.6.2.2 Volume flow control

Fan speed control

Of the methods mentioned, fan speed control is the most widely adopted, and today's ventilation systems have the advantage of the availability of very effective motor control technologies.

Two control families tend to dominate fan applications. First, speed control by variable frequency device (inverter) applied to essentially standard three-phase AC induction motors (suitably rated and constructed). These devices allow a speed control range of approximately 30 to 100 per cent (over-speed operation is also possible where sufficient motor capacity is available) and offer a variety of interface options for building management system (BMS) and other control system integration.

The second and, more recently, popular speed control type is referred to as 'EC' technology in reference to the electronic commutation applied to a high efficiency permanent magnet DC motor. Power supply conversion is generally provided on the motor itself, allowing direct connection to the AC mains supply. Again, a range of interface options is available.

AC induction motor designs have reached good levels of efficiency, particularly in larger sizes, and European legislation (IEC, 2014) for minimum motor efficiency levels extends down to approximately 80 per cent at 0.75 kW. The best EC-type motors are capable of reaching these efficiency levels in motors with output ratings down to approximately 200 W.

It is important for the system designer to understand that control elements (both electrical and mechanical types) have an inherent power conversion efficiency that is less than unity and that their use may also have a detrimental effect on the base motor efficiency.

These effects need to be assessed and compared with the potential energy savings with full knowledge of the modes of system operation.

Mechanical volume controller

This is a device that is self-actuating and capable of automatically maintaining a constant pre-set volume through it, provided that the pressure drop across it is above a minimum of about 120 Pa and below a maximum of about 250 Pa. As the supply air pressure increases, most devices of this type tend to close progressively by means of a flexible curtain or solid damper — a multi-orifice plate fixed across the complete airway of the unit. As such a unit achieves volume reduction by reducing the airway, there is a tendency to generate noise, particularly when working at high air pressures. For this reason, the volume controller is generally supplied in an acoustically treated terminal unit. It is factory pre-set to pass a specific volume and, when installed, will automatically give a pre-balanced air distribution system up to and including the terminal unit. It can be adjusted on-site, if desired.

Pressure regulating valve

This is an assembly consisting of one or two rows of shaped blades, the size of which changes when volume adjustment is required. Because of the particular blade shape, the device gives volume adjustment up to pressure drops of about 630 Pa without generating excessive noise.

The majority of dampers are set on-site, but they can be controlled from a static pressure-sensing element. Such units are generally supplied as a separate component for direct installation in the ductwork and not as part of a terminal unit.

Damper control

A damper is normally of the butterfly or multi-leaf type and capable of controlling the volume, providing the pressure drop across the damper does not exceed about 40 Pa. If the pressure drop is higher, there will be a tendency to generate excessive noise. Normally the damper is supplied as a separate component for direct installation in the ductwork and not as part of a terminal unit. Final adjustment is carried out manually on-site.

Dampers, while essential for airflow balancing in branched systems, waste fan energy and should not generally be used for primary air volume control. See GIR 41: *Variable Flow Control* (Action Energy, 1996) for further information on volume control.

2.6.2.3 Control of temperature

The control of temperature may be achieved by:

— *blending*: two separate airstreams, one warm and one cool, are supplied to a zone and mixed in a terminal unit to produce a supply air temperature that offsets the zone cooling or heating loads

— *reheat*: controlled reheat of a pre-conditioned, low temperature air supply by means of hot water, steam or electric coils, may be used to give a resultant supply air temperature that will satisfy the zone requirement.

2.6.3 Mixing boxes

A mixing box is a plenum in which recirculated and fresh air are mixed before entering an AHU. It may be part of the ductwork installation, a builder's work chamber or a standard module attached to packaged plant.

Mixing boxes must be designed to provide sufficient mixing so that freezing outside air does not stratify below warm recirculation air on entering the filters. If in doubt, a frost coil at the air intake should be provided. Motorised dampers should be located and set to promote mixing of the airstreams. Parallel blade dampers may assist mixing. Air blenders/baffles can also be used. To improve the range ability of a motorised control damper, the face velocity should be increased to 5–6 $m \cdot s^{-1}$ by adjusting the duct size or by blanking off an appropriate area of the duct at the damper. Damper quality is critical; play in linkages and pivots should be minimal and leakage on shut-off should be less than 0.02.

The use of high velocities and the other methods mentioned to promote improved mixing does have consequences in terms of system operating power and of noise generation.

2.6.4 Air terminal devices: diffusers and terminals

2.6.4.1 Introduction

An air terminal device is needed to ensure the correct discharge of air from a ventilation system into the ventilated space. Air can be supplied to the space in a number of ways (HEVAC, 2015), the principal division being between diffusers and perpendicular jets. Airflow patterns for both types are strongly dependent upon the presence or absence of the Coanda effect (see 'Coanda effect' in section 2.4.3.5). Table 2.34 summarises the types of air terminal devices and provides information on typical face velocities (based on any local control devices being fully open) and noise levels.

The location of terminal devices is also an important consideration. A floor-based supply is usually selected if raised floors are in place as might be common for IT systems. Floor-based systems allow the ceiling mass to be exposed. They may however restrict the furniture layout unless any under-floor units or distribution grilles are designed for easy relocation. Access for maintenance is, in theory, easy. Displacement system diffusers are normally floor based or floor mounted. Alternatively, diffusers may be ceiling based. This allows greater flexibility of furniture layout and also allows heat to be more efficiently extracted from light fittings. Supply terminals may also be incorporated into wall (high or low level), desktop, seat back or under seats. Further guidance can be obtained from HEVAC (2015). Conventional mixing systems are typically ceiling based.

Diffusers may be radial, part-radial or linear and normally utilise the Coanda effect and or/swirl to reduce the risk of excessive room air movement. A perpendicular jet is formed by discharging air through grilles, louvres, nozzles or any opening that allows perpendicular flow. Direction and spread adjustment can be provided using blades and/or swivel adjustment.

2.6.4.2 Terminal and diffuser types

Types vary according to need, and it is important to select the correct component. Common types are described in more detail below (REHVA, 2003; Jackman, 1990).

Pure displacement terminals

Pure displacement terminals aim to get air into the room with a minimum of eddies, room air mixing and temperature pick-up before it reaches the occupants. Hence there is a very small temperature difference between the supply air and that of the occupied zone.

Induction-type diffusers

Induction-type diffusers are intended to promote various levels of eddy mixing of the room air at the diffuser face. This allows lower supply air temperatures and hence marginally greater displacement cooling capacity. They have a larger approach temperature, generally require some mechanical cooling and impart a higher turbulent intensity with potential discomfort. Induction type diffusers for displacement ventilation require a substantial diffuser open area to obtain low velocities. Without this the discharge, velocity will be too high to support displacement ventilation (see section 2.2.8.2).

Swirl-type diffusers

Swirl type diffusers introduce air into a space with a swirling rotational discharge. This results in a rapid induction of room air into the primary air stream causing a quicker reduction of primary air velocity and temperature differential than in the case of conventional square or circular diffusers.

2.6.5 Ventilation air intake and discharge points

Outdoor air is drawn into a mechanical ventilation system through an air intake and discharged into the atmosphere from the ventilation system through a discharge terminal.

Each intake and discharge point should be protected from the weather by louvres, cowls or similar devices. Any space behind or under louvres or cowls should be 'tanked' and drained if there is a possibility of penetration by, and accumulation of, rain or snow that could stagnate and give rise to unpleasant odours within the building. Bird screens and insert mesh should be used to prevent entry by birds or other large objects. Intake points should be situated to minimise pollution from potential sources (existing and planned) including:

— traffic
— boiler flues and exhausts from standby generators (or combined heat and power engines)
— cooling towers and other heat rejection plant
— vents from plumbing, oil storage tanks etc.
— ventilation exhausts from fume cupboards, kitchens, toilets, car parks, print rooms
— stagnant water (e.g. on flat roofs)

— roosting ledges for birds (droppings can be a source of biological contamination)

— gardens or areas of vegetation (sources of fungal spores or pollen)

— areas where leaves or other litter might accumulate

— radon gas.

Because traffic is generally a ground-level pollutant, there is normally a reduction in pollutant concentration with height, so that concentrations are lower at roof level. Vehicle loading bays can be subject to traffic pollution.

Whilst wet cooling towers give rise to the greatest health concern because of the potential risk of legionella, other heat rejection equipment can also affect system performance by elevating the temperature of the intake air and increasing the cooling demand on the system.

Locating system discharge and intake points close together facilitates the use of some heat-recovery strategies. However, it will also increase the risk of 'short circuiting'. Even extract systems from 'normal' occupied areas will contain pollutants generated by internal sources. These may not represent a health hazard but may still result in an odour nuisance if recirculated. The more remote the intake from the discharge point, the less the risk of short circuiting. Locating the intake and discharge on different façades can also help to reduce the risk. However, wind forces on the two fan systems (which will be balanced for openings on the same façade) may affect fan performance and cause flow instabilities, particularly where fan pressures are low. The influence of wind pressures can be reduced by:

— positioning openings within a zone of minimal pressure fluctuation

— providing balanced openings that face in two or more opposite directions or an omni-directional roof-mounted cowl.

Table 2.34 Types of air terminal device

Type	Application	Location	Core velocity / $m \cdot s^{-1}$		Description and remarks
			Quiet	Commercially quiet	
1. Perforated or stamped lattice	Supply, extract, transfer	Ceiling, side wall, floor	Up to 3	Up to 6	Simple form of grille with small free area. Alternatively can be used as supply diffuser with high air entrainment allowing large quantities to be diffused. For low-level 'laminar flow' panels to give displacement ventilation, a velocity of 0.25 $m \cdot s^{-1}$ is used.
2. Aerofoil blades (one row adjustable)	Supply, extract	Ceiling, side wall, desk top	4	8	Frequently used grille with large free area. Directional control in one plane only for supply applications.
3. Aerofoil blades (two rows adjustable)	Supply	Side wall	4	8	As type 2 but with directional control in two planes.
4. Fixed blade	Supply, extract		4	8	Robust grille with limited free area. Some directional control possible using profiled blades.
5. Non-vision	Extract, transfer	Side wall	3	8	Low free area. Designed to prevent through vision.
6. 'Egg crate'	Extract	Ceiling, side wall	4	8	Generally largest free area grille available.
7. Fixed geometry diffusers	Supply, extract	Ceiling, floor, desk top	4	8	Radial discharge diffusers offer good air entrainment allowing diffusion of large air quantities. Square or rectangular diffusers can provide 1-, 2- or 3-way diffusion. Angled blades can be used to apply twisting motion to supply air.
8. Adjustable diffusers	Supply	Ceiling	4	6	As type 7 but offers horizontal or vertical discharge. Can be thermostatically controlled.
9. Slot and discharge, linear diffusers	Supply, extract	Ceiling, side wall, desk top, under window	4	8	Offers vertical or horizontal single or multiple slots. Care must be taken with design of plenum box. Desk top units may incorporate induction of room air.
10. Air handling luminaires	Supply, extract	Ceiling	4	8	As type 9 but single slot only. Normally used in conjunction with extract through luminaire.
11. Ventilated ceiling nozzle	Supply, extract		—	—	Void above ceiling is pressurised to introduce air at low velocity through many single holes or through porous panels. Air entrainment is restricted and natural air currents may affect room air distribution.
12. Nozzles, drum and punkah louvres	Supply	Ceiling, side wall, under window, seat back	—	—	Adjustable type can be rotating drum or swivelling ball, with or without jet for long throws and personal air supply or 'spot' cooling. Fixed multiple nozzles are used for high-induction applications. Velocities depend on throw, noise and induction requirements.

Measures that should be considered to minimise re-entry from contaminated sources include (ASHRAE, 2009):

— grouping exhaust to increase plume rise due to the greater momentum of the combined exhaust

— placing inlets on the roof where wind pressures will not vary greatly with direction to ensure greater stability

— avoiding locating exhaust outlets within enclosures or architectural screens that may hold contaminants within areas of flow recirculation

— discharging exhausts vertically

— locating wall exhausts on the upper third of a façade and intakes on the lower third to take advantage of normal wind separation on a building façade (although consideration should be given to flow recirculation that can occur on a leeward façade)

— avoiding locating inlets and exhausts near edges of walls or roofs due to pressure fluctuations.

Toxic and hazardous exhaust must not be discharged in a manner that will result in environmental pollution. The local authority environmental health officer should be consulted to ensure that the proposed discharges will be acceptable. European Directive 80/779/EEC (EC, 1980) gives mandatory air-quality standards for smoke and sulphur dioxide (see also section 2.2.2). A vertical discharge stack, capable of imparting a high efflux velocity to the exhaust, may be required. If so, provision must be made for handling rainwater and avoiding corrosion. Industrial processes resulting in polluting emissions to air, water or land come under the requirements of the Environmental Protection Act (HMSO, 1990). CIBSE Guide A (2015a) provides guideline values for pollutants. Reference should also be made to CIBSE TM21: *Minimising pollution at air intakes* (1999) for more detailed guidance on pollution sources and assessment methods.

2.6.6 Process exhaust hoods

2.6.6.1 General

Exhaust hoods are required to collect stale or contaminated air from processes for safe discharge into the atmosphere. In the case of chemical or biological contamination, cleaning and filtration of the exhaust will be necessary.

Typical examples of extract hood are illustrated in Table 2.35 below. For each hood the table also gives the equations for air volume flow rates through overhead canopies for both cold and hot processes (Stewart, 1985). Appropriate control velocities and convective heat transfer rates are given in Tables 2.36 and 2.37 respectively.

Table 2.38 shows the effects of adjacent surfaces on the basic form of hoods and canopies. However, specific processes may require other hood arrangements not shown in either Table 2.35 or 2.38. A publication by the American Conference of Government Industrial Hygienists (ACGIH, 2013) provides a wide range of empirically based design data sheets for many common industrial processes, which should always be consulted before proceeding with the design of a local exhaust system.

The size, aspect ratio, position and number of openings used depend upon:

— the size and nature of the source (opening must overhang source if possible)

— the dynamics and rate of evolution of contaminant

— the access needs and position of the operator

— the prevailing room air currents (side baffles should be provided if possible).

2.6.6.2 Overhead canopies

Overhead canopies are only appropriate for hot processes that cannot be kept covered and must not be used if the operator is likely to lean over the process or if strong cross draughts are likely to occur. Baffle plates can be incorporated into larger hoods to ensure an even velocity across the opening, whilst very large hoods should be sectioned, each section having its own off-take.

2.6.6.3 Lateral exhaust

For processes in which the emission momentum is small or tends to carry the pollutant horizontally away from the source, horizontal slots or hoods at the edge of a work surface or tank may be used. Slots may be arranged one above the other (see Figure 2.39) or facing each other along

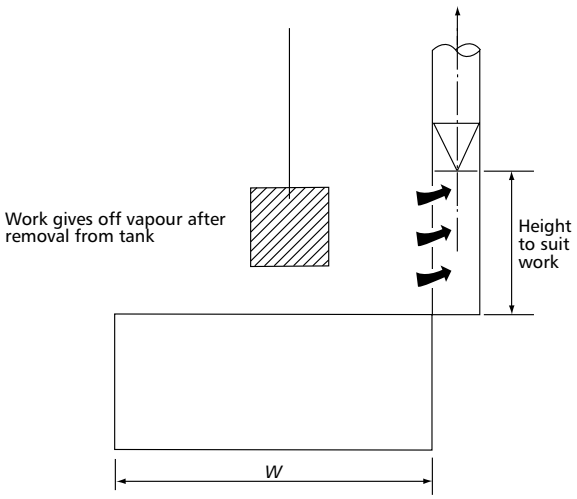


Figure 2.39 Open surface tank with drying facility, single side exhaust

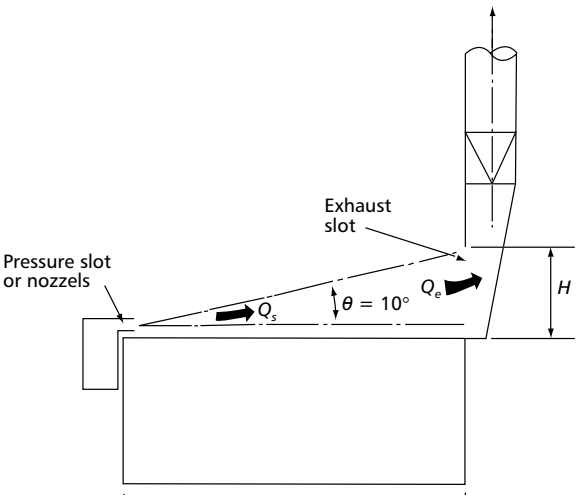
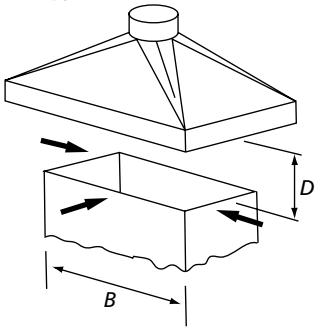
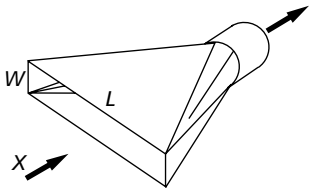
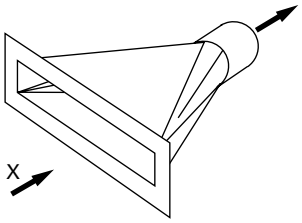
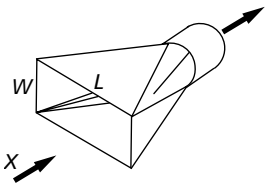
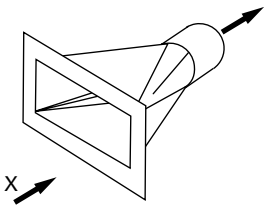


Figure 2.40 Push-pull hood

Table 2.35 Air volume flow equations for hoods and canopies

Type of opening	Equation	Notes
Canopy 	Cold source: $Q = 1.4\,P\,D\,v$	If $D > 0.3\,B$, use equation for hot source. Canopy should overhang tank by $0.4\,D$ on each side.
	Hot source, exposed horizontal surface: $Q = 0.038\,A_s\sqrt[3]{h\,D} + 0.5\,(A - A_s)$	Q is progressively underestimated as D increases above 1 m. Canopy should overhang tank by $0.4\,D$ on each side
	Hot source, exposed sides and top: $Q = 0.038\,A_s\sqrt[3]{\left(h\,A_t\,D\right)/A_s} + 0.5\,(A - A_s)$	Q is progressively underestimated as D increases above 1 m. Canopy should overhang tank by $0.4\,D$ on each side
Plain slot 	$Q = L\,v\left(4\,X\sqrt{X/W} + W\right)$	Aspect ratio R should be not less than 10
Flanged slot 	$Q = 0.75\,L\,v\left(4\,X\sqrt{X/W} + W\right)$	Aspect ratio R should be not less than 10. If $\times > 0.75\,W$, use equation for plain slot
Plain opening 	$Q = v\left(10\sqrt{R\,X^2 + A}\right)$	Aspect ratio R should not exceed 5; equation may be used for $R > 5$ but with loss of accuracy
Flanged opening 	$Q = 0.75\,v\left(10\sqrt{R\,X^2 + A}\right)$	Aspect ratio R should not exceed 5; equation may be used for $R > 5$ but with loss of accuracy If $\times > 0.75\,W$, use equation for plain opening

Symbols:

A = area of hood/opening (m^2)
A_s = horizontal surface area of source (m^2)
A_t = total exposed heated surface area of source (m^2)
B = breadth of source (m)
D = height above source (m)
L = length of hood/opening (m)
P = perimeter of source (m)
Q = volume flow rate ($m^3 \cdot s^{-1}$)
R = aspect ratio (L/W)
W = width of hood/opening (m)
X = distance from source (m)
h = rate of convective heat transfer ($W \cdot m^{-2}$)
v = control velocity ($m \cdot s^{-1}$)

opposite long edges, depending upon the vertical distance of the source above the rim of the tank. If the most remote part of the source is less than 0.5 m from the slot, a single exhaust slot along the longer edge is adequate, otherwise two slots, on opposite sides of the source, are required.

2.6.6.4 Jet-assisted hoods

Jet-assisted hoods are non-enclosing hoods combined with compact, linear or radial jets. They are used to separate contaminated zones from relatively clean zones in working spaces. They prevent contaminated air from moving into clean zones by creating positive static pressures, typically in the form of an air curtain.

2.6.6.5 Push-pull hoods

For sources larger than 1 m across, a push-pull hood arrangement should be used (see Figure 2.40) in which a slot or row of nozzles is used to blow air across the source. Design data for the hood illustrated in Figure 2.40 are given below.

Exhaust air quantity:

$$Q_e = (0.5 \text{ to } 0.75) \times A \quad (2.33)$$

where Q_e is the exhaust airflow rate ($m^3 \cdot s^{-1}$) and A is the area of open surface (m^2).

The value of the numerical factor depends on the temperature of the liquid, presence of cross-draughts, agitation of liquid etc.

Supply air quantity:

$$Q_s = \frac{Q_e}{w \times E} \quad (2.34)$$

where Q_s is the supply airflow rate ($m^3 \cdot s^{-1}$), w is the throw length (m) and E is the entrainment factor (see Table 2.39).

Height of exhaust opening:

$$H = 0.18\, w \quad (2.35)$$

where H is the height (m) of the exhaust opening.

Width of supply opening:

size for a supply velocity of 5–10 $m \cdot s^{-1}$.

The input air volume is usually about 10 per cent of the exhaust volume and the input air should be tempered to avoid frost damage. The source must not be placed in the input air path since this could result in deflection of the contaminant into the workspace. If necessary, baffles or screens should be used to deflect cross draughts.

2.6.6.6 Equipment selection principles and integration

Industrial extract equipment may be selected to:

— conform with emissions standards; industrial processes resulting in polluting emissions to air, water or land come under the requirements of the Environmental Protection Act 1990 (HMSO, 1990)

— prevent re-entrainment where they may become a health or safety hazard in the workplace

— reclaim usable materials

— permit cleaned air to be re-circulated

— prevent physical damage to adjacent properties

— protect neighbours from contaminants.

Circular ductwork is normally preferred, as it offers a more uniform air velocity to resist the settling of material and can withstand the higher pressures normally found in exhaust systems. Design velocities can be higher than the minimum transport velocity but should never be significantly lower. Fans (or other air-moving devices) and duct materials and construction should be suitable for the temperatures, abrasion and corrosion likely to be encountered. Fans should normally be located downstream of the air cleaner to reduce possible abrasions and create a negative pressure in the air cleaner so leakage will be inward. However, in some instances the fan may be located upstream from the cleaner to help remove dust.

Exhaust stacks must be designed and located to prevent the re-entrainment of discharged air into supply system inlets (see section 2.6.5). Toxic and hazardous exhaust must not be discharged in a manner that will result in environmental pollution and the local authority environmental health officer should be consulted to ensure that the proposed discharges will be acceptable.

2.6.7 Duct equipment

2.6.7.1 General

Ducting is generally available in rectangular, circular and flat oval sections, although other sections may be made for special situations. The majority of rectangular ductwork is made to order and available in any reasonable dimensions. Ductwork with less than 0.0225 m^2 cross-sectional area (e.g. 150 mm × 150 mm) will generally be more economic if made from circular section.

The designer should consider the full range of sections available and combine them to suit the specific location. Recommended sizes for rectangular, circular and flat oval ductwork are given in Appendix 2.A1.

2.6.7.2 Types of duct

Rectangular ducting

Rectangular ducting is most common for low-pressure systems because:

— it is readily adapted to fit into the space available

— it can be readily joined to such component items as heating and cooling coils and filters

— branch connections are made more easily.

For overall economy and performance, the aspect ratio should be close to 1:1 since high aspect ratios increase the pressure loss, the heat gains/losses and the overall costs.

Table 2.36 Control velocities for hoods

Condition	Example	Control velocity / m·s^{-1}
Released with practically no velocity into quiet air	Evaporation from tanks, degreasing etc.	0.25–0.5
Released at low velocity into moderately still air	Spray booths, intermittent container filling, low speed conveyor transfers, welding, plating	0.5–1.0
Active generation into zone of rapid air motion	Spray painting in shallow booths, conveyor loading	1.0–2.5
Released at high initial velocity into zone of very rapid air motion	Grinding, abrasive blasting	2.5–10

Note: the higher values apply if (*a*) small hoods handling low volumes are used, (*b*) hoods are subject to draughts, (*c*) the airborne contaminant is hazardous, or (*d*) hoods are in frequent use.

Table 2.37 Convective heat transfer rates for horizontal surfaces

Surface temperature / °C	Rate of heat transfer / W·m^{-2}
100	580
200	1700
300	3060
400	4600
500	6600

Table 2.38 Effect of side walls and adjacent surfaces

Type of opening	Baffle	Effect
Canopy, cold source	Side walls	Reduces effective perimeter, hence flow rate Q is reduced
Canopy, hot source	Side walls	Reduces cross draughts but minimal effect on flow rate Q
Plain slot	Long side on flat surface	$Q = L\,v\left(X\sqrt{2X/W} + W\right)$
Plain opening	Long surface on flat surface	For $R \le 2$: $Q = v\left(5\sqrt{(2/R)}\,X^2 + A\right)$ For $2 < R \le 5$: $Q = v\left(5\sqrt{(R/2)}\,X^2 + A\right)$
Flanged slot or opening	Long side (not flanged) on flat surface	For $X > 0.75$, calculate flow rate Q for plain arrangement and multiply by 0.75 W

Symbols:

A = area of hood/opening (m^2)
L = length of hood/opening (m)
Q = volume flow rate (m^3·s^{-1})
R = aspect ratio (= L/W)
v = control velocity (m·s^{-1})
W = width of hood/opening (m)
X = distance form source (m)

However, ducts with a 1:1 aspect ratio require a deep service area and are therefore rarely used in ceiling zones due to space limitations.

Rectangular ducting should not be the first choice for high-pressure systems, as it requires strengthening of the flat sides and needs to be sealed to make it suitable for this application.

Circular ducting

Machine-formed, spirally wound ducting and a standard range of pressed and fabricated fittings makes circular ducting more economical, particularly in low-pressure systems having a relatively small proportion of fittings. It is likely to be easier to install, particularly for the main runs of ductwork.

Table 2.39 Entrainment factors for push-pull hoods

Throw length / m	Entrainment factor
0–2.5	6.6
2.5–5.0	4.6
5.0–7.5	3.3
>7.5	2.3

Circular ducting is preferable for high-pressure systems and for systems operating at high negative pressures, due to its high inherent stiffness. Additional stiffening rings may be necessary at high negative pressure.

Pressed and fabricated fittings can be made of metal or plastic and fitted with push fit gasketed connectors for simple fitting and good airtightness.

Flat oval ducting

Flat oval ducting provides an alternative to circular ducting principally where there is a limitation on one of the dimensions in the space available for the duct run (e.g. depth of ceiling space). It combines the advantages of circular and rectangular ductwork because it can fit in spaces where there is insufficient room for circular ducting and can be joined using the techniques for circular duct assembly. Flat oval ducting has considerably less flat surface that is susceptible to vibration and requires less reinforcement than the corresponding size of rectangular duct. Flat oval duct is suitable for both positive and negative pressure applications within the limits defined in DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a).

Other sections

Other sections may be used, such as triangular sections to pass through roof trusses. Such sections present difficulties in the provision of fittings and connections to standard plant items and are likely to be more expensive than traditional sections.

2.6.7.3 Bend and duct fitting components

Background

In normal circumstances, the flow of air in ducts is turbulent, with the flow generally in the direction of the duct axis. Eddies and secondary motions will result in energy dissipation due to internal fluid friction. Streamlines will not be parallel to the duct centre-line. In unobstructed straight ducts, eddies give rise to only relatively small

transverse components of the duct velocity and the flow velocities are symmetrical about the duct axis.

Disturbance to the flow arising from obstructions, duct fittings or other components has two major effect.

— The eddies can be significantly larger in size and their velocities much higher.

— The flow velocities across the duct become asymmetrical, i.e. much higher velocities can occur in part of the duct section, whilst in other parts even reverse flow may occur.

From the point of view of duct design, the important aspects of the effects of disturbance to airflow are:

— increased pressure loss due to creation of eddies

— increased pressure loss as high-velocity air mixes with low-velocity air

— noise generated by the interaction on eddies with the inner surfaces of the ducts.

Bends

Figure 2.41 illustrates common bend types; their influence on the airflow is described below. Bends may be characterised as 'hard' or 'soft' according to whether the change of direction is in the plane of the longer or shorter side of the cross section, respectively (see Figure 2.42).

Radiused bends

The air will flow to the outer surface causing high velocities at discharge on the outside with much lower velocities on the inside. In addition, the centrifugal effect will cause a higher static pressure at the outer surface, leading to some transverse flow towards the inner surface, and hence producing a spiral motion at the outlet. If the bend is too tight (i.e. $r/w < 1$), flow will readily separate from the inside surface with subsequent eddying and increased pressure loss. In practice, radiused bends should have an r/w value of 1.5; for low pressure-loss situations r/w should be increased to 2. They should have a downstream straight duct of at least five equivalent diameters to allow the flow to stabilise again. As a general rule, the formation of an offset in a duct layout is better achieved using two angled bends ($<90°$) rather than two right-angled bends.

(*Note*: in this Guide, r is taken as the mean radius of the bend to the centre-line of the duct; DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a) relates r to the throat radius of the duct.)

Splitter bends

These are tight radiused bends that use internal splitters to improve the airflow (see Figure 2.43). Standard settings for splitters are given in Table 2.40, which is taken from BESA (2013a). The flow in the air passages is as described for the radiused bend, but because multiple streams emerge at discharge, the outlet velocity profile will be more uniform than for a plain radiused bend. Hence the minimum straight length of downstream duct may be reduced to about four equivalent lengths.

Mitred elbows (with turning vanes)

Rectangular duct bends with either dimension greater than 200 mm should have properly designed turning vanes. The angle of the turning vane should be the same as that of the bend. Information on the structural requirements of turning vanes is given in DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a). The advantage of this type of bend is that it should not significantly distort the velocity profile, so that other duct fittings or components can be placed closer to the outlet, provided the inlet conditions to the bend are uniform. If the flow is not uniform at the inlet, this non-uniformity may persist downstream of the bend.

Optimum design of turning vanes, with careful positioning, should provide a bend with less resistance to airflow than a good design of radiused bend, but this may not be achieved in practice. This is because the inside and outside corners of the bend are usually not rounded, and internal and side fixings provide some obstructions. The pressure losses may then be a little higher than those in a good design of radiused bend, particularly in the case of small duct sizes. Eddies will be formed where air separates from the outside surface of a turning vane causing this type of bend to generate more noise than radiused and splitter bends.

Research by the American Sheet Metal and Air Conditioning Contractors' Association (SMACNA, 2006) on a 600 mm square elbow with blades of 114 mm radius shows the optimum spacing to be 82 mm. When the length of the blades is greater than 900 mm, it is preferable to use double thickness turning vanes to add stiffness, but there is a penalty due to increased pressure drop.

Mitred elbows (without vanes or splitters)

This type of bend is not recommended for bends with angles $>30°$ because the flow becomes both distorted and very turbulent. The flow leaves the bend with higher velocities on the outside surface, and separation occurs at the inside sharp edge, leading to severe eddying. The one advantage of this eddying is that it will lead to mixing of temperature-stratified air but the pressure loss will be high, with large pressure losses resulting (see section 4.11.2.4 of CIBSE Guide C (2007)). For low-velocity systems, mitred elbows can produce useful sound attenuation due to a reflection effect. Other fittings should not be placed close to the elbow.

Branches

There are many designs of branches and junctions in use. The important features are that the flow should be divided (or combined) with the minimum interference and disturbance, and that changes in duct sizes should not be made at the branch but at a short distance downstream (or upstream).

Examples of good and economic branch design are shown in Figure 2.44. A good branch design cannot be effective if the flow entering the branch is not uniform across the section. For some of the BESA recommended tee designs, no experimental data are available for the pressure loss, but the designer should consider their use. Chapter 4 of CIBSE Guide C (2007) provides useful information. Note that the addition of a small shoe on the branch tee can reduce pressure loss in both the branch flow and the straight flow.

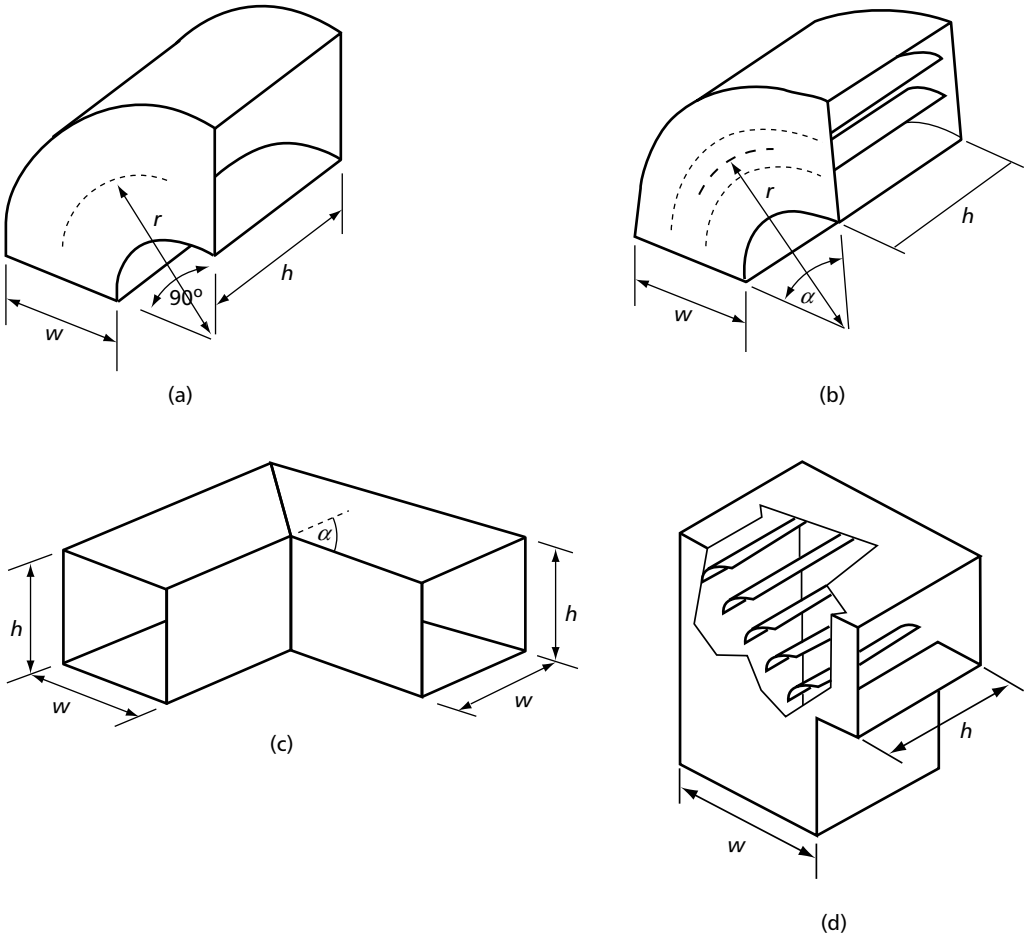


Figure 2.41 Common types of bends: (a) 90° radius bend without vanes, rectangular, (b) short radius bend with vanes (any angle), rectangular, (c) mitred elbow without vanes (any angle), (d) 90° mitred elbow with vanes

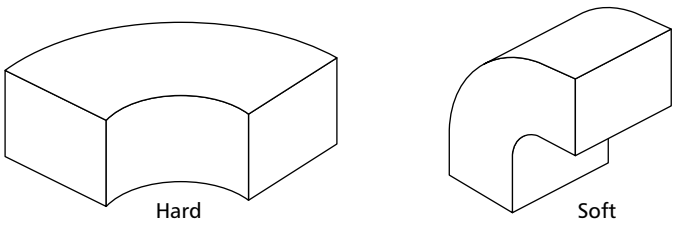


Figure 2.42 'Hard' and 'soft' bends

DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a) suggests appropriate shoe dimensions for various sizes of duct.

Change of section

Expansion

A tapered expansion of a duct causes an appreciable pressure loss due to the tendency of the flow to break away from the sides and form eddies. The greater the total included angle of divergence, the greater the pressure loss, especially for large changes in area.

The cheapest form of taper for rectangular ductwork is to maintain the same plane for three sides and incline the fourth side only (see Figure 2.45). In any diverging section, when the plane of any side changes by more than 22.5°, DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a) recommends the inclusion of splitter vanes, which should bisect the angle between any side and the duct centre-line (see Figure 2.46). However, it is not clear by how much the friction pressure drop is reduced by the introduction of such vanes. Certainly the inclusion of splitters would not seem worthwhile when the change in section (A_2/A_1) >4. Further information can be found in CIBSE Guide C, chapter 4 (2001).

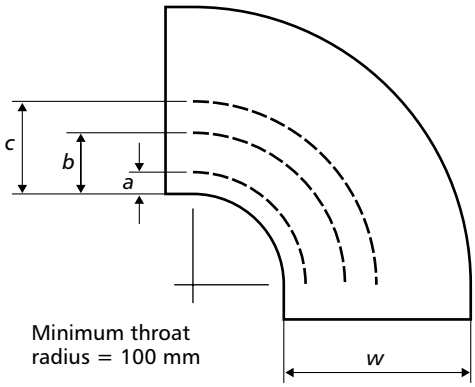


Figure 2.43 Short radius bend with splitters; position of splitters (reproduced from DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a) by permission of BESA)

Table 2.40 Short radius bends with splitters; position of splitters (BESA, 2013a)

Dimension w / mm	Number of splitters	Splitter position		
		A	B	C
400–800	1	$w/3$	—	—
800–1600	2	$w/4$	$w/2$	—
1600–2000	3	$w/8$	$w/3$	$w/2$

Note: splitters not required for bend angles less than 45°

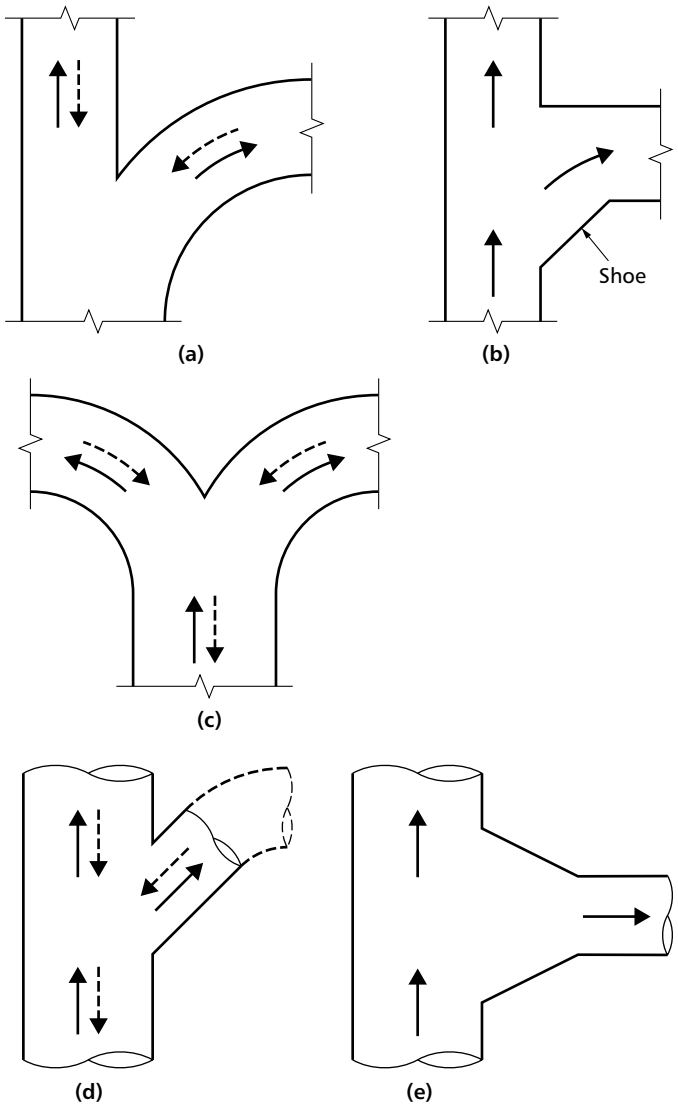


Figure 2.44 Examples of good duct design; (a) 90° swept branch, rectangular, (b) 90° branch tee with shoe, rectangular, (c) 90° radiused twin bend, rectangular, (d) 45° branch tee, circular, (e) 90° conical branch tee, circular

Contraction

Relatively little pressure drop is caused by a contraction. The designer should not feel constrained in choosing the taper angle for a contraction. No splitter vanes are needed for a contraction.

Other fittings

As a general rule, fittings should avoid abrupt changes in direction and sharp edges that cause the flow to separate and form eddies, which in turn increase pressure loss and noise generation. A fitting such as a damper can create vortices, which will result in a greater pressure drop than normal in a subsequent downstream fitting. Separation between the fittings by a minimum length of 5 equivalent diameters is recommended.

In the case of bends in rectangular ductwork, the combination of two bends in close proximity can give a lower pressure drop than two that are far apart. Further information can be found in CIBSE Guide C, chapter 4 (2007). This is not the case for two segmented circular ducts in close proximity, but the effect of close coupling is not significant.

2.6.7.4 Duct support and fixing components

General

Supports are an essential part of the ductwork system and their supply and installation are normally the responsibility of the ductwork contractor. The choice between available methods of fixing will depend on the type of building structure and on any limitations imposed by the structural design. Unless the designer has specified the requirements in detail, the load to be carried will be understood to be limited to the ductwork and its associated thermal and/or acoustic insulation. However, where the duct is large enough to allow human access for cleaning, the duct and its supports should be sufficiently strong to withstand the additional load and the type and location of access components should allow the person carrying out the cleaning to enter and exit the duct. The range of supports available includes an increasing range of proprietary types.

With a proprietary device, unless the designer has specified the requirements in detail, it will be the responsibility of the ductwork installer to ensure that it meets the requirements, with a sufficient margin of overload, and that it is installed in accordance with the manufacturers' recommendations.

Fixing to building structure

The fixing to the building structure should be of a strength and durability compatible with those of the ductwork support attached to it. A fixing to concrete or brickwork must be made in such a way that it cannot loosen or pull out through normal stressing or through normal changes in the building structure.

Horizontal ductwork

The hanger is normally mild steel plain rod or studding or flat strap, pre-treated by hot-dip galvanising, sherardising, electro-deposited zinc plating or other acceptable anticorrosion treatment. Other materials, such as multi-stranded wire, may also be acceptable. Provided the integrity of the ductwork is maintained, hangers may be attached to the corners of either the flanges or stiffeners, as an alternative to the use of a bottom bearer. Details of the construction of supports are given in DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a).

Where horizontal ductwork passes through a compartment boundary such as a wall, fire dampers should be used to maintain fire integrity

Vertical ducts

The design of supports for vertical ducts is dictated by site conditions and they are often located to coincide with the individual floor slabs. The designer must specify the particular requirements if the spacing exceeds four m. Vertical ducts should be supported from the stiffening angle or the angle frame or by separate supporting angles fixed to the duct.

Where vertical ductwork passes through a compartment boundary such as a floor, fire dampers should be used to maintain fire integrity.

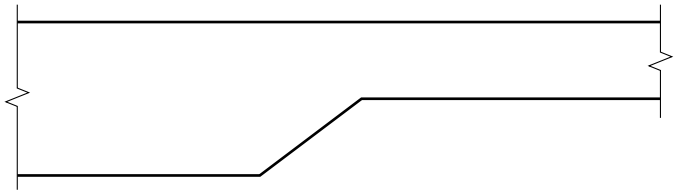


Figure 2.45 Change of section for a rectangular duct; one side only inclined

The support bearer, which, depending on duct/structural opening size, could be either channel or angle section, may be utilised in any of the following arrangements:

— Fixed directly to duct skin with sealed fixings (flat face only of either rectangular or flat oval ductwork).

— Supporting the underside of a flat bar clip in halves (circular or flat oval ductwork).

— Supporting the underside of either the stiffening frame or the flanged joint of any duct section.

— Supporting either a stiffening frame or a flanged joint below using drop rods/studs.

Insulated ducts with vapour sealing

Vapour sealing may be required where the temperature of the air within the duct can fall low enough to promote condensation on the exterior surface of the duct. This can cause moisture penetration through the thermal insulation.

In this case, the most important requirement is to limit penetration of the seal by the support. The extent of any vapour sealing of ductwork thermal insulation, and the method to be used, must be clearly specified in advance by the designer.

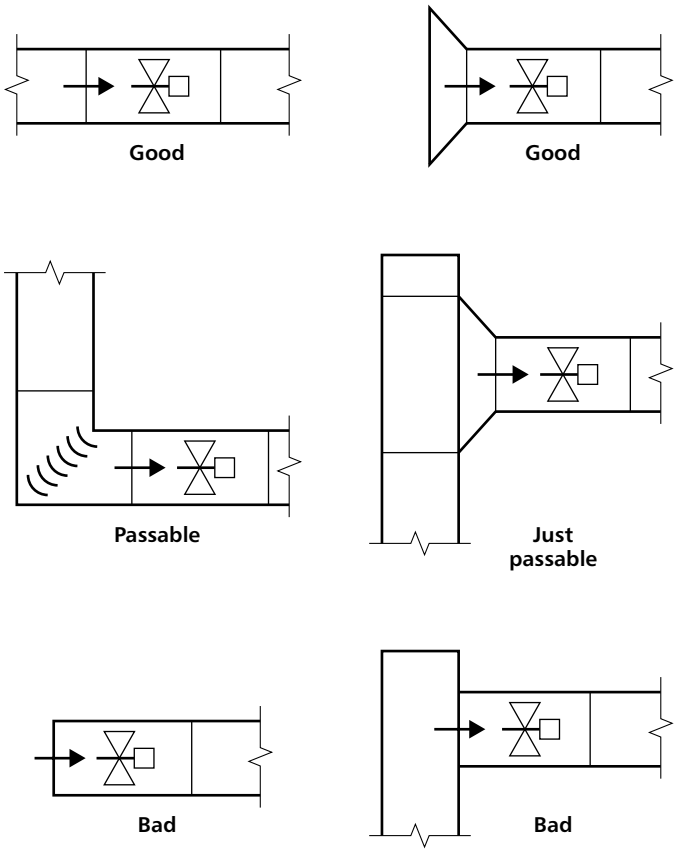


Figure 2.47 Outlet connections to centrifugal fans

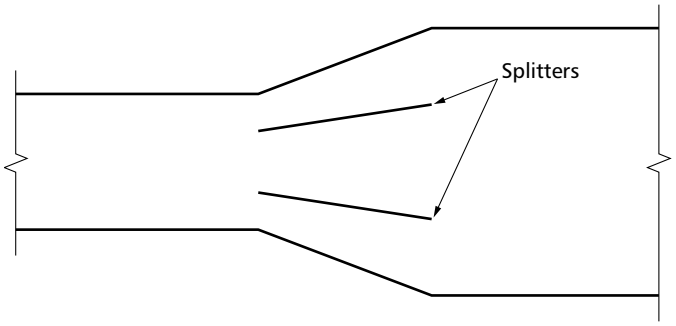


Figure 2.46 Change of section for a rectangular duct with splitters

Heat transfer

It is not normally necessary to make special arrangements for the limitation of heat transfer via the duct supports. However, there may be special cases where the temperature difference justifies a heat barrier to conserve heat or to prevent condensation. Such requirements must be specified by the designer.

Fire-resisting ductwork

Ductwork supports illustrated in DW/144: *Specification for Sheet Metal Ductwork* (BESA, 2013a) cannot be used on fire-rated ductwork systems. Oversizing can be an acceptable method of achieving fire rating of supports.

Fire-resisting ductwork may be required to meet the requirements of either European or British standards. Further comprehensive information may be found in the *Fire Rated and Smoke Outlet Ductwork* ('the ASFP Blue Book') (ASFP, 2000). Additional information may also be found there for smoke control ductwork.

2.6.8 Ductwork connections

2.6.8.1 Fan connections

The fan performance figures given by manufacturers in their catalogue data are based on tests carried out under ideal conditions, which include long uniform ducts on the fan inlet/outlet. These standard test conditions are unlikely to occur in practice. An objective of good ductwork design should therefore be to ensure that, as far as practicable, the fan performance will not be de-rated by the system. Ensuring that the fan inlet flow conditions comprise uniform axial flow velocities with low levels of turbulence can help to achieve this.

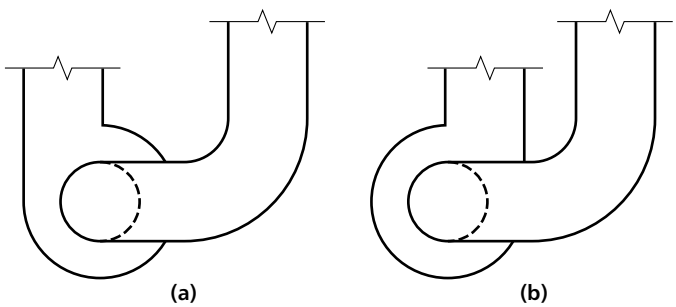


Figure 2.48 Centrifugal fan, swirl to impeller rotation: (a) swirl in same direction as impeller, (b) swirl in contrary direction to impeller

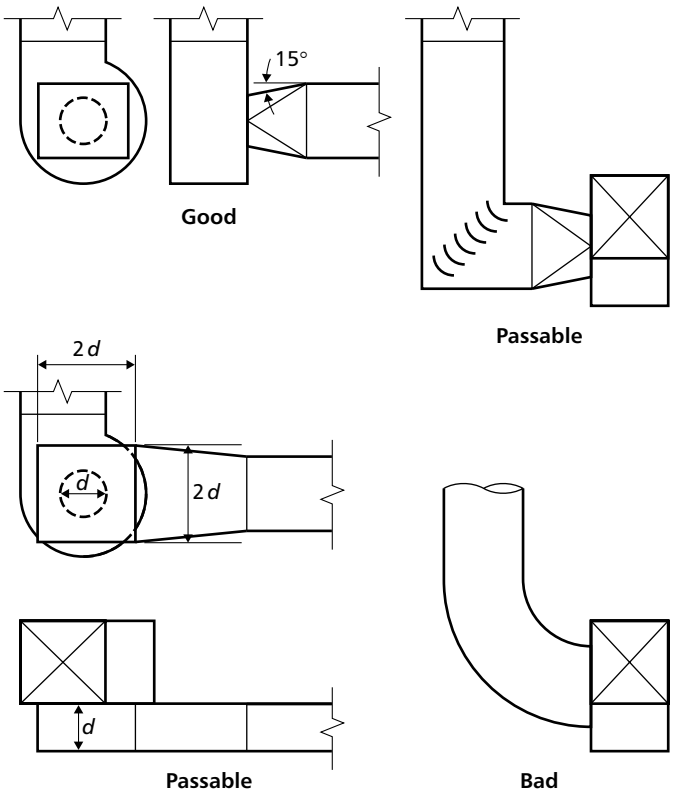


Figure 2.49 Centrifugal fans; inlet connections

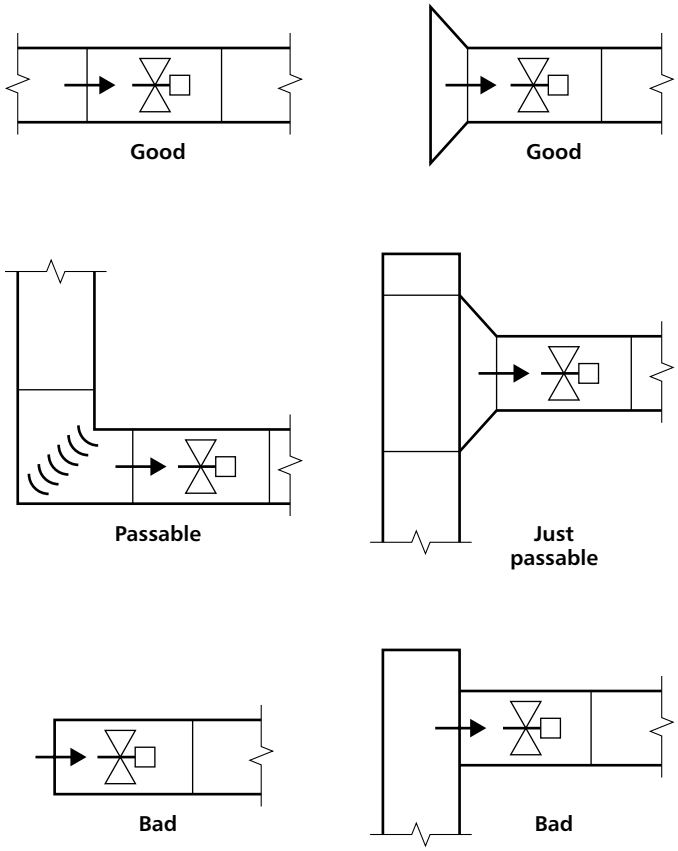
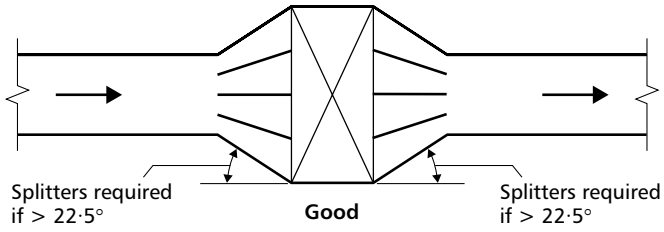


Figure 2.50 Axial fans; inlet connections



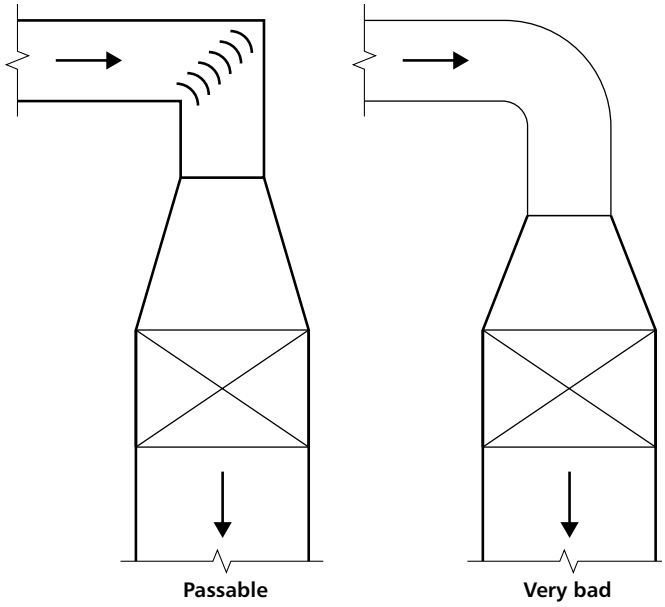


Figure 2.51 Plant connections

Where the outlet duct is larger than the fan discharge connections, there should be a gradual transition as illustrated in Figure 2.47 with a following section of straight duct having a length equivalent to three duct diameters. Figure 2.48 also gives examples of good and bad centrifugal fan outlet connections, which apply equally to axial flow fans.

The design of the fan inlet connection must be carefully considered to avoid swirl in the airstream. When the air spins in the same direction as the impeller, the performance and power consumption of the fan are reduced. When the air spins in the opposite direction to the impeller, the power consumption and noise will increase with hardly any pressure increase. Airstream swirl is usually induced by large variations across the fan inlet eye caused by the air passing round a tight bend immediately before the eye. The two forms of connection to centrifugal fans likely to cause swirl are shown in Figure 2.47.

For any condition in which a centrifugal fan is located within a free inlet the clear distance between the suction opening and the nearest wall should not be less than the diameter of the inlet. If two fans with free inlets are positioned within the same chamber their adjacent suction openings should be at least 1.5 diameters apart. Examples of good and bad practice in duct inlet connections to centrifugal fans are shown in Figure 2.48 and to axial fans in Figure 2.50.

2.6.8.2 Plant connections

Airflow across air treatment components such as filters, heat exchangers and humidifiers will be influenced by the pattern of the approaching airstream and, if unsatisfactory conditions are created, the performance of the components

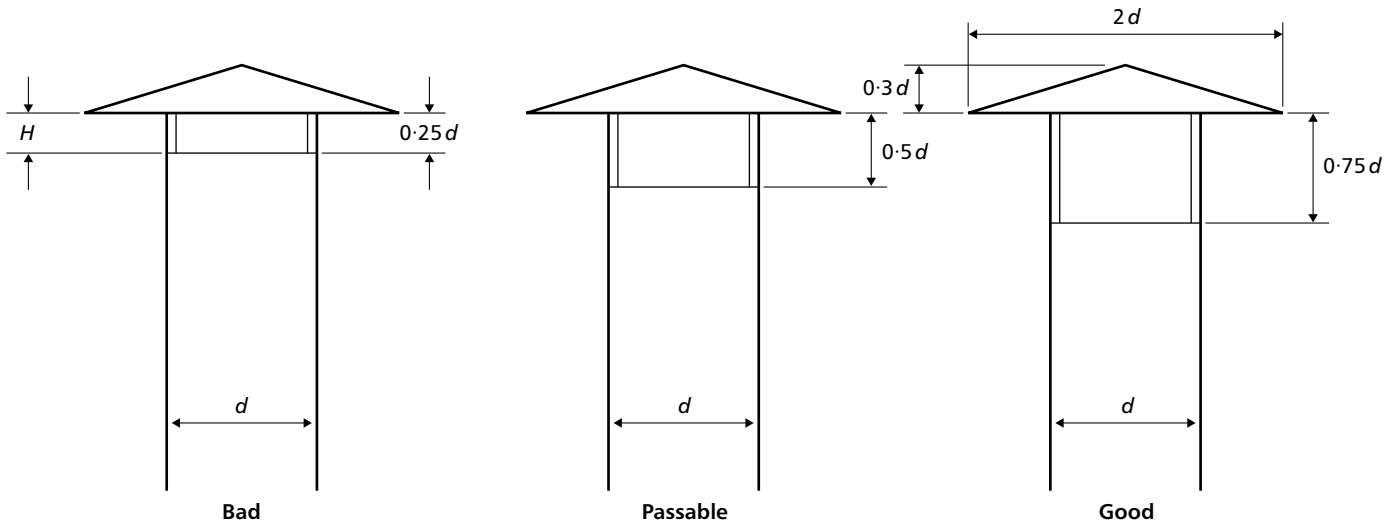


Figure 2.52 Discharge cowls; good and bad design

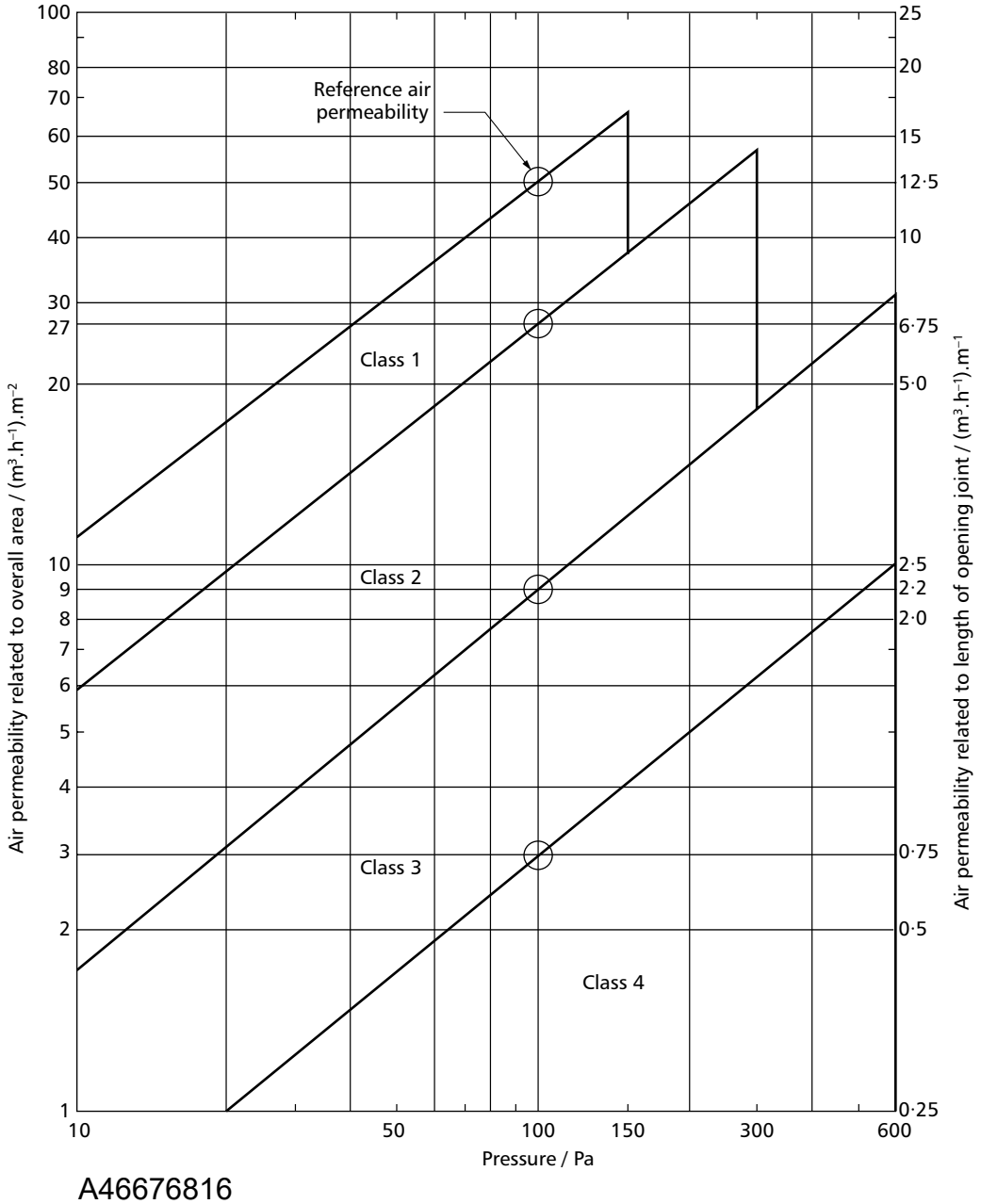


Figure 2.53 Classification of doors and windows by air permeability (reproduced from BS EN 12207: 2000: *Windows and Doors. Air permeability. Classification* (BSI, 2000) by permission of the British Standards Institution)

will be reduced. Examples of good and bad practice are shown in Figures 2.51 and 2.52 below.

2.6.8.3 External louvres and cowl connections

Recommendations on the clearance that should be provided between a cowl and an external vertical duct opening are illustrated in Figure 2.52 (see also sections 4.11.2.31–4.11.2.35 of CIBSE Guide C (2007)). Where adequate clearance cannot be provided, fitting an inverted cone deflector under the cowl can reduce the resistance.

2.6.9 Natural ventilation equipment

2.6.9.1 Openable window design

BS EN 12207: 2000: *Windows and doors. Air permeability. Classification* (BSI, 2000) classifies window and door performance according to their permeability (see Table 2.41 below). Reference air permeabilities are recorded for each class of window related to the permeability of both the overall area and of the opening joint. These are defined at a test pressure of 100 Pa. BS EN 12207: 2000 (BSI, 2000) describes how limits can be defined for other test pressures and how windows are subsequently classified according to the relationship between the two permeability assessments.

Figure 2.53 shows the upper limits of each class, which are derived from the reference air permeabilities at 100 Pa related to the area and length of opening joint, see Table 2.41.

General information on window design and selection is available from other CIBSE/SLL publications such as SLL LG10: *Daylighting — A guide for designers* (SLL, 2015) and CIBSE AM10: *Natural ventilation in non-domestic buildings* (2005). There are a number of important criteria, which are outlined in the following sections.

Ventilation capacity

The ventilation capacity is the amount of air that will flow through a given window area of different designs. It depends on the ratio of the effective open area to the façade area of the window unit. Ventilation capacity will be maximised by increasing the vertical separation and magnitude of those open areas. This will in turn depend on the way the window opens (i.e. side, top/bottom, centre pivot, sliding etc.), and the distribution of the open area over the vertical height of the window. Figure 2.54 shows the open areas for a horizontal centre pivot window compared with a side-hung window. A typical pressure gradient caused by inside–outside temperature differences is also shown. The centre pivot window has a much higher ventilation capacity because the open area is concentrated at regions of high pressure difference. In contrast, much of the open area of side-hung windows is in a region of small pressure difference.

Adjustability

Good control at small openings is particularly important for winter comfort. The flow characteristic is influenced by the mode of opening the window and factors such as the shape and thickness of the window frame. Figure 2.55 illustrates that the effective open area of a window may not increase very rapidly until the opening angle is quite large.

Table 2.41 Reference air permeabilities at 100 Pa and maximum test pressures related to overall area and length of opening joint

Class	Reference air permeability at 100 Pa and maximum test pressure			
	Related to overall area		Related to length of opening joint	
	Permeability / $(m^3 \cdot h^{-1}) \cdot m^{-2}$	Max. test pressure / Pa	Permeability / $(m^3 \cdot h^{-1}) \cdot m^{-1}$	Maximum test pressure / Pa
0*	—	—	—	—
1	50	150	12.50	150
2	27	300	6.75	300
3	9	600	2.25	600
4	3	600	0.75	600

* Not tested

Impact on comfort

The position of the room air inlet will have an effect on comfort factors such as draughts. Air entering the space at the occupied level can improve comfort in summer, when the air movement will provide a cooling benefit. In winter when the entering air is much colder, the same opening may result in discomfort from draughts. Consequently, separate winter openings may be preferred (either separate high-level windows or trickle ventilators). To avoid high summer ventilation rates (causing papers to be disturbed), the height of that part of the window where air enters the space should be above desk level.

Thermal contact

In strategies utilising night cooling and thermal capacity, the ventilation air needs to be able to make good thermal contact with the fabric in order to effect good heat transfer.

Security

The implications of open windows, particularly in night ventilation mode, need to be considered. Some window designs can be lockable in a part-open position, which allows adequate night ventilation rates but minimises the risk of intruders gaining access to the building.

Integration with solar control strategies (particularly blinds)

The blind and window opening may interact in a number of ways including:

— the movement of the window may be restricted by an independent internal (or external) blind; this is mainly a problem for pivoting windows

— with pivoting windows and mid-pane blinds, there is the impact on shading performance when the angle of the blind louvres to the incident radiation changes as the window is opened

— the effect of the blind in providing a resistance to airflow; the blind elements (unless they are mid-pane) will provide an obstruction to the free area of

the opening (this is independent of window type, see Pitts and Georgiadis (1994)).

Window specification

Information on the performance characteristics of various window types (see Figure 2.56) is given below. The effect of these different characteristics should be assessed with reference to the criteria listed above.

— *Horizontal pivot windows*: these have a high ventilation capacity because large open areas are created at a separation equivalent to the window height. With single-sided ventilation, air will enter at the lower level and exit via the top of the window. An opening of 22° is usually considered the norm for 'fully open'; for example for a typical 1200 mm wide by 1600 mm high window this results in an effective open area of 0.66 m^2. They are easily adjustable to provide control of the ventilation rate. Maximising the height of the top of the window in the room will help exhaust warmer air at ceiling level when operating in single-sided ventilation mode. Glazing at high level will also promote good levels of natural light deep into the space. When operating in wind-driven cross-ventilation mode, air will enter at the top and bottom of the window. The air entering through the top gap will be directed upward and this can improve thermal contact with exposed ceilings for effective night ventilation. Solar radiation striking the opaque surfaces of the wall or the ground adjacent to the façade can generate rising convection currents. These can be deflected into the room if the outward projection of the window extends beyond the window reveal.

— *Vertical pivot windows*: because the opening is distributed uniformly over their height, these windows have a lower ventilation capacity. For the same 22° opening, the effective open area is reduced by 40 per cent relative to the horizontal pivot. Vertical pivot windows can act as a form of 'wind scoop' for wind directions parallel to the face of the building. Because they have a large vertical opening, they are more likely to allow rain into the building. Carefully designed weather stripping is required for both horizontal and vertical centre pivot windows to achieve a good performance in winter.

— *Top/bottom hung windows*: as ventilators, these are less effective still, since all the opening area is concentrated at one end of the window height. The effective open area is about 35 per cent of the horizontal pivot type. Depending on where the opening is, the summer ventilation will either provide cooling to the occupant and poor thermal contact with the ceiling, or vice versa. Top hung windows can act as scoops for warm air rising up the outside of the building (e.g. from convection currents generated by solar gain on building surfaces).

— *Side-hung windows*: these are similar in performance terms to vertical pivot windows. Because of the greater distance from window edge to pivot (and hence greater turning moment), they are more susceptible to being blown by gusts of wind. Inward opening windows can cause clashes with furniture positions. The combination of top-hung winter ventilators and side-hung summer windows (with effective weather stripping) provides good all-round performance. The top hung winter ventilator can also provide a secure opening for summer ventilation that, in combination with the side-hung opening, will enhance stack effect.

— *Sliding windows (including sash)*: depending on whether they are vertical sliding (sash) or horizontal sliding windows, these will have similar ventilation characteristics to the horizontal and vertical pivot window respectively. Sliding windows can provide good control over summer ventilation. Sash windows allow the stack effect to be controlled through adjustment of the opening size at both the top and bottom of the window. However, ensuring a good seal in the closed position requires particular attention. This is important in terms of reducing draughts and energy losses in winter. Recent designs have significantly improved the performance of sliding windows in this respect. The design of sash windows needs to be such as to facilitate easy opening of the upper sash.

— *Tilting top vents*: these provide smaller opening areas than the other systems, because the opening portion

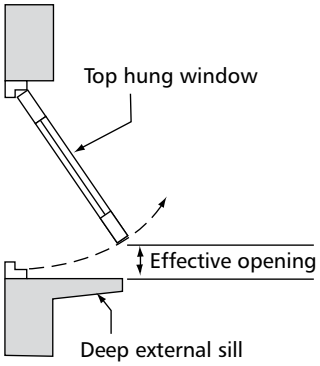


Figure 2.55 Effect of a sill on the relative open area of a window

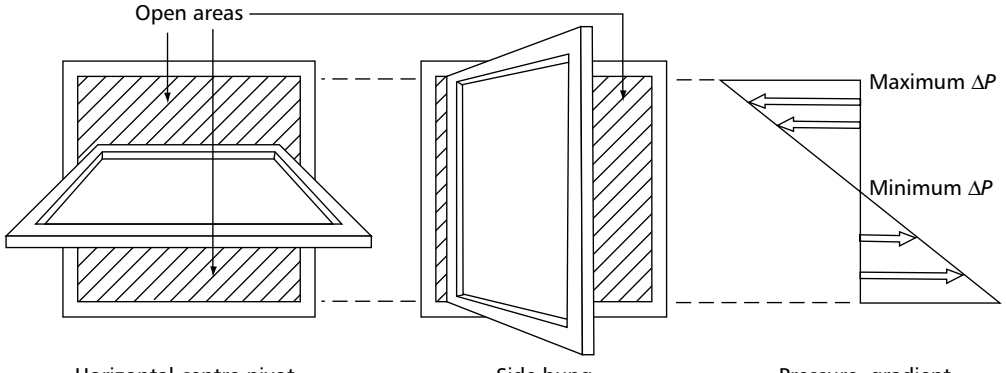


Figure 2.54 Ventilation capacity of different window configurations

occupies only a proportion of the window height. However they can provide good draught-free ventilation, especially in cross-ventilation mode. If the vent is bottom hung and opening inwards (the 'hopper' window), the natural flow pattern may encourage good thermal contact with the ceiling. However, care must be taken to protect the opening from driving rain.

— *Tilt and turn windows*: these are a combination unit offering bottom- and side-hung options (although the side-hung mode is mainly intended for cleaning purposes). A study of several buildings by Willis *et al.* (1995) suggests that the tilt setting provides too much ventilation in winter and insufficient ventilation in summer. The turn mode can cause clashes with furniture.

Whereas windows perform many functions, sections 2.6.9.2 to 2.6.9.8 describe openings in the façade whose sole purpose is to provide ventilation. Note that any such devices should offer a very low resistance to airflow, as the driving forces for natural ventilation may only be in the region of 10 Pa. Further guidance on product development and natural ventilation design tools is available from BRE (1999c).

2.6.9.2 Air bricks and trickle ventilators

Air bricks incorporate no provision for control of infiltration rate. Automatic ventilators, which provide nominally constant infiltration under variable wind velocities, should be considered as an alternative. The concept of 'build tight, ventilate right' is increasingly recognised as the basis of good design for ventilation. This relies upon an airtight fabric and the provision of a means of controlled background ventilation. In a naturally ventilated building this is often provided by trickle ventilators with higher rates of ventilation provided by other means such as the window or specific controlled damper devices.

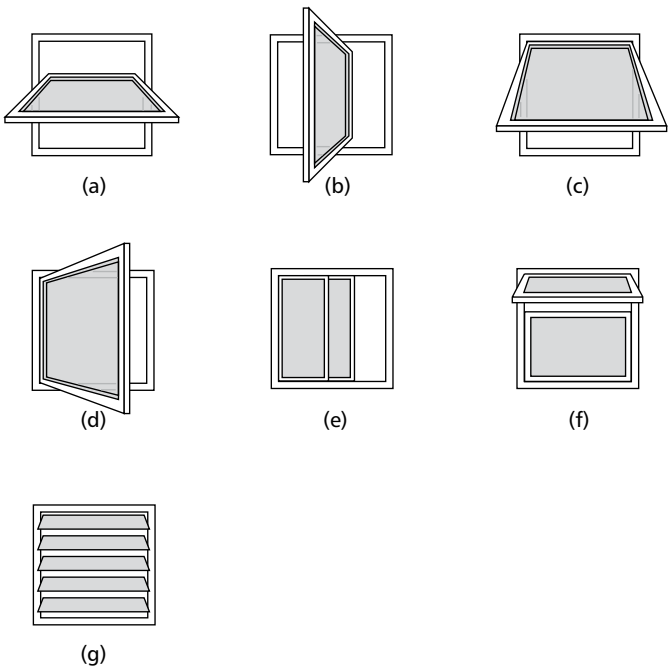


Figure 2.56 Window types: (a) horizontal pivot, (b) vertical pivot, (c) top/bottom hung, (d) side hung, (e) sliding, (f) tilting top vent, (g) louvre

Trickle ventilators are usually designed to provide the required minimum fresh air rate, particularly in winter. For England and Wales, Part F of the Building Regulations (NBS, 2010b) should be consulted for further details of the requirements, and the *Technical Handbook* (Scottish Government, 2015) for requirements in Scotland.

Draughts, especially those occurring at ankle height, can be avoided by directing the incoming air upwards, or positioning the ventilators at high level, e.g. > 1.75 m above the floor. This allows incoming air to mix with the warmer room air before reaching floor level. Alternatively, air can enter through wall ventilators positioned behind heaters. The form of the ventilator should promote rapid mixing with the room air to minimise cold draughts. General guidance on the use of trickle ventilators has been published by BRE (1998).

Added to this is the daily 'reservoir' effect of the trickle vents that purge the room overnight and provide a room full of fresh air ready for the following day's occupants. The larger the room volume, as with the higher ceilings in naturally ventilated rooms, the longer this reservoir effect will last during the occupied period. As trickle vents are intended to promote background ventilation only, their main application is for fresh air supply in the winter months. Twenty-four-hour use of trickle ventilation can provide a reservoir of fresh air that may be sufficient to maintain air quality throughout the day. With higher pollutant loads, rapid ventilation by opening windows for short periods or by mechanical ventilation might be required. For this reason, trickle ventilators are usually used in conjunction with other types of ventilation opening.

Trickle vents can be in the window frame, part of the glazed unit or independent of the window (usually above it). Various refinements on the basic trickle ventilator are available. Acoustic trickle ventilators are available that reduce noise, but they bring a penalty of increased pressure drop.

Control options available include the following.

— *Basic (uncontrolled)*: consisting of a series of holes or slots that are covered to give protection from the weather. No control is possible, hence positioning and appropriate selection are very important.

— *Standard controllable (including 'hit and miss')*: closure may be possible through the use of a manually operated slide that covers the openings. Occupants need to understand the operation of such devices.

— *Humidity controlled*: mostly used in kitchens and bathrooms within dwellings, as the scope for use in offices is limited with moisture not being the dominant pollutant.

— *Pressure controlled*: generally used in offices; inside/outside pressure difference is one possible control strategy.

— *Pollutant (e.g. CO_2 , CO, smoke controlled)*: used in schools, theatres, shopping malls etc. and sometimes in dwellings. Practical use for offices is limited as, except for CO_2 (where considerable drift has been reported), these are not normally the dominant pollutants.

The ventilation performance of trickle ventilators is traditionally specified in terms of 'free air space' or 'open

area'. Acoustic effectiveness is considered in the light of the 'effective area' or 'equivalent area'. This is considered in detail in BRE guidance (BRE, 1998).

Effective area is also considered to be a more realistic measure of airflow performance. It is defined as the area of a single sharp-edged hole (in a thin plate) that passes the same volume airflow rate and at the same applied pressure difference as the vent being tested. It requires to be measured on an airflow test rig. Most trickle ventilators with the same equivalent area will have similar airflow performance, even though their free areas might differ. Consideration of effective area is now required in Part F of the Building Regulations (NBS, 2013b).

2.6.9.3 Louvres

These are usually constructed of either glass or aluminium blades. Security bars can be fitted inside the louvres and this enhances their potential application in the night ventilation mode. Versions incorporating acoustic attenuation are also available. Whilst providing good control over summer ventilation, adjustable louvres usually present the greatest crack length for a given opening. However, conventional hinged louvres are usually difficult to seal when closed, making it difficult to limit infiltration losses.

2.6.9.4 Roof ventilators

In combination with low-level openings in the fabric, roof ventilators can be used to take advantage of summer stack effect, particularly for tall spaces. However, they must be specified to have low crack leakage or wind-induced draughts will cause discomfort in winter.

For maximum effect the outlet should be on the ridge of a pitched roof and the cap should project sufficiently above the ridge to minimise the influence of turbulence arising from wind blowing up the slope of the roof. Natural ventilation openings should try to avoid being installed on the slope of a roof and avoid being located in high-pressure areas of the building environment, where down-draughts are likely to occur.

2.6.9.5 Fixed lights

Crack leakage from roof lights should not be relied upon to provide ventilation even though minor leakage may arise along the crack length of the perimeter.

2.6.9.6 Dampers

Dampers are usually used for applications where automatic control is required. In the context of natural ventilation, this is usually for air inlets, both side-wall mounted above and below false floor level and at main exhaust points (e.g. roof vents). Again, the key performance criterion is the ability of the damper to provide an airtight seal when closed to minimise energy losses. If effective control is required then a significant proportion of the available pressure differential must occur across the damper in order to provide control authority.

2.6.9.7 Dampered openings with louvres

There are dampered openings available that are fixed to the outside building façade and protected from water ingress by a suitable weather-protective louvre. Such systems take advantage of either the stack or mixed-mode principle and manufacturers have developed decorative internal cover grilles if the opening is within the occupied space and even allowed for low-pressure hot water (LPHW) coils to be used in conjunction with these to temper the incoming air for winter conditions and prevent cold slugs of air entering directly into the room.

2.6.9.8 Acoustic dampers with silencers

Internally where the air passes through the building exchanging from room to room or room to atrium, an acoustic damper (Figure 2.57) may be required as a control point for the design of the system. This may require additional silencers to perform to the relevant space-required noise standards but the dampers with acoustic properties should be reviewed for their initial performance.

2.6.9.9 Shafts and ducts

Many ventilation strategies rely on shafts to take air vertically through a building. Similarly, ducts (including floor voids) are used to provide horizontal distribution. The criteria for sizing these airways are very different to those used in sizing conventional mechanical ventilation systems in order to keep pressure drops within the range available from natural driving forces. This means that adequate space must be allowed to incorporate these larger ducts or shafts. A second crucial issue is the requirement to keep the inlet ducts clean to minimise air-quality problems. This will typically require inlet screens and access for cleaning.

By definition, shaft outlets are at high level and therefore are in a region of higher wind speed. This means that the magnitude of the wind pressure acting on the shaft is likely to be large. Wind effects will probably dominate the pressure distribution through the system except at very low wind speeds. It is therefore vital that outlets are designed to create wind pressures that reinforce the intended flow direction. Usually this means creating a negative pressure coefficient at the top of the shaft, the exception being the wind scoop.

Orme *et al.* (1994) provide information on the above roof pressure coefficients. For isolated buildings with no local flow interference, the minimum height of the stack above roof level to avoid back-draughts is given by:

$$h = a\,[0.5 + 0.16\,(\theta - 23)] \tag{2.36}$$

where h is the height above roof level (m), a is the horizontal distance between the outlet and the highest point of the roof (m) and θ is the pitch of the roof (degrees).

For roof pitches of less than 23°, the height of the outlet must be at least 0.5 m above the roof level. These simplified relationships represent a minimum stack height; greater heights may well provide higher suction pressures. This can be beneficial since it is possible to generate a suction greater than that generated on an opening on the leeward vertical face of the building.

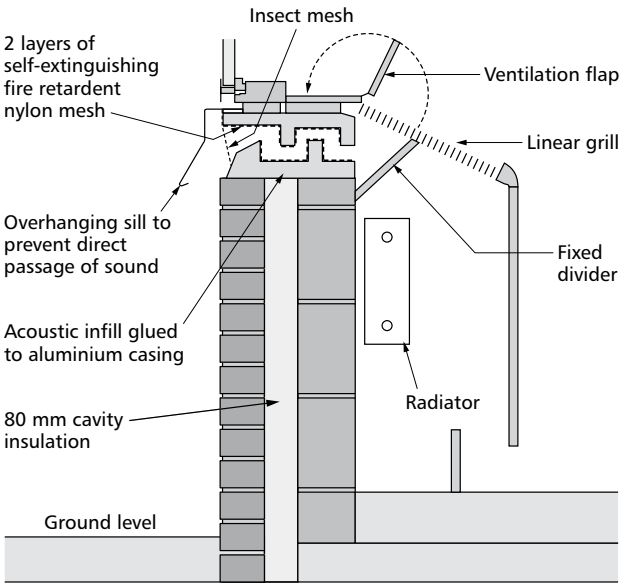


Figure 2.57 Ventilation opening with acoustic protection, based on an illustration from BB93 (EFA, 2004)

More information on pressure coefficients over roofs is given in BS EN 1991-1-4: 2005 + A1: 2010: *Eurocode 1. Actions on structures. General actions. Wind actions* (BSI, 2005c). For complex roof profiles or where surrounding buildings or other obstructions disturb the wind, model testing would be advisable.

As well as the position of the roof outlet, the geometry of the outlet will also affect the pressure coefficient. The outlet should prevent rain entering the stack and can provide flow acceleration local to the outlet to further reduce static pressures.

2.6.9.10 Transfer grilles

Transfer grilles may be required as a minimum to allow air movement across a building if cellular accommodation has been provided. The resistance of these transfer grilles must be included in the design calculation when sizing the façade unit sizes.

2.6.9.11 Wind towers

Wind towers are variously referred to as windcatchers and wind scoops. These are derived from ancient Middle East 'badgir' systems in which a rectangular cross-section chimney is divided by diagonal quadrants into four ducts. Each is exposed to its own opening at the top of the chimney and to a diffuser at its base (see Figure 2.58). Depending on wind direction, positive pressure drives air through the wind-facing quadrants while suction pressure extracts air through the remaining quadrants. In desert regions this took advantage of high-level wind while minimising the risk of sand being driven into the building, as would occur through low-level openings. These devices are multi-directional and function irrespective of wind direction, as any of the four faces can allow supply air to be introduced and to pressurise the room below, with the opposite louvre face achieving a negative pressure and acting as an exhaust louvre. Various manufacturers have developed modern versions of this system. Specific manufacturers' details should be reviewed to check performance criteria are met with this method.

In climates where the balance of driving force varies between wind and temperature, the flow patterns become complex and these devices can perform both as wind towers and chimney stacks according to the net driving force (see section 2.4.6). In terms of mathematical analysis, the opening heights, dimensions and orientation can be treated in exactly the same way as any other natural opening as described in chapter 4 of CIBSE Guide A (2015a) and section 2.4.6. Modern designs focus on reducing the aerodynamic resistance and pressure drops across components. In critical cases, performance data should be independently evaluated by laboratory testing. Flow resistance usually restricts the depth of penetration to two stories. As with chimneys and atria, they can be used to assist in deep-plan natural ventilation.

External roof-mounted terminals have been developed to take advantage of the wind-tower principle and allow a constant airflow relating to wind-driven forces. These terminals take the form of an exposed, roof-mounted, four-sided louvre screen with appropriate weathering properties and suitable roof section. The internal section of the louvre is split into four separate sections across the corners of the terminal to allow wind to penetrate at least one side of the face of the terminal positively and allow air to enter the building and pressurise the room below positively. This creates a negative pressure on the opposite side of the terminal, allowing exhaust warmer air to be evacuated and replaced with the fresh air supplied. These terminals are multi-directional.

2.6.9.12 'Passive' stacks

Stack ventilation can be enhanced by using passive stacks (see Figure 2.59). These are vertical ducts that are typically 100–150 mm in diameter. The lower end terminates in the ventilated space at or close to ceiling level. The upper end penetrates the roof and is ideally located in the wind-

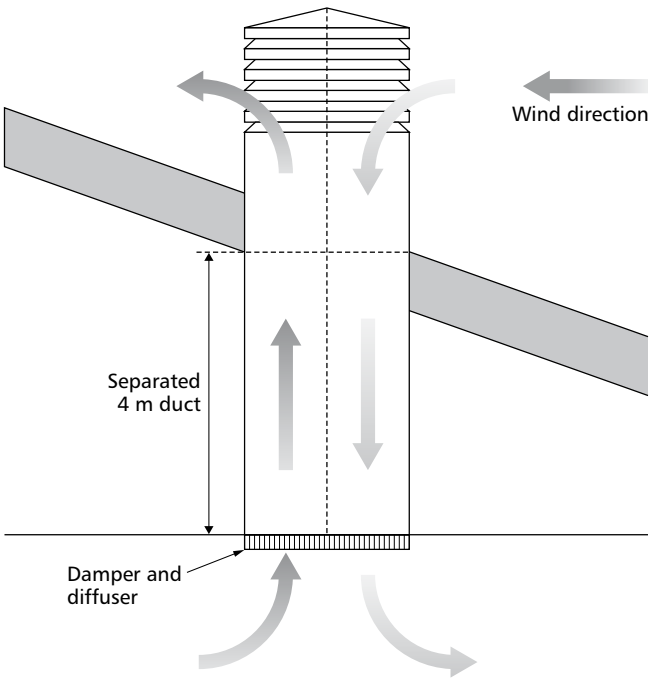


Figure 2.58 A roof mounted wind tower, reproduced from AM10: *Natural ventilation in non-domestic buildings* (CIBSE, 2005)

generated suction region so that ventilation can be driven by both wind and stack-driving forces. Make-up air is provided by trickle ventilators. The essential requirement is for the air in the chimney to be warmer than the ambient air. In dwellings, stacks are placed in 'wet' rooms and 'dry' air is drawn from the living and bedrooms.

Standard passive stack ventilation (PSV) systems have a simple inlet grille to the duct. Humidity-sensitive vents are available that can provide increased flows when humidity is high. Acoustic treatment may be required to reduce ingress of external noise. Fire dampers are required where ducts pass through a fire-separating floor.

For guidance on sizes and available products, manufacturers will be able to advise on the maximum and minimum duct sizes to handle the required airflow through the stack or chimney. Manufactures can calculate driving forces and select suitable equipment to achieve the desired results and prove this system will be able to cope with the required specification.

It is possible to enhance the stack pressures by means of absorbing solar gain (the so-called 'solar chimney') introduced via glazed elements. Location of the solar stack on the sunny side of the building in order to capture the solar radiation will generally result in cooler air being drawn in from the opposite shaded side. Solar performance requires careful thermal analysis because it relies on a rapid rate of heat transfer from the solar heated components to the raising ventilation airstream.

Care should be taken to ensure that there is a net heat gain into the chimney during cooler weather, i.e. the solar gain must be greater than the conduction loss. In cold weather, the conduction heat loss will result in low surface temperature for the glass that may be sufficient to generate down-draughts inhibiting the reverse of the general upward flow through the chimney. The wind-driving pressures can be enhanced by careful design of the roof profile and/or the chimney outlet configuration.

As a means of providing adequate ventilation on very hot and still days, consideration should be given to installing extract fans in the stack to pull air through the building. However, the fan should not provide a significant resistance to flow when the chimney is operating in natural draught mode and noise should be carefully considered (see section 2.3.2.4).

The analysis on stack ventilation often makes the presumption that the air in the stack is at building temperature and outside air is at a lower temperature. A steady reverse-flow pattern, with outdoor airflow down the stack, is possible if the stack was to assume the outdoor rather than indoor temperature. This can occur, for example, if the building has been allowed to cool during unoccupied periods (e.g. weekends or over night). Reverse flow should be avoided in cold weather but it can be used to advantage at night in the warmer seasons where free cooling may be available due to the night-time drop in temperature. This allows air to be drawn into the building at lower than occupant comfort temperatures thus allowing the building to cool significantly prior to the next day's expected elevated temperatures. More technical information on reverse flow in stacks is published by Li (2002).

2.7 Commissioning, operation and maintenance

2.7.1 Testing and commissioning

2.7.1.1 Introduction

All ventilation systems and associated ductwork systems should be tested and commissioned, and those of significant size (e.g. with a fan capacity above 1 $m^3 \cdot s^{-1}$) should also be leak tested. The needs of on-site regulation should be planned and provided for in the design stage, otherwise balancing the system within acceptable limits may not be possible. The designer must accept the implications of the commissioning procedures to which the air distribution system will be subjected. Inadequate commissioning will

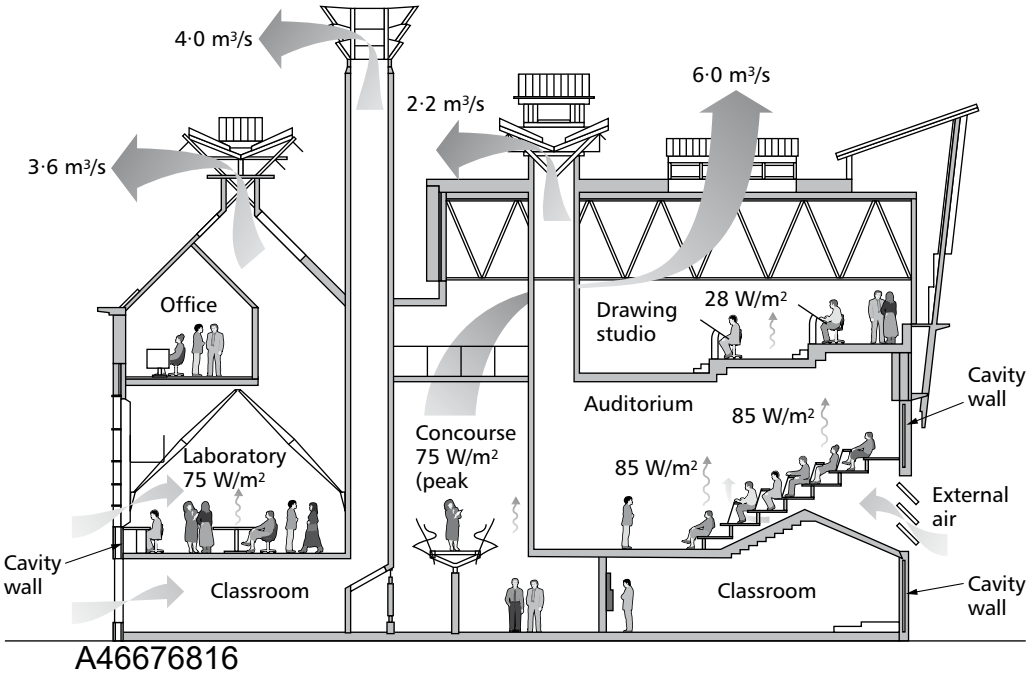


Figure 2.59 An example of a design using a passive stack system to enhance natural ventilation; Queens Building, de Montfort University (reproduced courtesy of Short Ford Architects)

result in poor environmental performance, energy wastage, draughts and noise. The designer's objectives must be to design an air distribution system where arrangements of ductwork and the selection and disposition of the components, particularly the means of air regulation, will promote a balanced and stable airflow. In the UK commissioning is explicitly included in the Building Regulations.

The measuring, regulating and apportioning of airflow in a distribution system are a means to an end. The objective is to ensure that the performance of the commissioned installation is adequate to maintain the specified environmental conditions of the space with optimum efficiency.

Procedures for commissioning air-handling systems are given in CIBSE Commissioning Code A: *Air distribution systems* (2006b) and BSRIA AG 3/89.3: *Commissioning Air Systems* (2001). Table 2.42 shows a summary of the flow-measuring techniques recommended by BSRIA for various ducts and terminals.

Before system regulation starts, the building needs to be complete, with windows and doors open or shut according to their normal state. The air distribution system needs to be complete, with leakage testing satisfactorily concluded. A reasonable standard of system cleanliness should be achieved before system start up.

Each system should be considered on its own merits and a detailed commissioning method statement produced and agreed prior to commissioning. It is important that the designer provides full information on all relevant aspects of the design, particularly VAV systems, in sufficient detail for the commissioning specialist to produce a comprehensive method statement. The commissioning specialist should review the recommendations of the equipment suppliers with regard to the inclusion of their equipment in the commissioning process for the air distribution system.

Successful commissioning and building operation depends on the following design considerations.

— Avoid long duct runs, since these can create balancing difficulties in commissioning.
— The use of variable speed fans allows rapid matching of fan duties during commissioning.
— Ensure there are sufficient dampers and access panels to reduce commissioning time.
— The setting of the automatic control system should be finalised by the controls specialist in liaison with the commissioning specialist.

2.7.1.2 Legislation

CIBSE Commissioning Code M: *Commissioning management* (2003) provides an overview of the management arrangements for commissioning required to ensure compliance with Parts F (NBS, 2013b) and L (NBS, 2013a) of the Building Regulations. Steps include:

— design for commissioning
— co-ordination of the commissioning process
— installation quality assurance
— pre-commissioning
— preparation
— commissioning
— confirming compliance
— certification
— building log book (CIBSE TM31: *Building log book toolkit* (2006c))
— system handover.

Building Regulation 38 (TSO, 2010) requires the handing over of all design, installation positioning and maintenance information for any and all fire safety items.

2.7.1.3 Design provisions to facilitate commissioning

Introduction

Consideration should be given to access for commissioning, inspection, maintenance and cleaning. Openings need to be safe and have sealed panels/covers designed so that they can be easily removed and refixed. Multiple setscrews are not recommended, and self-piercing screws are not acceptable as a method of fixing. Safety restraints should be connected to access panels located in riser ducts.

A sufficiently large area, free of services and other obstructions, is needed around panels and covers to allow them to be removed.

An access panel is required to be adjacent to items of in-line equipment that require either regular servicing or intermittent access. The openings need to be sized as a minimum to allow hand and/or arm access. The designer should specify the size and location of the panels where larger dimensions are required. In these cases the panels should not exceed 450 mm × 450 mm. It may be more practicable to use removable duct sections or flexible ducts/connections.

An inspection panel should be provided adjacent to items of in-line equipment that need only visual inspection of internal elements from outside the ductwork. Such inspection openings should have a minimum size of 100 mm × 100 mm for rectangular ducts and 100 mm diameter for circular ducts.

It will be the responsibility of the insulation contractor to 'dress' the insulation to the edges of the access openings without impeding the functionality of the panel, cover or door.

Provision of access panels

Access panels should be provided for the inspection and servicing of plant and equipment; Table 2.45 provides guidance. However, the ductwork system designer may choose to demonstrate that adequate provision has been made for access, such as by reference to a ductwork cleaning specialist.

In addition, the following should be noted.

— Fire/smoke dampers: panels should be located to give access to both the blades and the fusible links. On multiple assembly units it may be necessary to provide more than one panel; the need for such access may be determined by the external access

Table 2.42 Flow measurement techniques (reproduced from BSRIA AG 3/89.3: *Commissioning Air Systems* (2001) by permission of the BSRIA)

Position	Measurement technique	Instruments
Main duct (total flow at fan)	* Velocity traverse in duct	Pitot tube with micromanometer
	† Wilson flow grid	Micromanometer
Branch ducts	* Velocity traverse in duct	Pitot tube with manometer
Terminal connecting ducts	* Velocity traverse or single point reading in duct	Pitot tube with micromanometer or mini-rotating vane anemometer where velocity < 4 $m \cdot s^{-1}$
Grilles	* Velocity traverse across face	Rotating vane anemometer
	* Hood	Rotating vane anemometer or integral hood assembly
Ceiling diffusers	* Flow hood	Rotating vane anemometer or integral hood assembly
	* Velocity in connecting duct	Pitot tube/manometer or mini-rotating vane anemometer
	* Static pressure in connecting duct	Diaphragm pressure gauge or pitot tube
	† Average peripheral velocity and area	Mini-rotating vane anemometer or thermal anemometer
Slots and linear diffusers	* Face velocity (for slots of equal width and same louvre setting)	Mini-rotating vane anemometer or thermal anemometer
	* Flow hood	Rotating vane anemometer or integral hood assembly
	† Velocity in connecting duct	Pitot tube/manometer or mini-rotating vane anemometer
Perforated ceiling	* Velocity in connecting duct to ceiling void	Pitot tube/manometer or mini-rotating vane anemometer
Perforated panel diffuser	* Velocity in connecting duct	Pitot tube/manometer or mini-rotating vane anemometer
	* Flow hood	Rotating vane anemometer or integral hood assembly
	† Face velocity (no deflection)	Rotating vane anemometer or integral hood assembly
Decorative terminals	* Velocity in connecting duct	Pitot tube/manometer or mini-rotating vane anemometer
Induction units	* Static pressure in nozzle plenum	Diaphragm pressure gauge
High velocity nozzles	* Jet velocity	Pitot tube/manometer or mini-rotating vane anemometer
	* Static pressure in connecting duct; previous calibration or maker's data	Diaphragm pressure gauge
Fan coil units	* Velocity in connecting duct	Pitot tube/manometer or mini-rotating vane anemometer
Extract openings (grilles)	* Face velocity	Pitot tube/manometer or electronic hood
Slots, perforated panels, decorative openings	* Velocity in connecting duct	Pitot tube/manometer or mini-rotating vane anemometer
Combined lighting units, adjustable exhaust valves	* Manufacturer's recommended technique	Pitot tube/manometer or mini-rotating vane anemometer
	* Velocity in connecting duct	

Note: * indicates preferred measuring technique for stated location
† indicates second choice (i.e. more difficult to use in practice or subject to a greater possibility of error)

conditions and the internal reach to the blades and their fusible links.

— Heating/cooling coils and in-duct fans/devices: the panel should be located on the air entry side i.e. upstream.

— Filters: panel should be located in the air entry side i.e. upstream (note: dimensions of access may need to be changed to suit filter elements of the front withdrawal type).

— Inspection covers: inspection covers should be provided adjacent to regulating dampers where either the control linkage is mounted internally within the airstream or if a multi-bladed unit is an integral part of the ductwork run. It is not necessary to provide inspection covers adjacent to either single blade regulating dampers or flanged damper units.

— Hand holes: hand holes to permit proper jointing of duct sections should be provided at the manufacturers' discretion but kept to a minimum and made as small as practicable. The hand-hole cover should be sealed and securely fastened.

Cleaning of ductwork must be taken into account in the design and installation stages by ensuring adequate and safe provision is made for access.

Filter removal and replacement must be considered by ensuring sufficient space and means of access is provided.

Good ductwork design

The duct sizing procedure (see section 2.3.5) should take into account the requirements of system balancing. The position and number of regulating dampers included in the design should be sufficient for this purpose.

Table 2.43 Information to be provided in schematic drawings

Items of system	Information to be provided
Fans	Fan total pressure
	Volume flow rates
	Motor current
Plant items	Type and identification numbers from equipment schedules
	Volume flow rates
	Pressure losses
	Dry-bulb temperatures, Wet-bulb temperatures, Humidity — For coils and humidifiers as appropriate
Dampers (including motorised) and fire dampers	Identification numbers from equipment schedules
	Location
	Volume flow rates
Main and branch ducts	Location
	Dimensions
	Volume flow rates
Terminals	Identification numbers from equipment schedules
	Location
	Dimensions
	Volume flow rates and velocities
	Operating pressures
Test holes and access panels	Location
Controllers	Set points

Notes:
(1) Fan total pressure is the difference between the total pressure (static pressure + velocity pressure) at the fan outlet and the total pressure at the fan inlet.
(2) Where volume flow rates are variable, maximum and minimum values should be provided.

Communication

The designer should pass on the design intent to the commissioning engineer by indicating which parts of the system are high, medium and low pressure, and by providing:

— relevant parts of the specification

— schematic drawings as listed in Table 2.43 (see also Figure 2.60 below, which shows a basic schematic for system regulation including damper positions)

— equipment schedules

— controller and regulator schedule

— fan performance curves

— wiring diagrams for electrical equipment, including interlock details

— manufacturers' operating and maintenance instructions.

The information listed above should also be included in the building's log book.

Provision and siting of volume control dampers

Note: it is important to have a means of recording the positions of volume control dampers that have been set during commissioning; spray paint over the quadrant is effective for smaller sizes of dampers.

Low- and medium-pressure systems

Manually operated balancing dampers are generally needed:

(*a*) in the main duct downstream of the fan

(*b*) in the branch or zone ducts

(*c*) in sub-ducts serving four or more terminals

(*d*) at terminals not covered by (*c*) above.

Dampers integral with terminals should only be used for final trimming of air volumes, or noise and air distribution problems may result. Dampers should not be used for primary duty control

High-pressure systems

Where pressure reduction in a high-pressure system is essential, it is recommended that:

— throttling dampers should not be used in high-pressure and high-velocity sections because of duct leakage and noise problems; if this cannot be avoided then additional attenuators and external sound barrier mats may be needed at the damper and downstream to limit noise break-out

— orifice plates or proprietary pressure-reducing valves should be used as first choice in main branches

— where dampers are required they should be confined to areas of relatively low duct velocities; iris type in circular ducts, streamlined blade construction in rectangular ducts.

Variable volume systems

Rather than using throttling dampers in the main duct, system static pressure control in VAV systems should be effected by:

— variable speed motors on the fan(s) or

— inlet guide vanes with centrifugal fans or

— variable pitch blades on axial-flow fans.

Motorised dampers

Motorised dampers for throttling airflow should be opposed-blade type opening through a full 90°; for mixing purposes they should be parallel-blade type opening only through 60°.

Throttling dampers should be sized to have an authority of 5–8 per cent of the fan total pressure. Mixing dampers should be sized to have a face velocity of 4–10 $m \cdot s^{-1}$. To obtain maximum benefit from outside air cooling, fresh air/

recirculation air dampers must have a good shut off; this means they should:

— be rigid with accurate square connections

— be provided with end and edge seals of flexible material

— not be distorted during fitting.

2.7.1.4 Instrument connections

Instrument connections should be provided at locations determined during the design process.

Openings required for other purposes

It is the designer's responsibility to specify the location and size of any openings required other than those covered in this section. In the case of hinged access doors it is the designer's responsibility to indicate on the drawings the location and size of hinged access doors required, ensuring that there is an area free of services and other obstructions to enable the door to be satisfactorily opened. Unless otherwise specified by the designer, openings should not be larger than 1350 mm high and 500 mm wide. Doors should open against the air pressure. Both the opening in the duct and the access door itself need to be adequately reinforced to prevent distortion. A suitable sealing gasket should be provided, together with sufficient clamping type latches to ensure an airtight seal between the door and the duct.

For safety reasons, the manufacturer should incorporate means to prevent personnel being trapped inside the duct, for example by providing access doors with operating handles both inside and outside the duct.

2.7.1.5 Test holes

General

Except in special circumstances, it is not usual practice to install airflow measuring devices permanently in air ducts. The normal procedure is to make velocity traverses across the duct at appropriate locations using a pitot tube. The small test holes for using a pitot tube are usually made by the commissioning specialist.

Test holes for in-duct measurement are needed on the main duct following the air-handling plant. The basic locations for siting test holes for flow measurement are shown in Figure 2.61 as 'principal measuring points'. If there is insufficient space, an alternative is to provide test holes in principal branches so that the total flow from the fan can be obtained by summation. These points are shown in Figure 2.61 as 'secondary measuring points'.

Test holes for in-duct airflow measurement are required:

— on both sides of the fans and heating and cooling coils (for pressure drop measurement)

— in the main ducts

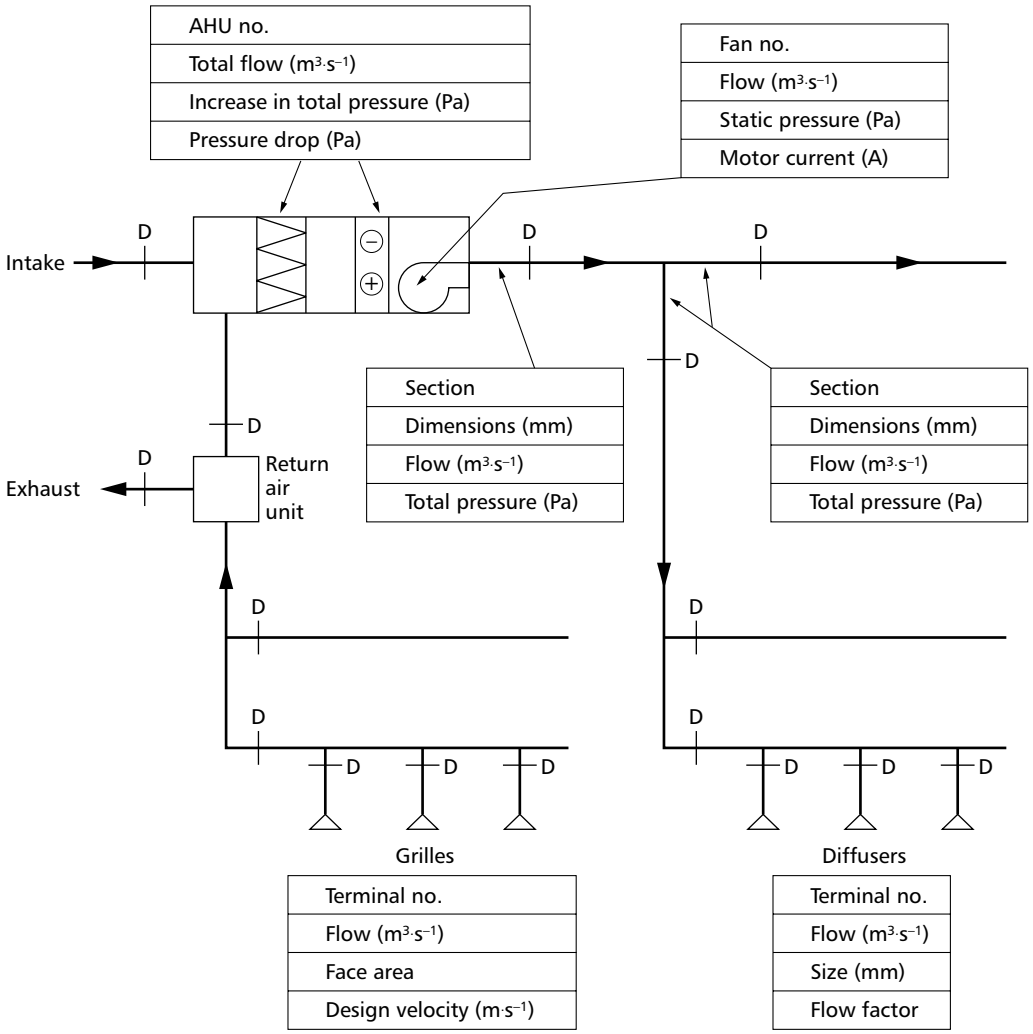


Figure 2.60 Basic schematic for system regulation showing damper positions (reproduced from BSRIA AG 3/89.3: *Commissioning Air Systems* (2001) by permission of BSRIA)

— in all branches

— in centrifugal fan drive guards opposite the end of the fan spindle, for speed measurements.

The number and spacing of holes at a particular location are given in BSRIA AG 3/89.3: *Commissioning Air Systems* (2001); these recommendations are summarised in Table 2.44 and Figure 2.62.

The location chosen for the measurement point should be:

— at least 1.5 duct diameters upstream of sources of turbulence such as dampers and bends; if this is not possible then well downstream of these sources

— where there is enough space around the duct to insert the pitot tube and take readings

— where the duct has a constant cross-sectional area.

Minimum distances of test holes from sources of turbulence are given in Figure 2.62.

Test hole specification

The main test hole locations are shown in Figure 2.61. Usually the installer will not have drilled the test holes, this being left to the commissioning specialist. However, the designer and the installer should have taken account of the location of test holes to ensure access. It is sometimes appropriate to use re-sealable test holes, included in the ductwork prior to installation.

Figure 2.62 shows the minimum distance of test holes from sources of turbulence. Figure 2.63 gives the dimensions of a standard test hole for a pitot tube for in-duct measurement.

For rectangular ducts, the number of test holes depends on the duct dimensions. For circular ducts, a single test hole is required for ducts less than 150 mm in diameter, and two holes spaced at 90° are required for larger ducts. The appropriate position, number and spacing of test holes are given in BSRIA AG 3/89.3: *Commissioning Air Systems* (2001).

2.7.1.6 Cleanliness of new ductwork and components

The designer should specify the requirements for:

— cleanliness levels for ductwork leaving the factory

— protection during transit

— protection during site storage

— protection of ductwork risers

— inspection and cleaning during installation and before handover.

TR/19: *Guide to Good Practice: Internal Cleanliness of Ventilation Systems* (BESA, 2013c) provides for three grades of pre-commission cleanliness. The designer should determine which is appropriate for the specific installation and state this in the design specification.

In manufacturing ducts, attention should be paid to the grease used in production. The ductwork should leave the factory as clean and dry as possible. Any remaining grease film is a potential base for microbial growth.

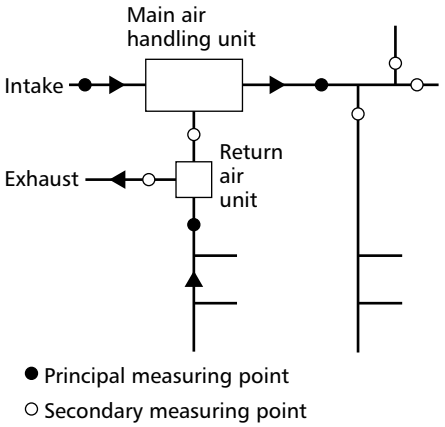


Figure 2.61 Basic test hole positions for flow measurement in duct systems (reproduced from BSRIA AG 3/89.3: *Commissioning Air Systems* (2001) by permission of BSRIA)

The whole ductwork installation should be inspected and, where necessary, cleaned before handover. The preferred cleaning method should be specified in the handover documents, including guidelines on access to all points to be cleaned.

During installation the installer should ensure that dust and debris are prevented from entering the ductwork system to ensure that the installation is clean prior to commissioning. The commissioning process should include an inspection of ductwork cleanliness. Where this is not the case, it may be necessary to employ a specialist ductwork cleaning company. The commissioning should not commence until cleanliness has been inspected and certified. The installation should be in a clean state at handover.

Inspection of the ventilation system will usually start with a visual check of the outside air intake, which can be a source of pollution and contamination. A smoke test can quickly determine if outside air is entering the system. Further items to check will be dampers, protective devices against weather, insect and rodents, the hygiene of coils, fans and insulation, the presence of water and condition of condensate drain pans and humidifier reservoirs.

Checking the need for cleaning should be done periodically. Eurovent includes recommendations on indoor air quality (IAQ) (Eurovent, 1999).

2.7.2 Maintenance and cleaning

2.7.2.1 Introduction

Over time, the performance of ventilation systems will deteriorate. The designer should be aware that the air distribution system may become a major odour source. It is possible, with regular cleaning and maintenance, to eliminate nearly all the odour emissions from the system, in both new and renovated buildings.

Components will need regular servicing and replacement to prevent failure. In addition, contaminants such as bacteria, fungal spores, skin scales, dust and moisture could contaminate the ductwork and clog filters. Regular maintenance and cleaning are therefore needed to ensure the correct and efficient operation of the ventilation system.

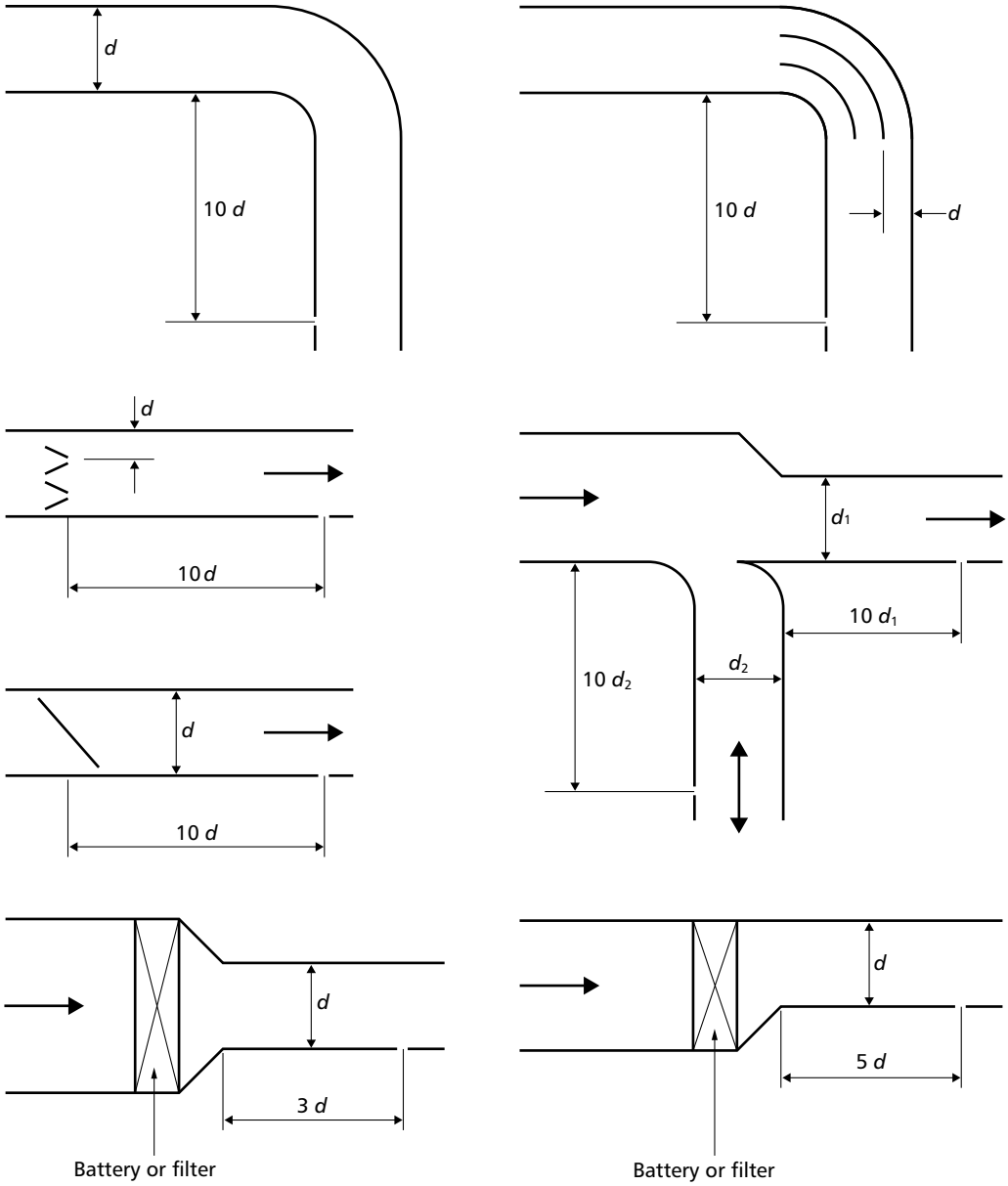


Figure 2.62 Minimum distance of test holes from sources of turbulence (reproduced from BSRIA AG 3/89.3: *Commissioning Air Systems* (2001) by permission of BSRIA)

Table 2.44 Test hole positions; special requirements for the measurement of total airflow from the fan (reproduced from BSRIA AG 3/89.3: *Commissioning Air Systems* (2001) by permission of BSRIA)

Type of fan	Position of test holes*	
	Upstream	Downstream
Centrifugal	4 *d*	10 *d*
Axial:		
— single stage	4 *d*	Not advised
— single stage with guide vanes	4 *d*	10 *d*
— two-stage, contra-rotating	4 *d*	10 *d*

* *d* = diameter (equivalent diameter for non-circular ducts) of duct following the fan

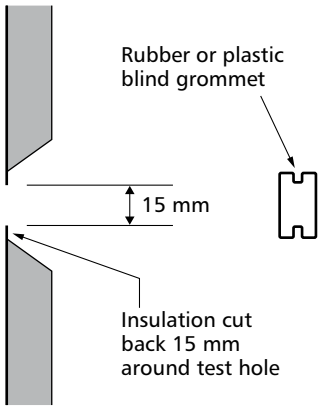


Figure 2.63 Dimensions of standard test holes (reproduced from BSRIA AG 3/89.3: *Commissioning Air Systems* (2001) by permission of BSRIA)

Steps include:

— repeating commissioning exercises

— cleaning

— scheduled replacement of components (filter etc.)

— identifying and rectifying faults.

2.7.2.2 Legislation

The EU Workplace Directive has been implemented in the UK by the Workplace (Health, Safety and Welfare) Regulations (HMSO, 1992). The Health and Safety Commission's Approved Code of Practice and guidance L24 (HSE, 1994) states that: 'Mechanical ventilation

systems (including air-conditioning systems) should be regularly and properly cleaned, tested and maintained to ensure that they are kept cleaned and free from anything which may contaminate the air.' This has applied to all workplaces since January 1996. Additionally, provision for access space for maintenance of the ventilation systems will need to be considered at the design stage. Inspection requirements are also enshrined in the European Energy Performance of Buildings Directive (EPBD) (EU, 2010).

The Regulatory Reform (Fire Safety) Order 2005 (TSO, 2005) requires a responsible person to implement risk assessments on all areas for fire. In addition, they should maintain all fire safety installations and keep records about all such items.) See also Building Regulation 38 (TSO, 2010).

2.7.2.3 Maintenance

Cleaning

Ventilation components and ductwork systems should be clean on completion (see also BS EN 15780: 2011: *Ventilation for buildings. Ductwork. Cleanliness of ventilation systems* (BSI, 2011b)). TR/19: *Guide to Good Practice* (BESA, 2013c) says that where specific verifiable levels of internal cleanliness are required it will be the responsibility of the designer to specify the inclusion of a specialist cleaning contractor.

During use over a number of years, a slow build-up of deposits can occur, particularly at points where the air velocity reduces. More rapid build-up of dirt will result when filters are faulty or damaged, poorly installed or badly maintained.

See 'Testing, commissioning, cleaning and maintenance' in section 2.3.5.2 for information on ductwork cleaning methods.

Special requirements apply to cleaning and maintenance of ductwork in applications such as food preparation (see DW/171: *Standard for Kitchen Ventilation Systems (*HVCA, 2000)), process industries and plant rooms. Detailed maintenance requirements for ductwork are set out in SFG20: *Standard Maintenance Specification for Building Services* (BESA, 2012).

When undertaking maintenance work within ducts, it is essential that sensor probes are withdrawn to protect them from being damaged.

Table 2.45 Requirements for access to duct-mounted components

Component	Location of access opening(s)
Dampers	Both sides
Fire dampers	One side
Heating/cooling coils	Both sides
Circular sound attenuators	One side
Rectangular sound attenuators	Both sides
Filter sections	Both sides
In-duct fans	Both sides
Airflow control device	Both sides

Design for cleaning

To enable cleaning to be carried out safely and efficiently, it is important that the air distribution system is designed and installed so that all internal surfaces and components can be accessed.

A comprehensive standard for access installation is provided by BS EN 12097: 2006: *Ventilation for buildings. Requirements for ductwork components to facilitate maintenance of ductwork systems* (BSI, 2006b).

Components (for example dampers, sensors, airflow measuring devices) should be installed so that they can be cleaned in situ or removed for cleaning. If removal is not possible, service access should be provided according to Table 2.45. Access should be provided that is not obstructed by suspended ceilings, electric cables, lighting, pipes or other ducts.

Abrupt bends, area reductions and sharp objects, such as projecting screws, inside duct joints should be avoided to prevent injury to maintenance and cleaning personnel. Stiffeners and other equipment inside the ductwork should not obstruct the cleaning process. Access doors and covers should be easy to open and be constructed and installed to match the type and location of any thermal, acoustic or fire insulation.

A ductwork component that can be dismounted for cleaning can also be regarded as an access door on condition that its dimensions are in accordance with Table 2.46 or sufficient for the specified and documented cleaning method. Access to duct-mounted components should be provided in accordance with Table 2.45, unless the component is easily removable for cleaning or can be cleaned through the ductwork without obstructions.

The location of and distance between openings depends on the quality of supply-and-extract air and also on the defined or available cleaning method. Unless the cleaning method is known or can be fixed at the design stage, the distance between the openings should not exceed 10 m or not be more than two ≥ 45° bends.

Designers should take specialist advice and stipulate their requirements for the periodic internal cleaning and maintenance of ductwork.

Table 2.46 Openings for ducts; recommended minimum dimensions

Duct type and size	Access opening size	
	A/mm	B/mm
Circular ducts (diam. d/mm):		
— $200 < d \leq 315$	300	100
— $315 < d \leq 500$	400	200
— $500 < d$	500	400
— inspection opening	600	500
Rectangular (side length s/mm):		
— $s < 200$	300	100
— $200 < s \leq 500$	400	200
— $s > 500$	500	400
— inspection opening	600	500

Air quality and health issues

The air quality within a building is influenced by contaminants in the form of particles and gases that are generated within the building envelope and those brought in from outdoors. Contaminant particles may enter the building with the outdoor air. These can include carbon produced by combustion and vehicles, and particles of biological origin. Contaminant gases produced within a building include the volatile organic compounds (VOCs) emitted by some construction materials, fabrics and adhesives, and fumes emitted by photocopiers and laser printers. Gases admitted from outdoors include vehicle exhaust gases. Biological agents such as bacteria, fungal spores and pollen grains can enter the building from outside. Particles generated indoors can include human skin scales, bacteria, viruses and fungi, faecal matter from the house dust mite, textile fibres, building materials and paper dust. Settled deposits in ductwork may cause contamination of air supply by release of chemicals such as odorous VOCs, produced either microbiologically or chemically.

Designers do not normally consider the health effects of microbes in ductwork systems, since their focus is the attainment of specified operating conditions, generally for comfort purposes. It is important to be aware of the potential health issues arising from microbial material in ductwork. There are currently no environmental health criteria setting safe microbial exposure. Possible harmful health effects on the occupants of buildings from microbial growth within the fabric include allergies, infection and toxicosis. Further information about these is provided in CIBSE TM26: *Hygienic maintenance of office ventilation ductwork* (2000b).

Ultraviolet (UV) light can be very effective in deactivating pathogens and other airborne bacteria, viruses and moulds. Where a high-quality air supply is required, such as in health-care facilities and situations where there is a high occupation density, UV lamps can be installed in the ductwork. Medium-pressure lamps, e.g. 3.5 kW and 300 mm in length, run very hot and must be switched off when the fan is not operating. Provision of UV lamps will also have implications for maintenance.

New ductwork construction

According to BS EN 15780: 2011 (BSI, 2011b), in the handover documents the cleanliness quality class, cleanliness criteria and measurement methods should be specified; recommendations for cleaning methods and guidelines for reaching the points to be cleaned should also be given.

The design information should give consideration to the expected cleaning method. Where the system has been designed to be cleaned by wet cleaning methods, warnings regarding conditions and restrictions of use should be given. For example, wet methods are applicable only where ducts are sufficiently moisture-tight, internal surfaces are smooth and slope and drainage arrangements have been provided so that fluid and contaminant can be evacuated.

A sufficient number of access doors should be provided in the ductwork. Special care should be taken regarding obstacles to cleaning, such as dampers, sound attenuators etc., which are mounted in the ducts. In many cases, additional access doors are needed after or before such obstacles, which then can be cleaned carefully. Requirements for location of and distance between access doors are presented in BS EN 12097: 2006: *Ventilation for buildings. Requirements for ductwork components to facilitate maintenance of ductwork systems* (BSI, 2006b) and BS EN 13779: 2007: *Ventilation for non-residential buildings. Performance requirements for ventilation and room-conditioning systems* (BSI, 2007a). Note that it is important that access panels should themselves be reasonably accessible for future maintenance operations.

Cleanliness quality classification

The designer should specify the requirements for the cleanliness quality class to be achieved (see Table 2.47).

The cleanliness quality classification allows the specifier to set measurable maximum acceptable dust accumulation levels, as benchmarks for acceptance.

Annex F of BS EN 15780: 2011: *Ventilation for buildings. Ductwork. Cleanliness of ventilation systems* (BSI, 2011b) provides further guidance on protection, delivery and installation procedures.

Existing ductwork

The normal operation of ductwork systems will introduce dirt both from the external air brought into the system and from re-circulated air containing dust and other particles. The filtration system (where provided) should be designed to remove dirt and dust. However, the level of filtration, the standard of filter medium used and the adequacy of seals and fittings around the filtration equipment can all lead to increased levels of dust and dirt. These in turn can have an effect on plant performance such as reducing the efficiency of the fan and heat transfer equipment. The function of the air movement system and the cleanliness quality class of the building and installation can determine the requirements for cleaning. Certain process applications, for example food and pharmaceuticals, are likely to have considerably higher standards of ductwork cleanliness than those serving a warehouse.

BS EN 15780: 2011: *Ventilation for buildings. Ductwork. Cleanliness of ventilation systems* (BSI, 2011b) provides benchmark measurement levels to define acceptable cleanliness levels for each of the three cleanliness classes and for supply, recirculation and extract.

Dust deposition in ductwork

Dust will generally be deposited mainly over the lower surfaces of air distribution ducts, with the deposition increasing with distance from the AHU. There may be additional deposition where the local flow of air is slowed. This will happen at points where there is a resistance to the flow of air including the filters, heating and cooling coils, corner vanes and changes in the direction of ducting, changes in cross-sectional area and at surface imperfections and jointing cracks between duct sections. Once it is deposited, a physical disturbance or a change in the flow speed would be required to re-entrain significant amounts of the dust into the air.

Table 2.47 Typical applications of cleanliness quality classes (reproduced from Table A1 of BS EN 15780: 2011: *Ventilation for buildings* (BSI, 2011b) by permission of the British Standards Institution)

Quality class	Typical examples
Low	Rooms with only intermittent occupancy, e.g. storage rooms, technical rooms
Medium	Offices, hotels, restaurants, schools, theatres, residential homes, shopping areas, exhibition buildings, sport buildings, general areas in hospitals
High	General working areas in industries, laboratories, treatment areas in hospitals, high-quality offices

Moisture

It is important to take precautions to avoid the generation or ingress of moisture, as the presence of moisture or free water droplets on the surfaces of ducts is well known as a potential cause of microbial contamination. This is normally avoided by the system design and control, but unwanted moisture can arise under some circumstances, for example:

— where the metal duct surface temperature falls below the dew-point of the air flowing through it

— downstream of cooling coils operated below the dew-point (a spray eliminator is usually installed downstream of cooling coils used for dehumidification, but 'normal' cooling coils may also operate unintentionally under these conditions)

— where there is a leak of water from a heating or cooling coil or from water pipework outside the air duct

— as a (temporary) residue from any wet cleaning process

— by ingress of rain water.

See section 2.7.2.5 for cleaning methods.

Fire-resisting products

All fire-resisting products and smoke control items need to be checked regularly and records maintained—see Appendix V and Appendix W of BS 9999: 2008: *Code of practice for fire safety in the design, management and use of buildings* (BSI, 2008a) and the requirements of the RRFSO (TSO, 2005).

2.7.2.4 Inspection for cleaning

Inspection of the ventilation system will usually start with a visual check of the outside air intake, which can be a source of pollution and contamination. A smoke test can quickly determine if outside air is entering the system. Further items to check will be dampers, protective devices against weather, insect and rodents, the hygiene of coils, fans and insulation, the presence of water and condition of condensate drain pans and humidifier reservoirs.

Checking the need for cleaning should be done periodically. Eurovent includes recommendations on indoor air quality (IAQ) (Eurovent, 1999).

Figure 2.64 provides a schematic flowchart for procedures to maintain cleanliness of ventilation systems.

Local exhaust ventilation may be intended to control substances hazardous to health, including biological agents. The Health and Safety Executive (HSE) recommends examination and testing of such systems at least every 14 months and more frequently for certain processes (HSE, 1998).

Ventilation ductwork may be inspected optically using visual inspection instruments (e.g. borescopes) or by remote control inspection vehicles using closed-circuit television (CCTV) to record the internal condition of the ducts. Visual inspection (e.g. video) should be combined with quantitative methods of measuring dirt or microorganisms.

Special attention should be given to the cleanliness of:

— air filters

— sound attenuators

— humidifiers

— components for measurement or control.

The condition of all these items is generally a good indicator of the need for cleaning. It is recommended to start inspection from these components. After cleaning, all these components should be inspected to ensure that no damage has occurred and the cleanliness and functionality are as intended.

The need for cleaning following an inspection of the ductwork will depend on the level of dirt identified at the inspection and the particular requirements of the building, including the specific operations undertaken within the facility. Some buildings will be more sensitive to a build up of dirt and dust in the ductwork and are likely to need a more frequent inspection regime and subsequent cleaning.

Checking the results of cleaning should be combined with checking the functions of the system after cleaning, and readjustments made where required.

In order to maintain ductwork hygiene, both the supply and re-circulated airstreams should be clean (see TR/19: *Guide to Good Practice* (BESA, 2013c)). Access must be available for cleaning to minimise the build up of microbial growth on ductwork, fan blades or coils (see CIBSE TM26: *Hygienic maintenance of office ventilation ductwork* (2000b)); the latter can result in loss of performance. There is also a need for regular inspections. To minimise pressure drops caused by filtration, the airflow entering a filter should be uniform, requiring the filter surface to be as large as possible. A manometer should be installed across each filter bank to ascertain when filters need changing and access doors should be provided for ease of filter replacement.

2.7.2.5 Cleaning methods

There are several methods by which cleaning contractors can remove dust, debris and other surface contaminants:

— vacuum

— steam

— compressed air

— rotary brush.

Cleaning methods are more fully described in TR/19: *Guide to Good Practice* (BESA, 2013c) and BSRIA Technical Note

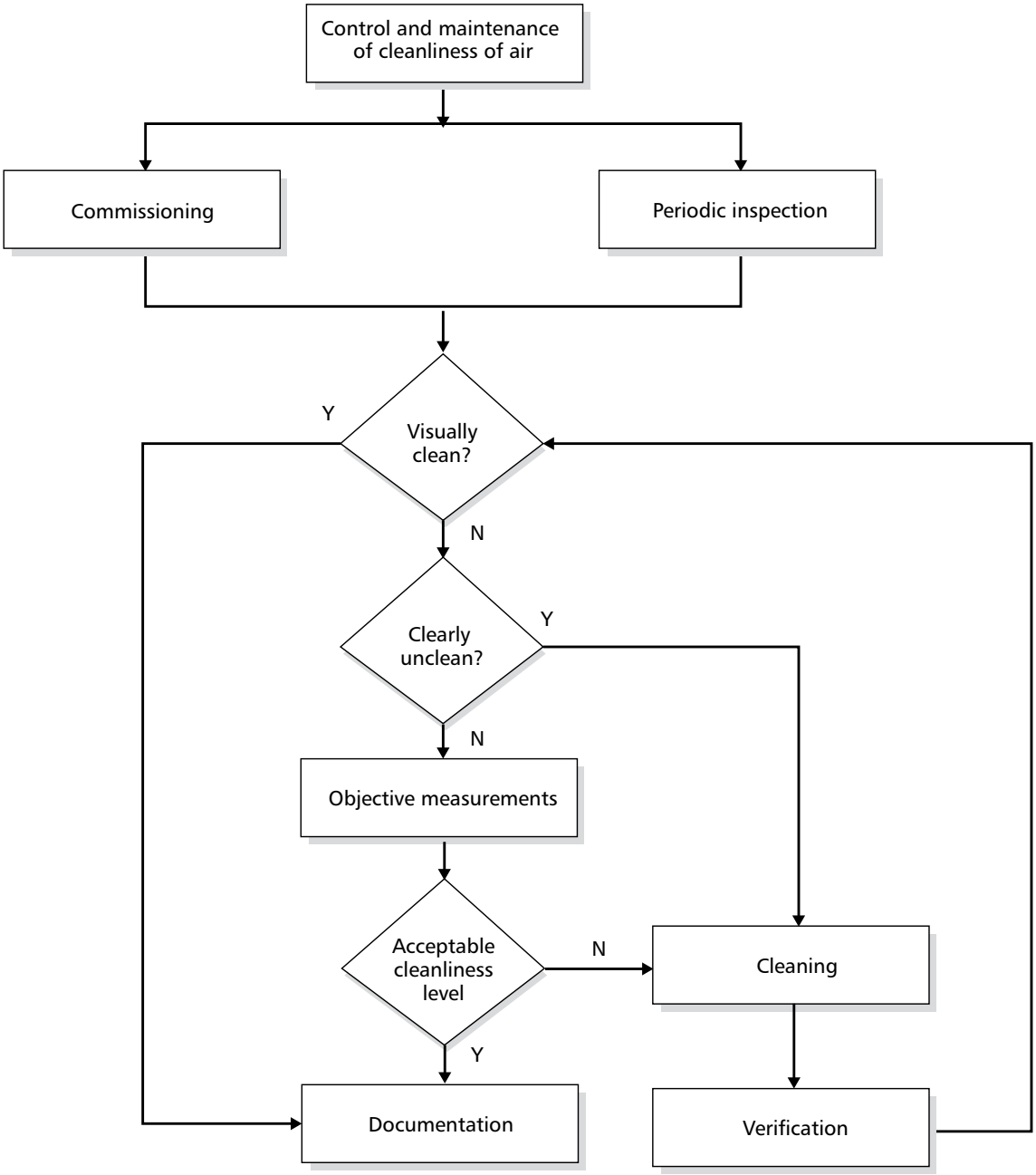


Figure 2.64 Schematic flowchart for procedures to maintain cleanliness of ventilation system (reproduced from BS EN 15780: 2011: *Ventilation for buildings* (BSI, 2011b) by permission of the British Standards Institution)

TN 18/92: *Ventilation System Hygiene: A Review* (1996). Methods will vary according to the air distribution system. On the basis that the contaminants are dry, dry methods of cleaning are adequate for supply air and general extract systems. Wet methods are needed for air ducts in commercial kitchens and similar installations where extract air contains smoke, grease and other impurities.

The cleaning process involves loosening dirt adhering to ductwork surfaces and its subsequent removal. The loosening can be remotely by compressed air or rotary brushing equipment in conjunction with removal by industrial vacuum collector. Dust may alternatively be removed directly by a technician crawling along the ducts using a hand-held vacuum cleaner. When cleaning within ducts it is essential that sensor probes are withdrawn to prevent them from being damaged.

Dust resulting from cleaning, particularly that which may contain biologically active material, should be disposed of safely.

When cleaning is complete, the ductwork system may require rebalancing. Most cleaning contractors leave dampers and other control devices in their 'as found' positions. Based on system performance, the property operator will then need to decide whether rebalancing is required. It is recommended that a commissioning specialist be appointed to undertake this task.

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Appendix 2.A1: Recommended sizes for ductwork

Table 2.A1.1 Recommended sizes for rectangular ductwork, including equivalent diameter, hydraulic diameter, cross sectional area and perimeter (based on BS EN 1505)

Longer side / mm	Parameter*	Shorter side / mm											Parameter*
		100	150	200	250	300	400	500	600	800	1000	1200	
150	d_e	*134*	*165*										d_e
	P	0.5	0.6										P
	d_h	*120.00*	*141.55*	*180.82*									d_h
	A	0.015	0.0225	0.03									A
200	d_e	*154*	*190*	*220*									d_e
	P	0.6	0.7	0.8									P
	d_h	*133.33*	*171.43*	*200.00*									d_h
	A	0.02	0.03	0.04	0.05								A
250	d_e	*171*	*212*	*246*	*275*								d_e
	P	0.7	0.8	0.9	1.0								P
	d_h	*142.86*	*187.50*	*222.22*	*250.00*								d_h
	A	0.025	0.0375	0.05	0.0625	0.075							A
300	d_e	*185*	*231*	*269*	*301*	*330*							d_e
	P	0.8	0.9	1.0	1.1	1.2							P
	d_h	*150.00*	*200.00*	*240.00*	*272.73*	*300.00*							d_h
	A	0.03	0.045	0.06	0.075	0.09	0.12						A
400	d_e	*211*	*264*	*308*	*346*	*387*	*441*						d_e
	P	1.0	1.1	1.2	1.3	1.4	1.6						P
	d_h	*160.00*	*218.18*	*266.67*	*307.69*	*342.86*	*400.00*						d_h
	A	0.04	0.06	0.08	0.1	0.12	0.16	0.2					A
500	d_e		*291*	*341*	*385*	*424*	*492*	*551*					d_e
	P		1.3	1.4	1.5	1.6	1.8	2.0					P
	d_h		*230.77*	*285.71*	*333.33*	*375.00*	*444.44*	*500.00*					d_h
	A		*0.075*	*0.1*	*0.125*	*0.15*	*0.2*	*0.25*	*0.3*				A
600	d_e		*316*	*371*	*419*	*462*	*537*	*603*	*661*				d_e
	P		1.5	1.6	1.7	1.8	2.0	2.2	2.4				O
	d_h		*240.00*	*300.00*	*352.94*	*400.00*	*480.00*	*545.45*	*600.00*				d_h
	A			0.12	0.15	0.18	0.24	0.3	0.36	0.48			A
800	d_e			*421*	*477*	*527*	*616*	*693*	*761*	*881*			d_e
	P			2.0	2.1	2.2	2.4	2.6	2.8	3.2			P
	d_h			*320.00*	*380.95*	*436.36*	*533.33*	*615.38*	*1538.46*	*800.00*			d_h
	A				0.2	0.24	0.32	0.4	0.48	0.64			A
1000	d_e				*527*	*583*	*683*	*770*	*848*	*984*	*1101*		d_e
	P				2.5	2.6	2.8	3.0	3.2	3.6	4.0		P
	d_h				*400.00*	*461.54*	*571.43*	*666.67*	*750.00*	*888.89*	*1000.00*		d_h
	A				0.25	0.3	0.4	0.5	0.6	0.8	1.0	1.2	A
1200	d_e					*632*	*741*	*837*	*924*	*1075*	*1205*	*1322*	d_e
	P					3.0	3.2	3.4	3.6	4.0	4.4	4.8	P
	d_h					*480.00*	*600.00*	*705.88*	*800.00*	*960.00*	*1090.91*	*1200.00*	d_h
	A					0.36	0.48	0.6	0.72	0.96	1.2	1.44	A

* d_e = equivalent diameter / mm; P = perimeter / m; d_h = hydraulic diameter / mm; A = cross sectional area / m^2

Table continuees

Table 2A1.1 Recommended sizes for rectangular ductwork, including equivalent diameter, hydraulic diameter, cross sectional area and perimeter (based on BS EN 1505[A1.1]) — *continued*

Longer side / mm	Parameter*	Shorter side / mm										Parameter*
		100	150	200	250	300	400	500	600	800	1000	1200	
1400	d_e						*794*	*898*	*992*	*1118*	*1299*	*1427*	d_e
	P						3.6	3.8	4.0	4.4	4.8	5.2	P
	d_h						*622.22*	*736.84*	*840.00*	*1018.18*	*1166.67*	*1292.31*	d_h
	A						0.56	0.7	0.84	0.112	0.14	0.168	A
1600	d_e						*843*	*954*	*1054*	*1231*	*1385*	*1523*	d_e
	P						4.0	4.2	4.4	4.8	5.2	5.6	P
	d_h						*640.00*	*761.90*	*872.73*	*1066.67*	*1230.77*	*1371.43*	d_h
	A							0.8	0.96	1.28	1.6	1.92	A
1800	d_e							*1006*	*1112*	*1256*	*1465*	*1612*	d_e
	P							4.6	4.8	5.2	5.6	6.0	P
	d_h							*782.61*	*900.00*	*1107.69*	*1285.71*	*1440.00*	d_h
	A							0.9	1.08	1.44	1.8	2.16	A
2000	d_e							*1053*	*1166*	*1365*	*1539*	*1695*	d_e
	P							5.0	5.2	5.6	6.0	6.4	P
	d_h							*800.00*	*923.08*	*1142.86*	*1333.33*	*1500.00*	d_h
	A							1.0	1.2	1.6	2.0	2.4	A

* d_e = equivalent diameter / mm; P = perimeter / m; d_h = hydraulic diameter / mm; A = cross sectional area / m^2

Table 2.A1.2 Recommended sizes for circular ducting (based on BS EN 1506)

Diameter, d / mm	Perimeter, P / m	Hydraulic diameter, d_h / mm	Cross sectional area, A / m^2
63	0.198	63	0.004
80	0.251	80	0.006
100	0.314	100	0.010
125	0.393	125	0.156
150	0.470	150	0.023
160	0.502	160	0.026
200	0.628	200	0.040
250	0.785	250	0.063
315	0.990	315	0.099
355	1.115	355	0.126
400	1.257	400	0.160
450	1.413	450	0.203
500	1.571	500	0.250
560	1.760	560	0.314
630	1.079	630	0.397
710	2.229	710	0.504
800	2.512	800	0.640
900	2.826	900	0.810
1000	3.142	1000	1.000
1120	3.517	1120	1.254
1250	3.927	1250	1.563

DW/144 provides detailed guidance on duct sizing and should be referred to. The revised DW/144 (2013) includes provision for reducing the thickness of the sheet metal used in some sizes of ductwork and supersedes previous guidance.

References

BESA (2013) *Specification for Sheet Metal Ductwork* DW/144 (Penrith: BESA)

BSI (1998) BS EN 1505: 1998 *Ventilation for buildings. Sheet metal air ducts and fittings with rectangular cross-section. Dimensions* (London: British Standards Institution)

BSI (2007) BS EN 1506 *Ventilation for buildings. Sheet metal air ducts and fittings with circular cross section. Dimensions* (London: British Standards Institution)

Appendix 2.A2: Space allowances

2.A2.1 Space allowances for ductwork

Figure 2.A2.1 shows the recommended space allowances for rectangular, circular and flat oval ductwork (BSRIA, 1992). Figure 2.A2.2 shows recommended space allowances for vertical risers, both insulated and uninsulated (DEO, 1996). Access to ducts is governed by the space required to install and insulate the ductwork and this is determined by the clearance from firm objects, the jointing method, and whether or not the ducts are to be insulated after installation. See BS 8313[2.A2.3] for details.

Duct clearances can be reduced with care, providing correct jointing, insulation and maintenance of vapour barriers is achieved. Consideration should also be given to how the ductwork will be tested and, eventually, replaced. See also BSRIA Technical Note TN10/92: *Space allowances for building services distribution systems* (BSRIA, 1992).

2.A2.2 Ductwork access: common problems

2.A2.2.1 Fire dampers

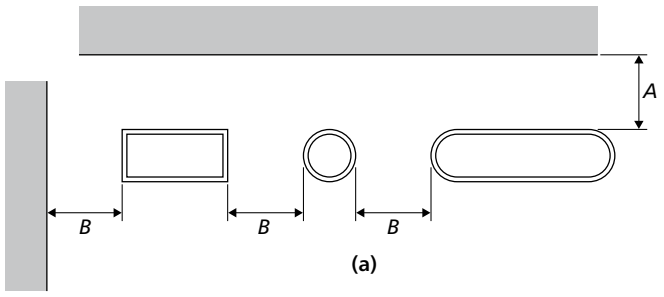
Access to fire dampers must not be obstructed by other services. Clear access must be ensured for inspection and testing. Figure 2.A2.3 illustrates two common problems.

2.A2.2.2 Ceiling-mounted terminal units

A typical installation is shown in Figure 2.A2.4. The ceiling grid immediately beneath the terminal unit should be demountable to facilitate access for removal and replacement of filters, fans, motors or the complete unit, if necessary. Access should be provided which is at least equal to the full plan dimensions of the unit (including control and commissioning valves) plus a minimum allowance of 100 mm on all sides.

2.A2.2.3 False ceilings and raised floors

Table 2.A2.1 shows typical floor-to-floor heights and the heights/depths of typical false floors/ceilings (Burberry, 1996). Figure 2.A2.5 illustrates some specific points.



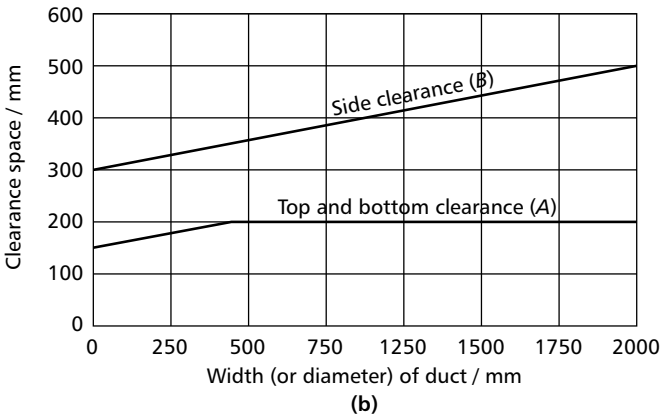


Figure 2.A2.1 Space allowance for rectangular, circular and flat oval ductwork (a) schematic, (b) recommended clearances (reproduced from BSRIA Technical Note TN10/92 by permission of the Building Services Research and Information Association)

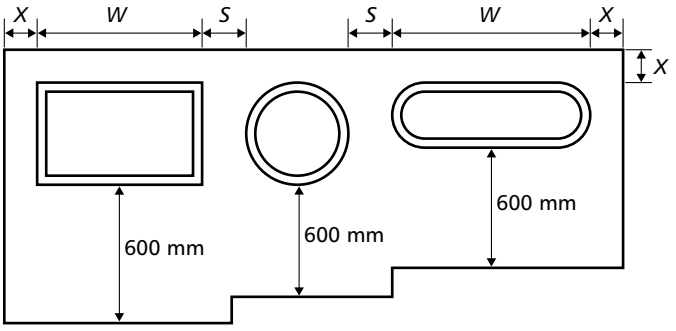
References

BSI (1997) BS 8313: 1997 *Code of practice for accommodation of building services in ducts* (London: British Standards Institution)

BSRIA (1992) *Space allowances for building services distribution systems — detail design stage* BSRIA Technical Note TN10/92 (Bracknell: Building Services Research and Information Association)

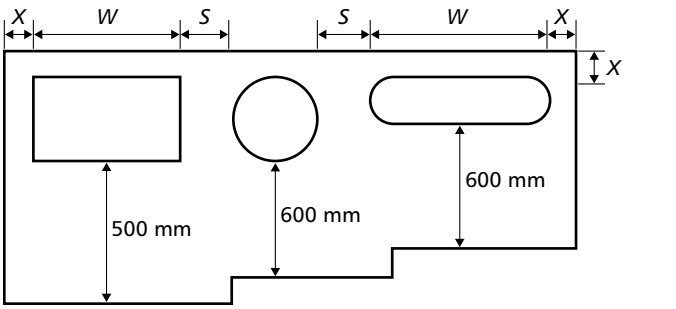
Burberry P (1996) *Architects Journal* 26 February 1986

DEO (1996) *Space requirements for plant access, operation and maintenance* Defence Estates Organisation (Works) Design and Maintenance Guide 08 (London: The Stationery Office)



If *W* less than or equal to 1000 mm: *X* = 200 mm, *S* = 400 mm
If *W* greater than 1000 mm: *X* = 400 mm, *S* = 600 mm

(a) Insulated ducts



If *W* less than or equal to 1000 mm: *X* = 100 mm, *S* = 300 mm
If *W* greater than 1000 mm: *X* = 300 mm, *S* = 400 mm

(b) Uninsulated ducts

Figure 2.A2.2 Space allowance for rectangular, circular and flat oval ductwork; (a) insulated, (b) uninsulated (reproduced from MoD Design and Maintenance Guide 08; © Crown copyright material is reproduced with the permission of the Controller of HMSO and Queen's Printer for Scotland)

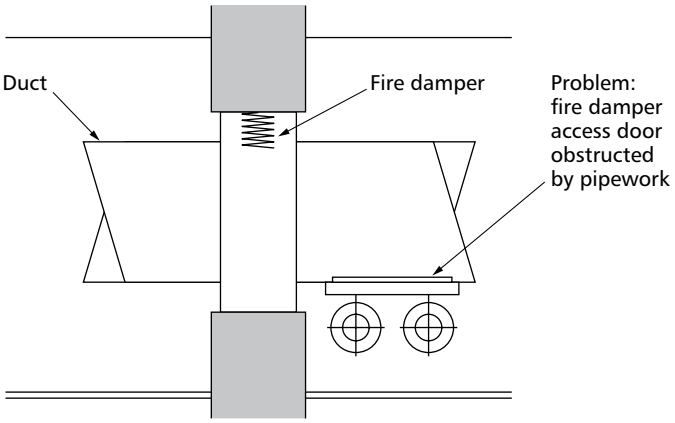


Figure 2.A2.3 Common problems with access to fire dampers (reproduced from MoD Design and Maintenance Guide 08; © Crown copyright material is reproduced with the permission of the Controller of HMSO and Queen's Printer for Scotland)

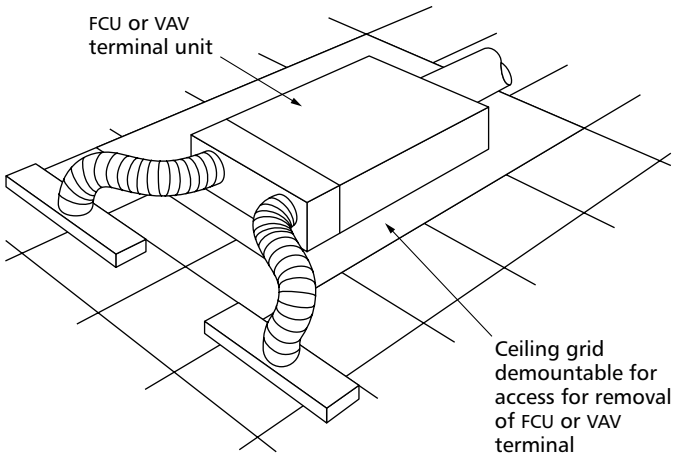
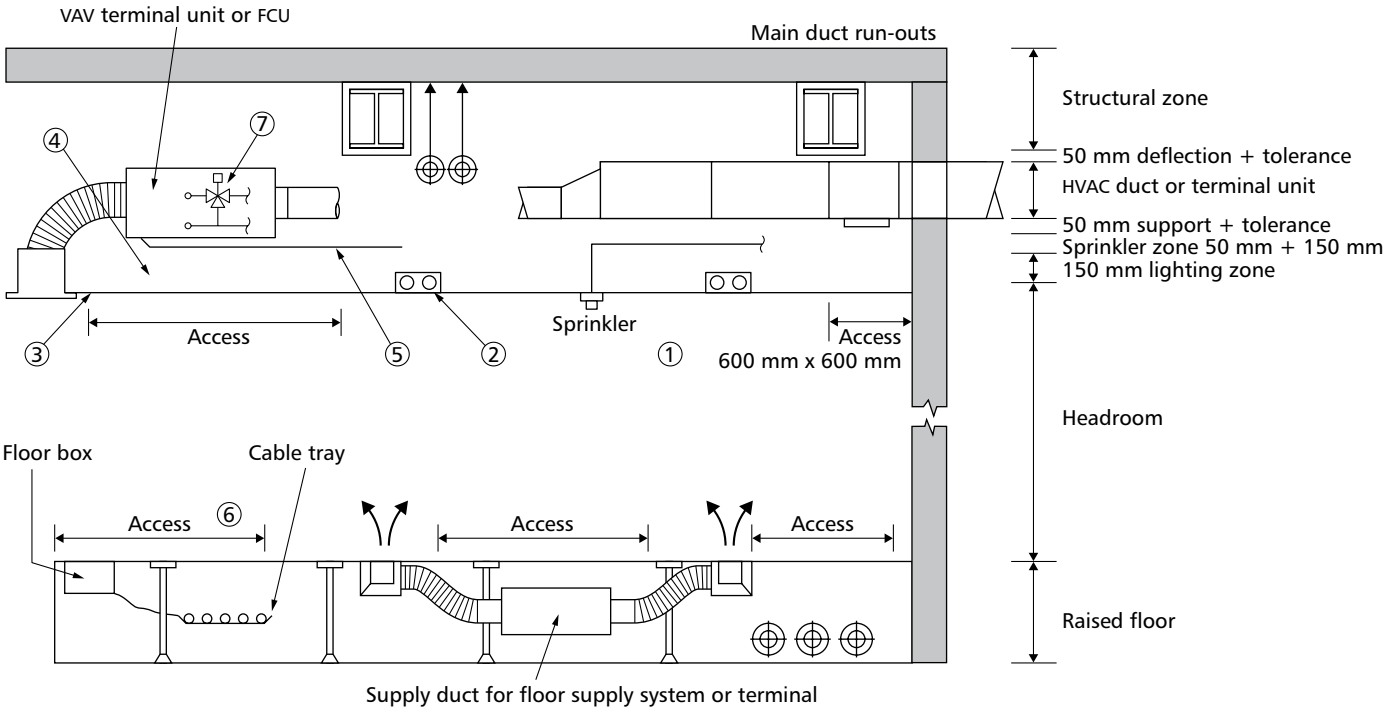


Figure 2.A2.4 Typical ceiling-mounted terminal unit (reproduced from MoD Design and Maintenance Guide 08; © Crown copyright material is reproduced with the permission of the Controller of HMSO and Queen's Printer for Scotland)

Table 2.A2.1 Typical floor-to-floor heights and heights/depths of typical false floors/ceilings (Burberry, 1996) for offices

Office type	Typical floor-to-floor height / m	Typical false ceiling height / m	Typical false floor depth* / m
Average quality office, refurbished office; average requirements for IT and engineering services	3.6–3.8	0.5–0.6	—
High quality office, minimal perimeter systems; above average requirements for IT and engineering services	3.9–4.2	0.8–1.0	0.4–0.6

* Option to reduce false ceiling height



① Ensure clear access to all fire dampers for inspection and testing
② Clearance of 1·5 times the luminaire depth to facilitate removal of the fitting
③ Demountable ceiling grid to permit access to the ceiling mounted terminal unit and removal
④ Clear access to the terminal unit for removable of the recirculation air filter (FCUs), cleaning of coil and condensate tray
⑤ Additional vertical space to be allowed for condensate drains and their fall (FCUs)
⑥ Access to raised floor shown for the situation where all floor tiles may not be removable
⑦ Provision should be made for permanent access to all commissioning and control valves

Figure 2.A2.5 False ceilings and raised floors (reproduced from MoD Design and Maintenance Guide 08; © Crown copyright material is reproduced with the permission of the Controller of HMSO and Queen's Printer for Scotland)

Appendix 2.A3: Maximum permissible air leakage rates

BESA specification DW/144 (2013)w Table 22 provides maximum permissible air leakage rates. Figure 207 in DW/144 shows the permitted leakage at various pressures.

Reference

BESA (2013) *Specification for Sheet Metal Ductwork* DW/144 (Penrith: BESA)

Appendix 2.A4: Methods of fire protection

The following information is taken from BESA specification DW/144 (2013), which should be referred to for further information.

2.A4.1 Protection using fire dampers

The fire is isolated in the compartment of origin by the automatic or manual actuation of closures within the system. Fire dampers should, therefore, be sited at the point of penetration of a compartment wall or floor, or at the point of penetration of the enclosure of a protected escape route.

Fire dampers should be framed in such a way as to allow for thermal expansion in the event of fire, and the design must provide for the protection of any packing material included.

Standard types of fire dampers and frames are described in section 22 of DW/144.

2.A4.2 Protection using fire resisting enclosures

Where a building services shaft is provided through which the ventilation ductwork passes, and if the shaft is constructed to the highest standard of fire resistance of the structure which it penetrates, it forms a compartment known as a 'protected shaft'. This allows a complicated multiplicity of services to be transferred together through a shaft transversing a number of compartments and reaching remote parts of the building, without requiring further internal divisions along its length. The provision of fire dampers is then required only at points where the ventilation duct leaves the confines of the protected shaft. However, if there is only one ventilation duct and there are no other services within the protected shaft, between the fire compartment and the outside of the building, no fire dampers will be required.

2.A4.3 Protection using fire resisting ductwork

In this method of fire protection, the ductwork itself forms a protected shaft. The fire resistance may be achieved by the ductwork material itself, or through the application of a protective material. This is provided that the ductwork has been tested and/or assessed to BS 476: Part 24 (1987) with a fire resistance, when tested from either side, that should not be less than the fire resistance required for the elements of construction in the area through which it passes. It should also be noted that the fire resisting ductwork must be supported with suitably sized and designed hangers, which reflect the reduction in tensile strength of steel in a fire condition, i.e.:

— fire resisting ductwork rated at 60 minutes (945 °C): tensile strength is reduced from 430 $N \cdot mm^{-2}$ to 15 $N \cdot mm^{-2}$

— fire resisting ductwork rated at 120 minutes (1049 °C): tensile strength is reduced to 10 $N \cdot mm^{-2}$

— fire resisting ductwork rated at 240 minutes (1153 °C): tensile strength is reduced to 6 $N \cdot mm^{-2}$.

Where the fire resisting ductwork passes through a fire compartment wall or floor, a penetration seal must be provided which has been tested and/or assessed with the ductwork to BS 476: Part 24, to the same fire rating as the compartment wall through which the fire resisting ductwork passes. It should also be noted that where the fire resisting ductwork passes through the fire compartment wall or floor, the ductwork itself must be stiffened to prevent deformation of the duct in a fire to:

— maintain the cross-sectional area of the duct

— ensure that the fire rated penetration seal around the duct is not compromised.

References

BESA (2013) *Specification for Sheet Metal Ductwork* DW/144 (Penrith: BESA)

BSI (1987) BS 476: *Fire tests on building materials and structures*; Part 24: 1987: *Method for determination of the fire resistance of ventilation ducts* (British Standards Institution) (1987)

Appendix 2.A5: Example calculations

2.A5.1 Ductwork sizing and pressure drop calculations

Ductwork sizing is so inter-related to pressure drop that the two calculations must be handled together, as will be seen in the following worked example. The ductwork sizing example is in four parts, as follows:

— The first part leads through the ductwork with explanations of the reasons for the first choice of size for each section of ductwork. Some of the sizes could or should be changed later in the light of subsequent calculations. The simple example, see Figure 2.A5.1, is designed to incorporate several different components and illustrate the consequences and choices which can be made. Only the supply ductwork is shown.

— The second part includes the calculations of pressure drop, using data contained in CIBSE Guide C (2007), section 4. A separate but similar calculation would be required for the return ductwork.

— Amendment of some duct sizes in the light of the pressure drop calculations.

— Consideration of the outdoor air supply duct.

2.A5.1.1 System design data

Figure 2.A5.1 illustrates a simple supply system to a suite of six private offices, each requiring 0.2 $m^3 \cdot s^{-1}$ of air. The main ductwork will be in the ceiling void of the corridors. Branches will be in ceiling voids within the offices. Outdoor air will constitute 40% of the total air being treated in the air handling unit (AHU). The main air supply has a winter design temperature of 30 °C.

For initial estimates only, the discharge diffusers will be assumed to give a pressure drop of 20 Pa for a flow of 0.2 $m^3 \cdot s^{-1}$.

It is anticipated that the interior of the building will have a positive pressure of 15 Pa to allow exhaust air to be extracted naturally.

2.A5.1.2 Preliminary sizing and explanation

From CIBSE Guide C[A6.1], Appendix 4.A1, properties of air are as follows:

— at 10 °C: $\rho = 1.24\ kg \cdot m^{-3}$; $\eta = 17.63 \times 10^{-6}\ kg \cdot m^{-1} \cdot s^{-1}$; $c_p = 1.011\ kJ \cdot kg^{-1} \cdot K^{-1}$

— at 30 °C: $\rho = 1.16\ kg \cdot m^{-3}$; $\eta = 18.55 \times 10^{-6}\ kg \cdot m^{-1} \cdot s^{-1}$; $c_p = 1.030\ kJ \cdot kg^{-1} \cdot K^{-1}$.

The minimum size of ductwork is constrained by acoustic considerations which limit air speeds. Otherwise life cycle costing should be the important factor. Thus, the limiting air velocities used as a starting point for duct sizing are as follows:

— *at external louvres*: air velocity, $c = 2.5\ m \cdot s^{-1}$ (from CIBSE Guide C, Table 4.12)

— *in the AHU*: air velocity, $c = 2\ m \cdot s^{-1}$ (face velocity; see Table 2.16)

— *in main duct*: air velocity, $c = 6\ m \cdot s^{-1}$ (Table 2.16)

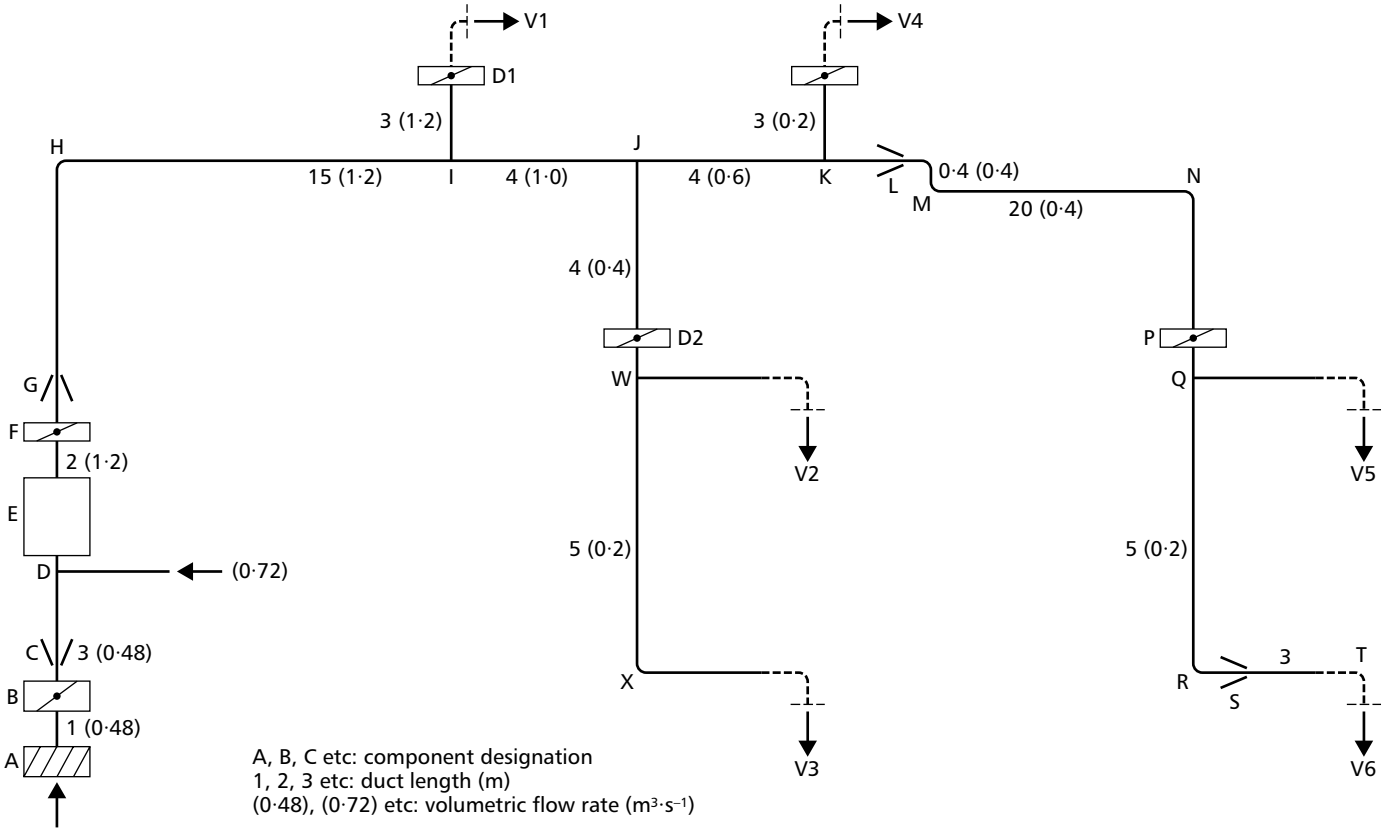


Figure 2.A5.1 Duct layout with lengths (m) and flow rates ($m^3 \cdot s^{-1}$)

— *in branch duct*: air velocity, $c = 5.5$ m·s^{-1} (Table 2.16)

— *in final duct*: air velocity, $c = 3$ m·s^{-1} (Table 2.16)

External louvres and mesh (A)

The pressure drop through louvres can be considerable. CIBSE Guide C, Table 4.35, recommends a maximum velocity of 2.5 m·s^{-1} through the free area in a 'normal' situation. Provisionally assuming a 90% free area, this implies a maximum face velocity of 2.25 m·s^{-1}.

For a total required airflow rate of 1.2 m^3·s^{-1}, 40% of which is outdoor air, the airflow rate at the inlet is:

$$q = 0.4 \times 1.2 = 0.48 \text{ m}^3\cdot\text{s}^{-1}$$

Hence:

$$A_{\min} = q / c = 0.48 / 2.25 = 0.213 \text{ m}^2$$

From Appendix 2.A1, Table 2.A1.1, a rectangular duct measuring 500 mm × 500 mm has a cross-sectional area, $A = 0.25$ m^2.

Substituting back into the previous equation gives velocity, $c = 1.92$ m^3·s^{-1}

(*a*) *External louvres*

CIBSE Guide C, section 4, gives tentative guidance on the friction factor for louvred duct entries. Provisionally assuming louvre ratios, as defined in Guide C, of $(h_i / h) = 0.7$ and $(x / x_1) = 0.9$, and louvres with vertical flat ends (case a), Guide C gives the pressure loss factor, $\zeta = 4.8$.

After selection of an appropriate louvre, the correct figure for pressure drop should be obtained from the manufacturer.

For a typical winter day, outdoor air might have a temperature of 10 °C, hence $\rho = 1.24$ kg·m^{-3}.

(*b*) *Bird mesh*

Provisionally assume a free area of 70%. CIBSE Guide C suggests pressure loss factor, $\zeta = 0.58$.

Outdoor air inlet damper (B)

Provisionally assuming for the moment that it will be an opposed blade damper with 3 blades, CIBSE Guide C suggests pressure loss factors based on the value of parameter x, given by:

$$x = n\,w / [2\,(h + w)]$$

where n is the number of blades, and w and h are the duct width (m) and height (m) respectively. Hence:

$$x = (3 \times 500) / [2 \times (500 + 500)] = 0.75$$

For the damper fully open ($\theta = 0°$), Guide C gives the pressure loss factor $\zeta = 0.52$.

After selection of an appropriate damper, the correct value should be obtained from the manufacturer.

Before continuing with the next item of ductwork, it is necessary to look ahead to the requirements of the air handling unit (E).

This will be handling airflow rate, $q = 1.2$ m^3·s^{-1}. Life cycle costing studies recommend a maximum face velocity of 2 m·s^{-1} for an air handling unit. Hence:

$$A_{\min} = q / c = 1.2 / 2.0 = 0.6 \text{ m}^2$$

For this cross-sectional area, Appendix 2.A1, Table 2.A1.1, suggests a rectangular duct measuring 1000 mm × 600 mm, giving $c = 2.0$ m.s^{-1}.

In anticipation of the tee at D, requiring 1000 mm × 600 mm, an expansion taper is included at C. (Clearly there would be a case both for simplicity and a lowering of face velocity if the louvre size had been chosen as 1000 mm × 600 mm in the first place.)

After the AHU, the air has a temperature of 30 °C, for which $\rho = 1.16$ kg·m^{-3}.

Expansion (C)

BESA specification DW/144 (2013) suggests a maximum taper included angle of $\theta = 45°$.

For expansion from (500 × 500) to (1000 × 600):

$$A_2 / A_1 = (1.0 \times 0.6) / (0.5 \times 0.5) = 2.4$$

For such small expansions the angle of the taper is not very important, so a value of $\theta = 45°$ is chosen.

The determination of ζ is quite complex. For a quick calculation, a speculative value might provisionally be taken from the table, especially as this is not a large expansion. Nevertheless a full calculation is demonstrated here. A typical winter temperature of 10 °C is chosen, but this is not critical.

Based on 500 × 500, $d_h = 500$ mm (from Appendix 2.A1, Table 2.A1.1). At (C), the airflow rate is: $q = 0.48$ m^3·s^{-1}. Hence, velocities before and after the expansion taper are: $c_1 = 1.92$ m·s^{-1} and $c_2 = 0.8$ m·s^{-1}. The Reynolds number is then given by:

$$Re_1 = \rho\, c\, d / \eta = (1.24 \times 1.92 \times 0.5) / 17.63 \times 10^{-6}$$
$$= 0.68 \times 10^5$$

Approximately, taking $A_2 / A_1 = 2$, and $Re = 1 \times 10^5$, Guide C, Table 4.79 gives $\zeta = 0.330$. (More accurately, by graphical interpolation, $\zeta = 0.50$.)

Tee, with shoe on the branch (D)

Note that for all tees, the value of ζ is to be used with the velocity pressure of the combined flow. The velocity for the combined flow is given by:

$$c_c = 1.2 / (1.0 \times 0.6) = 2.0 \text{ m}\cdot\text{s}^{-1}$$

For converging flow, the ratio of straight flow rate to combined flow rate is:

$$q_s / q_c = 0.48 / 1.2 = 0.4$$

From CIBSE Guide C the pressure loss factor for straight flow is: $\zeta_{s-c} = 0.22$.

Assume that the branch, carrying 0.72 $m^3 \cdot s^{-1}$, has a size 300 mm × 400 mm; hence $c = 6$ $m \cdot s^{-1}$. Therefore, ratio of branch flow rate to combined flow rate is:

$$q_b / q_c = 0.72 / 1.2 = 0.6$$

(Note that without a shoe, CIBSE Guide C, section 4.11.4.12, shows that the pressure loss factor for straight flow would have 0.46, i.e. twice that for a tee with a shoe on the branch.)

Air handling unit (AHU) (E)

The air handling unit, including heater battery, filter and fan, may be regarded as a 'black box' which must provide a pressure rise, external to itself, equal to the total pressure drop around the whole air circuit, supply and return.

Control damper, opposed blade, 3 blades (F)

As a first estimate, using CIBSE Guide C, section 4.11.4.18 (see above, section A6.1.2.2), parameter x is given by:

$$x = (3 \times 0.6) / [2 \times (0.6 + 0.6)] = 0.75$$

For the damper fully open ($\theta = 0$), hence $\zeta = 0.52$.

After selection of the damper, the correct value must be obtained from the manufacturer.

Duct (G–H–I)

For a building containing private offices, Table 2.16 gives the maximum permitted velocity in a main duct as 6 $m \cdot s^{-1}$. This also accords with figures derived from life cycle costing.

Again, using the expression $A = q / c$, the required cross-sectional areas of the duct is:

$$A = 1.2 / 6.0 = 0.2 \text{ m}^2$$

Appendix 2.A1, Table 2.A1.1, suggests either 600 mm by 400 mm, or 500 mm by 400 mm ductwork. For this example 500 mm by 400 mm is chosen, and the orientation such as to make the following bend (H), an 'easy' bend, i.e. $w = 400$ mm, $h = 500$ mm.

From the same table, the equivalent diameter is:

$$d_e = 492 \text{ mm}$$

Contraction (G)

For reduction from (1000 × 600) to (400 × 500), the ratio of cross-sectional areas is:

$$A_2 / A_1 = (400 \times 500) / (1000 \times 600) = 0.333$$

The maximum taper recommended in BESA specification DW/144 is an included angle $\theta = 45°$.

CIBSE Guide C, section 4.11.5.2, shows that for contractions the included angle is not important and ζ is small. Note that ζ is to be used with the outlet velocity, c_2. An included angle of 45° is chosen hence, from CIBSE Guide C by interpolation: $\zeta = 0.055$.

The outlet velocity is:

$$c_2 = q / A_2 = 1.2 / (0.4 \times 0.5) = 6.0 \text{ m} \cdot \text{s}^{-1}$$

Bend, with splitter vanes (H)

CIBSE Guide C section 4.11.4.2 applies. For $400 < w < 800$, Table 2.40 (based on BESA specification DW/144) recommends a single splitter vane. The BESA standard radius for bends is r = w, and this radius will be used. Hence:

$$h / w = 500 / 400 = 1.25$$

From CIBSE Guide C, Table 4.112, $\zeta = 0.05$.

Note that this value is considerably less than would have been the case without the vane.

Typical branch (I–D1–V1)

The 'index run', i.e. the pipe run likely to give the highest pressure loss, would appear to be the run from G to R to V6. In reality, it would depend upon the route taken by the return duct from the room supplied at V6.

Thus at the next few tees, it is necessary to consider only the pressure loss factors for straight flow, ζ_{c-s}. Since the pressure drop incurred by tees depends upon the relative size of the branch, it is worth digressing at this point to consider the branches to the final run outs.

In this example, each final branch has the same flow. It is more convenient for the branches to be circular, especially as it is convenient to make the final connection to a diffuser by a flexible duct. However the length of such flexible ducts should be kept to a minimum as their pressure loss is high.

Taking a typical branch, I–D1–V1, assumed now to be within the office space, noise is the most important criterion, therefore velocity $c < 3$ $m \cdot s^{-1}$ (see Appendix 2.A1, Table 2.A1.1). Generally, even lower velocities are used, a velocity $c = 2.5$ $m \cdot s^{-1}$ will be assumed. Hence, the branch duct area is:

$$A = q / c = 0.2 / 2.5 = 0.08 \text{ m}^2$$

For a circular duct, this gives a minimum diameter $d_{min} = 319$ mm. This is so close to a standard size of 315 mm that the difference might be considered trivial. Furthermore this is a branch which provides an air route of minimum length and resistance. It is tempting to have the smaller diameter for this first branch and larger branches for the others, but this might lead to confusion for the installers. As the branch ducts are short it might be thought that the pressure drop will be small. However, the use of a short length of flexible ductwork for the final connection to the diffuser can add a disproportionate pressure drop. For these reasons, $d = 315$ mm is chosen for the branch diameter.

For $d_b = 315$ mm, the branch cross-sectional area is $A_b = 0.0779$ m^2. Hence, the ratio of the cross-sectional area of the branch to that of the main duct flow is:

$$A_b / A_c = 0.0779 / (0.5 \times 0.4) = 0.390$$

The air velocity in the branch is:

$$c_b = q_b / A_b = 0.2 / 0.0779 = 2.57 \text{ m} \cdot \text{s}^{-1}.$$

Tee (with shoe) (I)

For the rectangular main duct (500 × 400): $A_c = 0.2$ m^2, $q_c = 1.2$ m^3·s^{-1}, hence $c_c = 6$ m·s^{-1}

For the circular branch ($d = 315$ mm): $A_b = 0.0779$ m^2, $q_b = 0.2$ m^3·s^{-1}.

Hence:

$$A_b / A_c = 0.0779 / 0.2 = 0.39$$

$$q_b / q_c = 0.2 / 1.2 = 0.166$$

$$q_s / q_c = 1.0 / 1.2 = 0.833$$

(Note that the pressure drop to the branch is less than it would be without the shoe, but is still considerably greater than that for the straight, which is to be expected.)

Branch (J–X)

This is required to carry 0.4 m^3·s^{-1} with a limiting speed of 5.5 m·s^{-1}. This implies a diameter of 304 mm. There would seem little option but to choose circular ductwork the next size up, i.e. 315 mm, though rectangular ductwork 300 mm × 250 mm could be chosen.

Ducts (I–J and J–K)

The straight runs I–J and J–K are short enough not to justify the complication of reductions in size, so, for convenience, the duct dimensions will remain the same as for ductwork run (G–H–I), i.e. 500 mm × 400 mm.

Tee (with shoe) (J)

For the rectangular main duct (500 mm × 400 mm): $A_c = 0.2$ m^2, $q_c = 1.0$ m^3·s^{-1}, hence $c_c = 5$ m·s^{-1}.

For the circular branch ($d = 315$ mm): $A_b = 0.0779$ m^2, $q_b = 0.4$ m^3·s^{-1}.

Hence:

$$A_b / A_c = 0.0779 / 0.2 = 0.39$$

$$q_b / q_c = 0.4 / 1.0 = 0.4$$

$$q_s / q_c = 0.6 / 1.0 = 0.6$$

Tee (without shoe) (K)

For the rectangular main duct (500 mm × 400 mm): $A_c = 0.2$ m^2, $q_c = 0.6$ m^3·s^{-1}, hence $c_c = 3$ m·s^{-1}.

For the circular branch ($d = 315$ mm): $A_b = 0.0779$ m^2, $q_b = 0.2$ m^3·s^{-1}.

Hence:

$$A_b / A_c = 0.0779 / 0.2 = 0.39$$

$$q_s / q_c = 0.4 / 0.6 = 0.667$$

Duct (L–M–Q)

This main branch could tolerate velocities up to 5.5 m·s^{-1}. The ductwork could conveniently be circular.

Hence, for $q = 0.4$ m^3·s^{-1}:

$$A_{min} = q / c = 0.4 / 5.5 = 0.0727 \text{ m}^2$$

$$d_{min} = 304 \text{ mm}$$

A diameter of 315 mm could easily be chosen here, but since this is the index run, it is advisable to minimise pressure losses along this run as this will make subsequent balancing easier. Therefore the next size up is selected: $d = 355$ mm.

Hence:

$$A_c = 0.100 \text{ m}^2$$

Contraction, rectangular to circular (L)

For reduction from rectangular (500 mm × 400 mm) to circular ($d = 355$ mm), with a maximum taper angle of $\theta = 45°$, CIBSE Guide C, section 4.11.5 applies.

$$A_2 / A_1 = 0.1 / 0.2 = 0.5$$

Segmented bends in close proximity (M)

CIBSE Guide C, section 4.11.2.5 applies. Separation of bends, $l = 400$ mm, so $(l / d) = 400 / 355 = 1.1$; $(r / d) = 1$ for each bend. The Reynolds number is given by:

$$Re = \rho c d / \eta = 1.16 \times 4.0 \times 0.355 / (18.55 \times 10^{-6})$$
$$= 0.888 \times 10^5$$

90° segmented bend (N)

By interpolation, from CIBSE Guide, Table 4.119, for $(r / d) = 1$, $R_e = 0.9 \times 105$, $d = 355$ mm:

$$\zeta = 0.305$$

Fire damper (P)

This should have a totally clear area when open, presenting a small resistance. Provisionally, until manufacturer's data are available, assume $\zeta = 0.12$.

Tee (without shoe) (Q)

For the circular main duct ($d_c = 355$ mm): $A_c = 0.10$ m^2, $q_c = 0.4$ m^3·s^{-1}.

For the circular branch ($d_b = 315$ mm): $A_b = 0.0779$ m^2, $q_b = 0.2$ m^3.s^{-1}.

Hence:

$$A_b / A_c = 0.0779 / 0.10 = 0.78$$

$$q_b / q_c = 0.2 / 0.4 = 0.5$$

Duct (Q–R)

Logically, the diameter could be reduced to 315 mm. However, since this is the index run, it is better to minimise

pressure loss, therefore it is better to maintain the duct diameter as 355 mm until after the final bend R.

90° segmented bend (R)

The air velocity is given by:

$$c = q / A = 0.2 / 0.1 = 2.0 \text{ m·s}^{-1}$$

Hence, the Reynolds number is:

$$Re = \rho c d / \eta = 1.16 \times 2.0 \times 0.355 / (18.55 \times 10^{-6})$$
$$= 0.44 \times 10^5$$

Symmetrical contraction (S)

For reduction from $d_1 = 355$ mm to $d_2 = 315$ mm, ratio of cross-sectional areas is:

$$A_2 / A_1 = (315 / 355)^2 = 0.79$$

CIBSE Guide C, section 4.11.2.8 applies. For an included angle $\theta = 45°$, CIBSE Guide C, Table 4.57 gives, by extrapolation: $\zeta = 0.055$.

The outlet velocity is:

$$c_2 = q / A_2 = 0.2 / 0.0779 = 2.57 \text{ m·s}^{-1}$$

90° segmented bend (T)

The Reynolds number is given by:

$$Re = \rho c d / \eta = 1.16 \times 2.57 \times 0.315 / (18.55 \times 10^{-6})$$
$$= 0.51 \times 10^5$$

Diffuser (V)

Provisionally, take:

$$\Delta p = 20 \text{ Pa}$$

2.A5.1.3 Calculation of pressure drop

For each duct fitting, along what is believed to be the index run, the pressure drop is given by:

$$\Delta p_t = \zeta \, {}^1/_2 \, \rho c^2$$

Appropriate values have already been obtained in section 2.A5.1.2 above, and a table of the calculations is shown as Table 2.A6.1.

For the straight lengths of duct, Figure 2.33 is used to obtain the pressure drop per unit length. The calculations are shown in Table 2.A5.2.

The pressure drops obtained in Tables 2.A5.1 and 2.A5.2 are summed to give a drop in total pressure of 70.4 Pa.

2.A5.1.4 Amendment to duct sizes to improve balance

Although the duct sizing has, by normal criteria, been on the generous side, the pressure drop along the index run is nevertheless dominated by the pressure drop along G–I and L–Q. If the design is left as it is, then branch run (I–D1–V1) will require considerable additional resistance by closing damper D1, which could cause additional noise generation. Furthermore, the system pressure drop will consequently always be greater and incur constant additional fan power and energy costs. Consideration should always be given to the alternative solution of reducing the pressure loss in the index run by increasing the duct size along the 'problem' runs. To illustrate this, the duct size from L–S could be increased to the next size up.

Table 2.A5.3 illustrates the effect of increasing the diameter of duct run (L–S) from 355 mm 400 mm. The effect is to reduce friction pressure drop by 10.8, some 16% of the total pressure drop, which would be worth achieving.

Table 2.A5.4 gives a break-down of the pressure drop incurred along the index run to V6 with the increased duct sizes. The drop in total pressure is now 59.7 Pa.

Before finally accepting these design sizes, it is worth checking on the pressure drop incurred by the airflow along the shortest duct run, namely E to V1, see Table 2.A6.5.

Note that the pressure drops along the index run (see Table 2.A5.4) and along the shortest run (see Table 2.A5.5) are now almost in balance, being 59.7 and 61.2 Pa respectively. This is due to the decision to employ larger size ductwork along the index run, and also to the fact that flow round to the branch at tee I is considerably more than along the straight, despite the shoe. Normally the control damper D1 would need to provide an additional pressure drop, but in this instance it is not necessary. Similar calculations should be carried out for each air route.

Assuming that all the air flow runs can be adjusted to have the same loss of total pressure, the 'design flow rates' should then occur. Note that the total pressure drop for the circuit is only that for one circuit as all the routes are in parallel.

At this stage the return ductwork has been neither designed nor sized. The exercise is similar to the above calculations for the supply ductwork. In this example, only 60% of the total air flow is to be recirculated. The pressure drops calculated would in general be very similar, except to note that the pressure drop through an extract grille will, or should be, considerably less than that through a supply diffuser. For the purposes of this example, a return airflow of 0.72 $\text{m}^3\text{·s}^{-1}$ is assumed, incurring a pressure drop of 50 Pa. This would give rise to a total pressure drop for the circuit of (60 + 50) Pa = 110 Pa.

Note that a cost–benefit analysis of enlarging duct L–S might not in isolation justify such enlargement. However, the 'knock-on' effects should not be overlooked; i.e. the pressure drop on the other four air routes would be affected such that dampers in non-index run routes might require less trimming. It has already been shown that, for example, damper D1 will require no measurable trimming.

The final duct layout using the amended duct sizes is shown in Figure 2.A6.2.

2.A5.1.5 Outdoor air supply

Note that, up to this point, the effect of the outdoor air inlet has not been considered because it does not constitute part of the main airflow loop. A few assumptions will now be made to illustrate the effect.

Suppose that the air leaks from each room to the external air resulted in the air within each room having a pressure of 15 Pa above the pressure outside the building. The pressure drop in the return ductwork (Δp_t) was found to be 50 Pa (see section 2.A5.1.4). Thus, the total pressure just before the air handling unit (E), will be (–50 + 15) Pa =–35 Pa.

Table 2.A5.6 draws together the fresh air inlet duct calculations from Tables 2.A5.1 and 2.A5.2. This shows that, for the design flow of outdoor air, the pressure drop is 15.0 Pa. This needs to be 35 Pa so that the right quantity of outdoor air is drawn in. This can be achieved either by closing down damper B considerably, or by selecting a smaller louvre and mesh screen.

These considerations of the outdoor air supply duct have no bearing on the fan selection which follows.

Table 2.A5.1 Calculation of pressure drops for fittings in the index run of supply ductwork (E–V6)

Item	Description	Guide C table ref.	Appropriate air velocity	Air velocity / m·s^{-1}	($\frac{1}{2}\rho c^2$) / Pa	Pressure loss factor, ζ	Pressure drop, Δp / Pa
A_1	Louvre	4.104	—	1.92	2.29	4.8*	11.0
A_2	Mesh screen	4.102	—	1.92	2.29	0.58	1.3
B	Outdoor air inlet damper	4.78	—	1.92	2.29	0.52*	1.2
C	Expansion taper	4.79	c_1	1.92	2.29	0.33	0.8
D	Tee, shoe, converging (straight flow)	4.88	c_c	2.0	2.48	0.22	0.5
D	Tee, shoe, converging (branch flow)	4.89	c_c	2.0	2.4	1.03	2.5
E	Air handling unit (AHU)	—	—	—	—	—	—
F	Damper	4.78		2.0	2.32	0.52*	1.2
G	Contraction taper (rect.)	4.80	c_2	6.0	20.9	0.055	1.1
H	90° bend with vane (rect.)	4.63	—	6.0	20.9	0.05	1.0
I	Tee, shoe, diverging	4.108	c_c	6.0	20.9	0.012	0.3
J	Tee, shoe	4.108	c_c	5.0	14.5	0	0
K	Tee	4.108	c_c	3.0	5.22	0.045	0.2
L	Contraction taper (rect. → circ.)	4.80	c_2	4.0	9.28	0.055	0.5
M	Double bend	4.122	—	4.0	9.28	0.58	5.4
N	Bend	4.119	—	4.0	9.28	0.305	2.8
P	Fire damper	—	—	4.0	9.28	0.12*	1.1
Q	Tee	4.133	c_c	4.0	9.28	0	0
R	Bend	4.119	—	2.0	2.32	0.35	0.8
S	Contraction (circ.)	4.126	c_2	2.57	3.83	0.055	0.2
T	Bend	4.119	—	2.57	3.83	0.36	1.4
V6	Diffuser	—	—	—	—	—	20.0*
						Total (E–V6):	36.0
I	Tee (branch flow)	4.108	c_c	6	20.9	0.83	17.3

* provisional value to be replaced with manufacturer's data following selection of equipment
Note: items A, B and C have not been added into the total, as the outdoor air supply is not in series with the return ductwork and will have to be considered separately later. Similarly, although the pressure drops across tee D have been illustrated, this would constitute part of the calculations for the return air ductwork.

Table 2.A5.2 Calculations for straight ductwork in the index run of supply ductwork (E–V6)

Run	Air velocity, c / m·s^{-1}	Duct length / m	Flow rate, q / m^3·s^{-1}	Dimensions / (mm × mm)	Equiv. diam., d_e / mm	$\Delta p / l$ Pa·m^{-1}	Pressure drop, Δp / Pa
A–B	1.92	1	0.48	500 × 500	545	0.09	0.1
C–D	0.8	3	0.48	1000 × 600	848	0.01	0
E–G	2.0	2	1.2	1000 × 600	848	0.01	0
G–I	6.0	15	1.2	500 × 400	492	1.0	15.0
I–J	5.0	4	1.0	500 × 400	492	0.75	3.0
J–K	3.0	4	0.6	500 × 400	492	0.29	1.2
K–L	2.0	1	0.4	500 × 400	492	0.13	0.1
L–Q	4.0	20.4	0.4	—	355	0.6	12.2
Q–S	2.0	5	0.2	—	355	0.16	0.8
S–T	2.57	3	0.2	—	315	0.34	1.0
T_1–T_2	2.57	0.4	0.2	—	315	8 × 0.35*	1.1
						Total (E–T_2):	34.4

* Flexible duct giving estimated pressure drop of 8 times that of smooth duct
Note: pressure drops along A–B and C–D have not been added into the total, as the fresh air supply is not in series with the return ductwork, and will have to be considered separately later.

Table 2.A5.3 Effect of a increasing diameter for duct run L–S

Item	Description	Length, l / m	$\Delta p / l$ Pa·m^{-1}	Pressure loss factor, ζ	$(\frac{1}{2}\rho c^2)$ / Pa	New pressure drop, Δp / Pa	Old pressure drop, Δp / Pa	Reduction / Pa
L–Q	Duct	20.4	0.28	—	—	6.1	12.2	6.1
Q–S	Duct	5	0.075	—	—	0.4	0.8	0.4
L	Contraction	—	—	0.055	5.88	0.3	0.5	0.2
M	Double bend	—	—	0.532	5.88	3.1	5.4	2.3
N	Bend	—	—	0.28	5.88	1.6	2.8	1.2
P	Fire damper	—	—	0.12*	5.88	0.7	1.1	0.4
Q	Tee	—	—	0.05	5.88	0.3	0	–0.3
R	Bend	—	—	0.282	1.47	0.4	0.9	0.5
S	Contraction	—	—	0.055	10.4	0.2	0.2	0
							Total saving:	10.8

* provisional value to be replaced with manufacturer's data following selection of equipment

Table 2.A5.4 Table of final calculations for ductwork and fittings in the index run (E–V6)

Item	Description	Dimensions / (mm × mm)	Length, l / m	$\Delta p / l$ / Pa·m^{-1}	Air vel., c / m·s^{-1}	$(\frac{1}{2}\rho c^2)$ / Pa	Press. loss factor, ζ	Press. drop, Δp / Pa
E–G	Duct	1000 × 600	2	0.01	2	2.4	—	0
F	Damper	1000 × 600	—	—	2	2.4	0.52*	1.2
G	Contraction taper (rect.)	—	—	—	6	20.9	0.055	1.1
H	90° bend, with vane (rect.)	500 × 400	—	—	6	20.9	0.05	1.0
G–I	Duct	500 × 400	15	1.0	6	20.9	—	15.0
I	Tee, shoe, diverging	500 × 400	—	—	6	20.9	0.012	0.3
I–J	Duct	500 × 400	4	0.75	5	14.5	—	3.0
J	Tee	500 × 400	—	—	5	14.5	0	0
J–K	Duct	500 × 400	4	0.29	3	5.22	—	1.2
K	Tee	500 × 400	—	—	3	5.22	0.045	0.2
K–L	Duct	500 × 400	1	0.13	2	2.32	—	0.1
L	Contraction taper (rect. → circ.)	400	—	—	3.18	5.88	0.055	0.3
M	Double bend (circ.)	400	—	—	3.18	5.88	0.536	3.1
N	Bend (circ.)	400	—	—	3.18	5.88	0.282	1.6
P	Fire damper (circ.)	400	—	—	3.18	5.88	0.12*	0.7
L–Q	Duct (circ.)	400	20.4	0.3	3.18	5.88	—	6.1
Q	Tee, without shoe (circ.)	400	—	—	3.18	5.88	0.05	0.3
R	Bend (circ.)	400	—	—	1.59	1.5	0.282	0.4
Q–S	Duct (circ.)	400	5	0.075	1.59	1.5	—	0.4
S	Contraction (circ.)	400 □ 315	—	—	2.57	3.96	0.055	0.2
T	Bend (circ.)	315	—	—	2.57	3.96	0.36	1.4
S–T	Duct (circ.)	315	3	0.34	2.57	3.96	—	1.0
T–T	Flexible duct (circ.)	315	0.4	2.8*	2.57	3.96	—	1.1
V6	Diffuser	—	—	—	—	—	—	20.0*
							Total (E–V6):	59.7
I	Tee (branch flow)	315	—	—	6	20.9	0.83	17.3

* provisional value to be replaced with manufacturer's data following selection of equipment

2.A5.2 Choice of fan or air handling unit (AHU)

2.A5.2.1 Fan specification

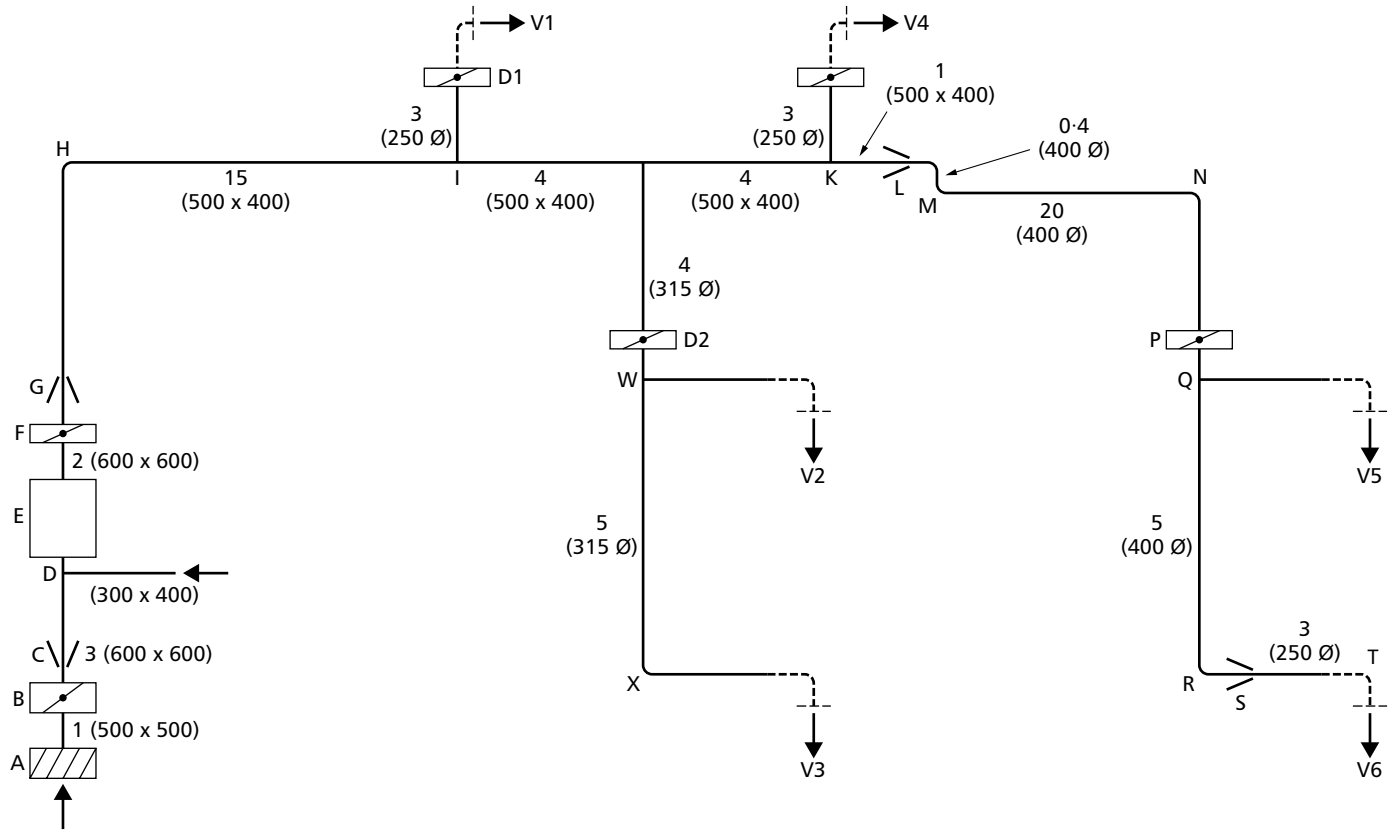
The air handling unit will be required to provide, external to the unit, an increase in total pressure of 110 Pa for a volumetric airflow rate of 1.2 m^3·s^{-1}.

The question of margins or safety factors sometimes arises. There is little point in adding a margin to both the air flow and to the pressure drop since an increased air flow in the calculations automatically causes a larger pressure drop. For low pressure ductwork, air leakage is likely to be trivial so there is no need to add a safety margin. However, although the accuracy of the pressure drop data has

Table 2.A5.5 Final pressure drops for shortest run (E–V1)

Item	Description	Length, l / m	Dimensions / (mm × mm)	Pressure drop, Δp / Pa
D–G	Straight duct	2.0	1000 × 600	0
G–I	Straight duct	15.0	500 × 400	15.0
I–V1	Straight duct	3.0 + 0.4	315 (diam.)	2.1
G	Contraction	—	—	1.1
H	Bend	—	500 × 400	1.0
I	Tee (branch flow)	—	500 × 400	17.3
T	Bend	—	315 (diam.)	1.4
F	Damper	—	1000 × 600	1.2*
D1	Damper	—	315 (diam.)	2.1*
V1	Diffuser	—	—	20.0*
			Total (supply run) (E–V1):	61.2

* provisional value to be replaced with manufacturer's data following selection of equipment



A, B, C etc: component designation
1, 2, 3 etc: duct length (m)
(500 x 400) etc: rectangular duct dimensions (mm)
(315 Ø) etc: circular duct diameter (mm)

Figure 2.A5.2 Final duct layout with lengths (m) and sizes (mm)

improved considerably over recent years, the published values are not precise. Therefore a margin of 10% could be added.

If a margin of 10% is added to the estimated pressure loss calculation of the ductwork, the air handling unit would be required to provide a rise in total pressure of 121 Pa for a flow of 1.2 $m^3 \cdot s^{-1}$.

Within the air handling unit there will be a considerable pressure drop through the filter and through the heat exchanger (also know as the 'heating coil'). However, for packaged units it is the responsibility of the supplier to select the fan so as to meet the pressure drop of the components within the unit and the ductwork.

If the fan is selected independently of any packaged air handling unit, then it is to be hoped that matching the system characteristic to the fan performance characteristic will result in an operating point somewhere near the point of maximum efficiency. If not, further amendments to the duct sizes might prove advisable. If the estimated level of the fan noise is found to be excessive, then the inclusion of sound attenuators may be necessary; this would add appreciably to the pressure drop and may require a different fan to be chosen.

2.A5.2.2 Specific fan power

Building Regulations Approved Document L imposes a limit on 'specific fan power'. This is defined as the sum of the design total circuit-watts, including all losses through switchgear and controls such as inverters, of all fans that supply air and exhaust it back outdoors (i.e. the sum of the supply and extract fans), divided by the design ventilation rate through the building.

For AC/MV systems in new buildings, the SFP should be no greater than 2 $W \cdot s \cdot litre^{-1}$, i.e. 2 $kW \cdot s \cdot m^{-3}$.

Table 2.A5.6 Pressure drops for outdoor air supply (A–E)

Item	Description	Length, l / m	Dimensions / (mm × mm)	Pressure drop Δp / Pa
A–B	Straight duct	1.0	500 × 500	0.1
C–E	Straight duct	3.0	1000 × 600	0
A	Louvre/mesh screen	—	500 × 500	12.3
B	Outdoor air inlet damper	—	500 × 500	1.2
C	Expansion taper	—	—	0.8
D	Tee, shoe, converging (straight flow)	—	—	0.5
			Total (A–E):	15.0

It is impossible at this stage to predict the electrical power consumption of the AHU, which has yet to be selected. However, since the total outside air requirement is 1.2 $m^3 \cdot s^{-1}$, the SFP will limit the consumption to 2.4 kW.

To illustrate the consequences, the following assumptions will be made:

— fan total efficiency, $\eta_f = 80\%$

— fan motor efficiency, $\eta_m = 85\%$

— pressure drop across the filter and heat exchanger = 200 Pa

From section 2.A5.1.4, the pressure drops for the supply and return ductwork are 60 Pa and 50 Pa, respectively. Therefore, the total pressure rise (including 10% margin) required is given by:

$$[(\Delta p_{t(supply)} + \Delta p_{t(return)}) \times 1.1] + \Delta p_{t(other\ components)} = (110 \times 1.1) + 200 = 321 \text{ Pa}$$

The air power required is:

$$q\,\Delta p = 1.2 \times 321 \text{ m}^3 \cdot \text{s}^{-1} \cdot \text{Pa} = 385 \text{ W}$$

Total electrical power required for fans:

$$P_e = (q\,\Delta p) / \eta_f\,\eta_m = 385 / (0.8 \times 0.85) = 0.566 \text{ kW}$$

Specific fan power:

$$\text{SFP} = P_e / q = 0.566 / 1.2 = 0.472 \text{ kW} \cdot \text{s} \cdot \text{m}^{-3}$$

This is well within the limit imposed by Approved Document L2, as would be expected for the very simple system used in the example. A larger, more realistic system, with more tortuous duct runs and sound attenuators, would incur much greater pressure losses, necessitating a more powerful fan and motor, and thus lead to a higher specific fan power.

2.A5.3 Air leakage

Up to this point, only total pressure and drops in total pressure of the air have been considered. However, air leakage depends upon the actual pressure (static pressure) of the air in the duct relative to that outside the duct. It is impossible to predict this value, though it can be measured after installation. The following illustrates the calculation of the permissible air leakage.

Air leakage is given by:

$$q_L = C\,A_s\,p^{0.65} \qquad (2.A5.1)$$

where q_L is the air leakage rate (litre·s^{-1}), C is a constant (litre·s^{-1}·m^{-2}·$Pa^{-0.65}$) and p is the static pressure in the duct relative to the air outside the duct (Pa).

For low pressure ductwork, $C = 0.025$ litre·s^{-1}·m^{-2}·$Pa^{-0.65}$.

It is possible to calculate the leakage progressively along the duct in accordance with the change in pressure of the duct air. However, for simplicity, the pressure at the mid-length position only of each length of duct will be considered.

The mean pressure in a duct will be approximately equal to the pressure half way along the duct, and is given by:

$$p = p_{t1} - {}^1/_2\,\Delta p - {}^1/_2\,\rho\,c_2 \qquad (2.A5.2)$$

where p is the mean pressure in the duct (Pa), p_{t1} is the total pressure at the beginning of the duct (Pa), Δp is the pressure loss along the duct (Pa), ρ is the density of the air in the duct (kg·m^{-3}) and c is the air velocity in the duct (m·s^{-1}).

The drop in total pressure along the supply air ductwork is 59.7 Pa (see section 2.A5.1.4). This means that the total pressure at the exit from the AHU will be 59.7 Pa above that of the room. That is the starting point for the calculations shown in Table 2.A5.7. However, to illustrate the procedure, the leakage from duct run J–K is calculated as follows.

Surface area of duct = duct length × perimeter. Hence:

$$A_s = 4 \times [2 \times (0.5 + 0.4)] = 7.2 \text{ m}^2$$

The pressure loss up to and just past tee J is the sum of the first eight items of Table 2.A5.4, i.e.:

$$\Delta p = 21.6 \text{ Pa}$$

Total pressure at start of duct run J–K is the total pressure at E minus the pressure drop up to tee J:

$$p_{t1} = 59.7 - 21.6 = 38.1 \text{ Pa}$$

From Table 2.A5.4, ${}^1/_2\,\rho\,c^2$ for duct run J–K is 5.22 Pa. The pressure drop halfway along J–K is (0.5 × 1.2) Pa. Therefore, using equation 2.A5.2, the mean static pressure half way along duct run J–K is:

$$p = 38.1 - 0.6 - 5.22 = 32.3 \text{ Pa}$$

Hence, using equation 2.A5.1, the air leakage is:

$$q_L = 0.025 \times 7.2 \times 32.3^{0.65} = 1.72 \text{ l} \cdot \text{s}^{-1}$$

In Table 2.A5.7, note that although the value of total pressure has been dropping consistently along the duct, in this portion of duct J–K, the actual pressure of the air is greater than in the preceding section. This is due to an accidental element of 'static regain'. At tee I, the main duct section has not changed although less air flows along the main duct after the branch. Thus in this section the air velocity, and thus the value of (${}^1/_2\,\rho\,c_2$), has diminished. This occurs at every tee, as shown in Table 2.A5.7 for runs K–L and Q–S.

Table 2.A5.7 suggests that the maximum leakage would be 20.8 l·s^{-1}. Therefore the permissible fraction lost through air leakage is 1.7% of the original flow rate of 1.2 $m^3 \cdot s^{-1}$ (i.e. 1200 l·s^{-1}). This does not justify specifying a higher flow rate, nor a recalculation of the pressure drop.

Note that the air in much of the return ductwork will be found to have negative static pressure, i.e. the pressure in the duct will be lower than the surroundings, so there will be air leaks into the ductwork.

2.A5.4 Drop in air temperature along the duct

2.A5.4.1 Uninsulated ductwork

Table 2.A5.8 shows the calculation of heat loss from the index run assuming uninsulated ductwork having a thermal

transmittance (U-value) of 7.89 W·m^{-2}·K^{-1}. The air temperatures inside and outside the duct are:

— temperature of air inside the duct at beginning of run, t_{ad1} = 30 °C

— temperature of air surrounding the duct, t_{as} = 20 °C.

Table 2.A5.8 shows that, along the index run E–V6, the heat loss is 4.98 kW, possibly being dissipated into a region that does not require heating. If the ductwork were situated in ceiling voids, which consequently became over-heated, then the heat loss would be less due to the higher temperature outside the duct. Of greater importance is that the temperature of the air at the end of the run will be significantly below the desired supply temperature of 30 °C. Table 2.A5.8 shows that the temperature of the supply air to zone V6 will be 23.5 °C, which will be inadequate. Clearly, it is recommended that ductwork carrying heated or cooled air should be insulated.

2.A5.4.2 Insulated ductwork

Table 3.8 gives recommended thickness of insulation for ductwork depending on the thermal conductivity (λ) of the insulation material. In the following example, λ = 0.035 W·m^{-1}·K^{-1}. The duct air temperature is nominally 30 °C and the temperature of the surrounding air is 20 °C, i.e. ($t_{ad1} - t_a$) = 10 K.

From Table 2.21, the recommended thickness for a duct carrying air at a temperature 10 K greater (or less) than the surroundings, and for a thermal conductivity λ = 0.035 W·m^{-1}·K^{-1}, is 50 mm. From Table 3.7, the overall thermal transmittance is U = 0.64 W·m^{-2}·K^{-1}.

For simplicity, it is assumed that the temperature drop along a section is trivial.

Taking duct run I–J as an example:

Surface area of duct = duct length × perimeter. Hence:

$$A_s = 4 \times [2 \times (0.5 + 0.4)] = 7.2 \text{ m}^2$$

The thermal transmittance is related to the surface area of the ductwork, not to the outer surface area of the insulation. The air has already cooled such that at (I) its temperature is 29.85 °C. In the first instance, it is assumed that this remains constant through I–J. Hence, using equation 3.2, the heat loss is given by:

$$\phi = U A_s (t_{ad} - t_{as}) = 0.64 \times 7.2 \, (29.85 - 20) = 45.3 \text{ W}$$

The temperature drop along duct run I–J is:

$$t_{ad1} - t_{ad2} = \phi / (q_m c_p) = \phi / (q \rho c_p)$$

where t_{ad1} is the temperature at the beginning of the duct run (°C), t_{ad2} is the temperature at the end of the duct run (°C), ϕ is the heat flux (W), q_m is the mass flow rate (kg·s^{-1}), c_p is the specific heat capacity of air (J·kg^{-1}·K^{-1}), q is the

Table 2.A5.7 Leakage calculations for the supply duct along the index run

Item	Length / m	Dimensions / (mm × mm)	Duct surface area, A_s / m^2	Total pressure at start of run, p_{t1} / Pa	Pressure loss, Δp / Pa	($^1/_2$ ρ c^2) / Pa	Mean static pressure, p / Pa	Leakage, q_L / l·s^{-1}
(*a*) Main duct run								
E–F	2	1200 × 600	7.2	59.7	0	2.4	57.3	2.50
G–I	15	500 × 400	27	57.4	16	20.9	29.8	5.96
I–J	4	500 × 400	7.2	41.1	3.0	14.5	25.1	1.46
J–K	4	500 × 400	7.2	38.1	1.2	5.22	32.3	1.72
K–L	1	500 × 400	1.8	36.7	0.1	2.32	34.3	0.45
L–Q	20.4	400	25.6	33.2	7.7	5.88	23.5	4.98
Q–S	5	400	6.3	24.5	0.4	1.5	22.8	1.20
S–V6	3	315	2.97	23.5	1.0	3.96	19.0	0.50
(*b*) Branch duct runs								
I–V1	3	315	2.97	24.1	1.0	3.96	19.6	0.51
Similar calculations for remaining branches								1.51*
							Total:	20.79

* Notional value for sum of air leakage from remaining branches, for purposes of example calculation

Table 2.A5.8 Heat loss calculations for uninsulated supply duct along the index run (U = 7.89 W·m^{-2}·K^{-1})

Item	Length / mm	Dimensions / (mm × mm)	Flow rate, q / m^3·s^{-1}	Duct surface area, A_s / m^2	Temp. at start of run, t_{ad1} / °C	Temp. diff. ($t_{ad} - t_{as}$) / K	Heat flux, ϕ / W	Temp. diff.* ($t_{ad1} - t_{ad2}$) / K
E–F	2	1000 × 600	1.2	6.4	30	9.83	496	0.34
G–I	15	500 × 400	1.2	27	29.66	8.95	1917	1.33
I–J	4	500 × 400	1.0	7.2	28.33	8.14	464	0.32
J–K	4	500 × 400	0.6	7.2	28.01	7.70	437	0.61
K–L	1	500 × 400	0.4	1.2	27.40	7.33	69	0.15
L–Q	20.4	400 (diam.)	0.4	25.6	27.25	5.77	1210	2.52
Q–S	5	400 (diam.)	0.2	6.3	24.73	4.30	214	0.89
S–T	3	315 (diam.)	0.2	3.0	23.84	3.64	87	0.36
T	—	—	—	—	23.48	—	—	—
						Totals:	4984	6.52

* Temperature difference between beginning and end of duct run

volumetric flow rate ($m^3 \cdot s^{-1}$) and ρ the density of the air ($kg \cdot m^{-3}$).

Therefore:

$$t_{ad1} - t_{ad2} = 45.3 / (1.0 \times 1.16 \times 1.030 \times 103) = 0.04 \text{ K}$$

The temperature at (J) is:

$$t_{a2} = 29.85 - 0.04 = 29.81°C$$

Hence, mean temperature in duct I–J = $^1/_2$ (29.85 + 29.81) = 29.83°C.

In principle, the heat loss ϕ should be re-calculated at the mean temperature, but in this instance the difference is trivial and may be ignored.

Note that though the heat loss from the next duct run J–K is the same (i.e. 45 W), the temperature drop is greater (0.06 K as opposed to 0.04 K). This is because, although the air temperature in the duct is almost the same, the airflow through section J–K is appreciably less (i.e. 0.6 $m^3 \cdot s^{-1}$ as opposed to 1.0 $m^3 \cdot s^{-1}$).

In summary, Table 2.A5.9 shows that the total heat loss from the index run is 522 W, the temperature drop is 0.83 K and the supply air temperature to V6 is 29.2 °C. This is sufficiently close to the required supply temperature at V1 of 29.8 °C for there to be no significant control problems. However the delivered heat to zone V6 is reduced by 8%, therefore there is a case for increasing the design outlet temperature of the air handling unit from 30 °C to 30.5 °C.

2.A5.5 Effects on airflows when closing down one branch

Figure 2.A5.3 shows a simplified duct network where boxes 1, 2 and 3 represent the ductwork circuits for supplying three zones. Box 5 represents the return ductwork. D is a damper which is initially open, but which will be closed down.

The design conditions are as follows:

— *duct system 1*: $q = 0.2$ $m^3 \cdot s^{-1}$; $\Delta p = 70$ Pa

— *duct system 2*: $q = 0.2$ $m^3 \cdot s^{-1}$; $\Delta p = 50$ Pa

— *duct system 3*: $q = 0.2$ $m^3 \cdot s^{-1}$; $\Delta p = 40$ Pa

— *duct system 4*: $q = 0.4$ $m^3 \cdot s^{-1}$; $\Delta p = 20$ Pa

— *duct system 5*: $q = 0.6$ $m^3 \cdot s^{-1}$; $\Delta p = 20$ Pa

— *damper D*: $q = 0.2$ $m^3 \cdot s^{-1}$; $\Delta p = 10$ Pa

From the above design requirement, the fan must produce a pressure rise of 70 Pa for a volume flow of 0.6 $m^3 \cdot s^{-1}$.

We can use the approximate simplification that the pressure drop of the system is proportional to the square of the velocity, and thus proportional to the square of the flow rate. (*Note*: not true where there are HEPA filters in the system). Thus pressure drop at any flow rate is easily obtained using:

$$\Delta p \mu q^2 \qquad (2.A5.3)$$

where Δp is the pressure drop (Pa) and q is the volumetric flow rate ($m^3 \cdot s^{-1}$).

Hence, from such values the 'system characteristic' can be constructed as shown in Figure 2.A5.4.

A fan would be chosen such that the intersection of the fan characteristic and the system characteristic gives the design requirement, as shown, of 0.6 $m^3 \cdot s^{-1}$ and a total pressure drop Δp_t of 70 Pa.

The following illustrates what happens to the flow in the various branches of the system when the resistance of one branch is changed as a result of closing damper D.

The problem can be resolved using either circuit resistances or capacities. Since valve manufacturers always give valve capacities, the following uses the capacity method for consistency. (See also Guide C, section 4, Appendix 4.A5.)

Capacity K is given by the relationship:

$$q = K \Delta p_p \qquad (2.A5.4)$$

where K is the capacity ($m^3 \cdot s^{-1} \cdot Pa^{-0.5}$)

Using equation 2.A5.4, the capacity of each leg of the network can be calculated, as follows:

$$K_1 = q_1 / \Delta p_{p1} = 0.2 / \div 70 = 0.02390 \text{ m}^3 \cdot \text{s}^{-1} \cdot \text{Pa}^{-0.5}$$

$$K_2 = q_2 / \Delta p_{p2} = 0.2 / \div 50 = 0.02828 \text{ m}^3 \cdot \text{s}^{-1} \cdot \text{Pa}^{-0.5}$$

$$K_3 = q_3 / \Delta p_{p3} = 0.2 / \div 40 = 0.03162 \text{ m}^3 \cdot \text{s}^{-1} \cdot \text{Pa}^{-0.5}$$

$$K_4 = q_4 / \Delta p_{p4} = 0.4 / \div 20 = 0.08944 \text{ m}^3 \cdot \text{s}^{-1} \cdot \text{Pa}^{-0.5}$$

$$K_5 = q_5 / \Delta p_{p5} = 0.6 / \div 20 = 0.13416 \text{ m}^3 \cdot \text{s}^{-1} \cdot \text{Pa}^{-0.5}$$

Table 2.A5.9 Heat loss calculations for insulated supply duct along the index run ($U = 0.64$ $W \cdot m^{-2} \cdot K^{-1}$)

Item	Length / mm	Dimensions / (mm × mm)	Flow rate, q / $m^3 \cdot s^{-1}$	Duct surface area, A_s / m^2	Temp. at start of run, t_{ad1} / °C	Temp. diff. ($t_{ad} - t_{as}$) / K	Heat flux, (ϕ / W	Temp. diff.* ($t_{ad1} - t_{ad2}$) / K
E–F	2	1000 × 600	1.2	6.4	30	9.99	41	0.03
G–I	15	500 × 400	1.2	27	29.97	9.91	171	0.12
I–J	4	500 × 400	1.0	7.2	29.85	9.83	45	0.04
J–K	4	500 × 400	0.6	7.2	29.81	9.78	45	0.06
K–L	1	500 × 400	0.4	1.2	29.75	9.74	7	0.02
L–Q	20.4	400	0.4	25.6	29.73	9.56	157	0.33
Q–S	5	400	0.2	6.3	29.40	9.32	38	0.16
S–T	3	315	0.2	3.0	29.24	9.20	18	0.07
T	—	—	—	—	29.17	—	—	—
						Total:	522	0.83

* Temperature difference between beginning and end of duct run

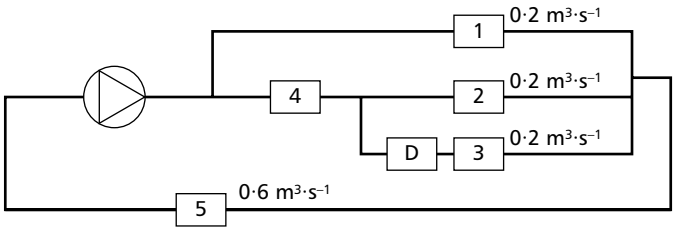


Figure 2.A5.3 Simplified duct network

With damper D closed, no flow will pass through leg 3.

K_2 and K_4 are in series, giving an effective capacity of $K_{2,4}$, i.e:

$$\frac{1}{K_{2,4}^2} = \frac{1}{K_2^2} + \frac{1}{K_4^2} = \frac{1}{0.02828^2} + \frac{1}{0.08944^2}$$

Hence:

$$K_{2,4} = 0.02696 \text{ m}^3\cdot\text{s}^{-1}\cdot\text{Pa}^{-0.5}$$

$K_{2,4}$ and K_1 are in parallel, i.e:

$$K_{1,2,4} = K_{2,4} + K_1$$
$$= 0.02696 + 0.02390 = 0.05086 \text{ m}^3\cdot\text{s}^{-1}\cdot\text{Pa}^{-0.5}$$

The total system capacity K_0 is the result of $K_{1,2,4}$ in series with K_5, i.e:

$$\frac{1}{K_0^2} = \frac{1}{K1_{1,2,4}^2} + \frac{1}{K_5^2} = \frac{1}{0.05086^2} + \frac{1}{0.13416^2}$$

Hence:

$$K_0 = 0.04756 \text{ m}^3\cdot\text{s}^{-1}\cdot\text{Pa}^{-0.5}$$

Had the capacity been calculated for the original system, it would have been found to be 0.0717 $\text{m}^3\cdot\text{s}^{-1}\cdot\text{Pa}^{-0.5}$.

A new system characteristic can now be determined from equation 2.A5.4 using the calculated value of K_o, e.g. for q = 0.55 $\text{m}^3\cdot\text{s}^{-1}$:

$$\Delta p = (0.55 / 0.04756)^2 = 133.7 \text{ Pa}$$

With the damper closed, the system has a new system characteristic, see Figure 2.A5.4. The intersection with the fan characteristic now gives a flow of 0.516 $\text{m}^3\cdot\text{s}^{-1}$ and a pressure drop of Δp = 117.7 Pa.

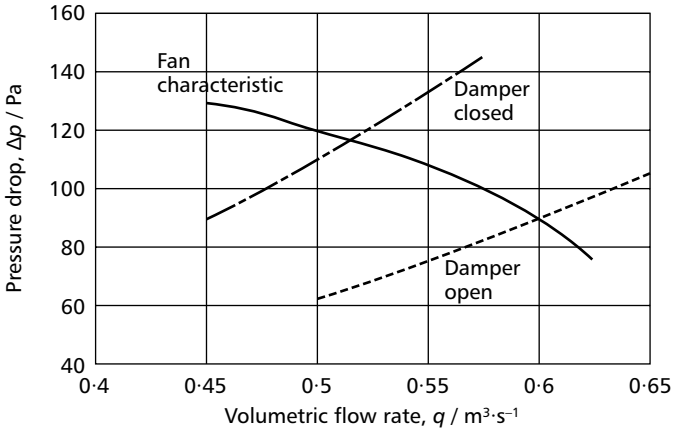


Figure 2.A5.4 System characteristic for simplified duct network; (*a*) characteristic with damper D open and (*b*) characteristic with damper D closed

It is now necessary to ascertain the proportions in which this total flow is apportioned between supply legs 1 and 2.

Knowing the flow through leg 5 (being either the return ductwork, or extract to the outside and inlet from the outside), the pressure loss through leg 5 can be calculated using equation 2.A5.4:

$$0.55 = 0.13416 \div \Delta p_5$$

Hence:

$$\Delta p_5 = (0.55 / 0.13416)^2 = 16.8 \text{ Pa}$$

The remainder is the pressure drop existing across leg 1, and across leg 4/2:

$$\Delta p_1 = \Delta p_o - \Delta p_5 = 117.7 - 16.8 = 100.9 \text{ Pa}$$

The flow through leg 1 can now be determined using equation 2.A5.4:

$$q_1 = 0.02390 \div 100.9 = 0.2401 \text{ m}^3\cdot\text{s}^{-1}$$

The rest of the flow passes along leg 4/2, i.e:

$$q_4 = q_o - q_5 = 0.516 - 0.240 = 0.276 \text{ m}^3\cdot\text{s}^{-1}$$

The flow rates resulting from closure of damper D are shown on Figure 2.A5.5.

It should be noted that, although the supplies to legs 1 and 2 were initially equal, this is no longer the case once any change is made to any other branch.

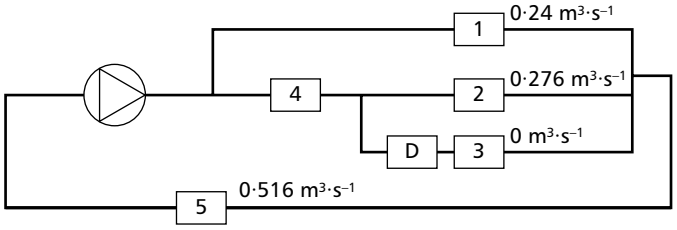


Figure 2.A5.5 Duct network with damper D closed

References

CIBSE (2007) *Reference data* CIBSE Guide C (London: Chartered Institution of Building Services Engineers)

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NBS (2013) The Building Regulations 2000 Approved Document L: *Conservation of fuel and power* (London: The Stationery Office)

Appendix 2.A6: Techniques for assessment of ventilation

2.A6.1 General

There are a number of assessment techniques available to calculate ventilation and cooling requirements and to look in detail at air movement. This appendix provides an overview of some of these techniques. CIBSE AM11 (2015a) and AM10 (2005) provide more detail on dynamic thermal simulation and assessment techniques for natural ventilation respectively.

2.A6.2 Ventilation and cooling

Section 2.2 includes airflow rate requirements for ventilation purposes. Airflow rate requirements for cooling purposes are normally based either on restricting peak summer temperatures in passive buildings or to meet the peak cooling load. Analyses may start by looking at peak temperatures to evaluate of the building's potential without mechanical cooling. These would assess the ventilation rates (natural and/or mechanical) and passive measures needed to meet summer temperature limits. Where cooling is to be provided, the cooling needed to maintain the temperature limits would be assessed. Airflow rates may then be calculated to deliver this cooling to the space.

There is a range of analysis methods available to suit different applications and stages in the design process. Design charts based on parametric analysis may be used (e.g. the BRE's *Environmental Design Guide*, 1998), although the user can work only within the range of variables covered by the charts. Section 5 of CIBSE Guide A (2015b) provides design information on the use of thermal dynamic models for calculating peak summertime temperatures and peak space cooling loads. Simple (dynamic) models (e.g. the admittance procedure) may be used to assess cooling loads and the probability of overheating. These approaches are based on a 24-hour design cycle and are suitable for mechanically cooled buildings with a repetitive diurnal operating cycle. However, where this is not an accurate reflection of building operation due to thermal mass or passive operation, dynamic thermal simulation may be used.

Appropriate consideration should be given to issues of weather data, control and thermal mass depending on the application. Selection of appropriate weather data is discussed in CIBSE AM10 (2005). Different data will be required for different purposes. For example, to estimate energy consumption, average weather data for the region will usually be the most appropriate. Data, including more extreme conditions, will be appropriate to test the ability of the building to accommodate various levels of internal heat gain and predict peak temperatures. Site-specific weather data can be of interest, but may have been collected over a relatively short period and may not necessarily be representative. It is frequently impossible to use such data to construct meaningful statistics to identify the percentage of time a specified internal temperature would be likely to be exceeded. There is also a danger that the design may lack robustness, being tailored to a unique weather sequence and reacting in a different and unpredicted way to more normal weather peaks. A more robust choice will often be to analyse the building in relation to appropriate national UK data and to make simple corrections to suit the differences between this and the site data; e.g. August average temperature and diurnal swing and August 2.5% exceeded peak temperature and the associated diurnal swing.

Loads and system performance often depend on more than one weather variable. Cooling and humidity conditions will be a function of wet bulb as well as dry bulb temperature. The performance of natural ventilation systems in particular can be affected by solar and wind conditions as well as temperatures, as these are often used to drive the ventilation. Design conditions for the individual weather variables will rarely coincide.

Controls used in the thermal model should reflect what can be expected to occur in practice. This is a particular issue in natural ventilation systems with manual control. Account should be taken of the way occupants use windows. Data are available on occupancy effects on natural ventilation, primarily based on the domestic sector. This work is summarised in AIVC Technical Note 23 (Dubrul, 1988).

Thermal mass should be modelled with appropriate surface heat transfer values and representation of heat flow within the mass. High thermal mass buildings must be allowed to come to their natural thermal equilibrium by having a lengthy period of simulation prior to the period over which the modelling results are reported and compared; 15 days is usually enough for this 'pre-conditioning' period, although a few buildings require longer. This can be tried first with 10 and 20 days and the results compared to check for significant differences. If a hot spell is being simulated, peak weather data should not be used throughout, as this will under-value the heat-absorbing benefits of the thermal mass. Instead, pre-conditioning with average weather for the season concerned can be undertaken, followed by a step change to the peak weather sequence — which in the UK seldom lasts more than 5 days. The design day is typically the third in the peak weather sequence.

2.A6.3 Air movement

Analyses of air movement may be needed, particularly for natural ventilation applications and air movement in large spaces such as atria. These provide information on air velocity, movement and temperature; volume flow rate; and optimal opening sizes, shapes and positions. Techniques available include computational fluid dynamics (CFD), physical models and air flow models. For room air distribution, performance is sometimes critically dependent on details of equipment design, and full-scale mock-ups may be required.

2.A6.3.1 Computational fluid dynamics (CFD)

CFD is a technique for predicting air movement that can address questions such as stratification and local air

movement. It therefore has particular application to consideration of large spaces such as atria. CFD methods can predict temperature and velocity distributions in a space and can be applied to assessments of comfort involving more of the influencing parameters than is possible in zonal models. Because of the extensive nature of the computations and the time varying nature of the natural driving forces, CFD is normally only used to generate 'snapshots' of how the design would work at a given point in time.

Another potential application for CFD is external flows around the building. The purpose is to generate the wind pressure coefficients needed by all models to predict natural airflow rates.

2.A6.3.2 Physical models

Physical models are especially useful for giving the non-technical members of the client and design team a good visualisation of airflow behaviour. By their nature, physical models are implicit design tools; assumptions need to be made then tested. The two main techniques relating to natural ventilation design are the salt bath technique and wind tunnel testing.

Salt bath

The salt bath technique is used to test stack driven ventilation strategies. Stack-driven flows are analysed at small scale in the laboratory using a model of the building immersed in a perspex bath containing saline solutions of different concentrations. The method models fluid flow, not surface heat transfer, and therefore cannot predict local effects such as solar patching on the floor of an atrium. Like the CFD technique it provides only a snapshot of performance.

Wind tunnel

Wind tunnel testing is the main source of information on wind pressure coefficients. It is not a method for proving the design of a natural ventilation system, since it only deals with external flows around a building.

Air flow models

Air flow models may be used to analyse natural ventilation air flow rates based on driving pressure differences and openings. These range from single zone models to more complex multi-zone models. Single zone models (Liddament, 1996) are appropriate where the building is open plan and there is no temperature stratification in the space. Building types that approximate to these requirements are dwellings, many industrial buildings and small open plan office buildings. Multi-zone models subdivide the building into a number of individual spaces, substantially increasing the complexity of the analysis (Feustel, 1991).

Software combining multi-zone flow models with thermal simulation analysis is also available. This software can provide an integrated analysis the internal temperature distribution and the stack induced natural ventilation flow rates (Kendrick, 1993).

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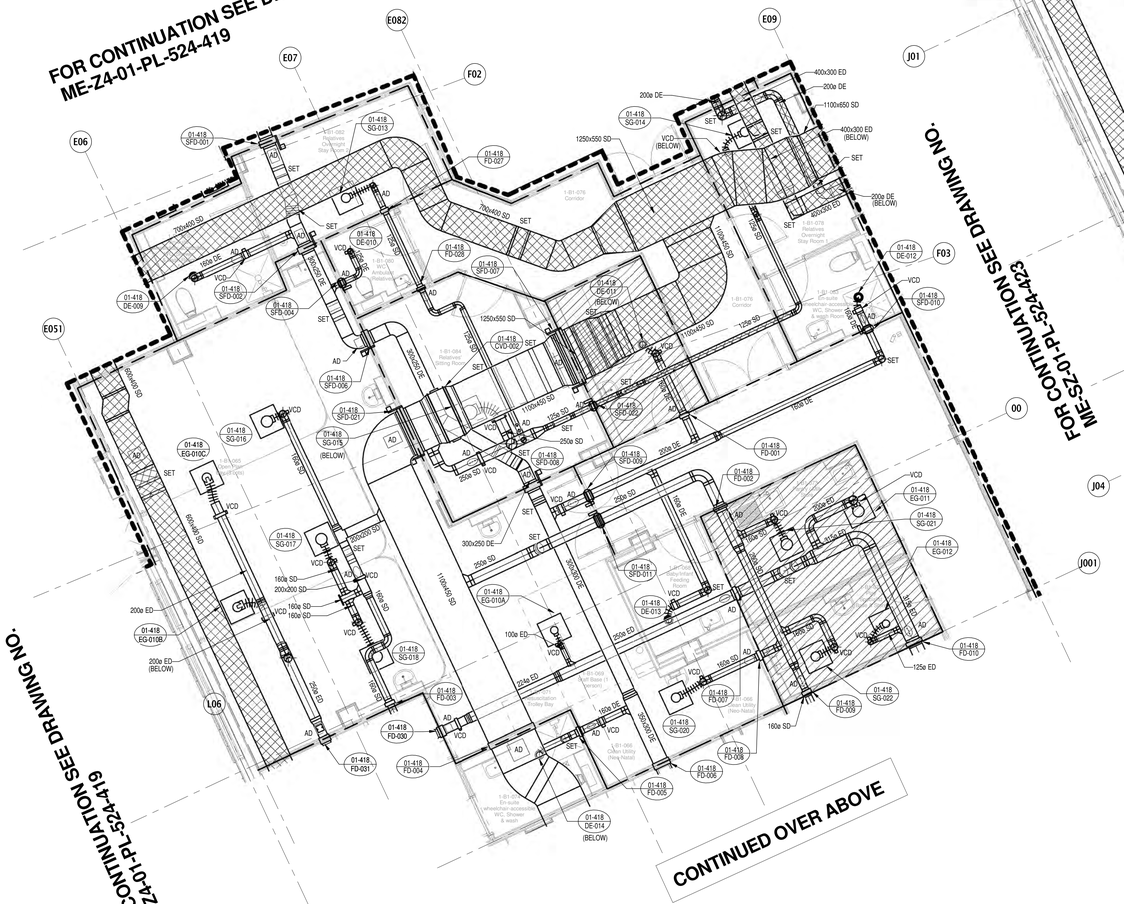
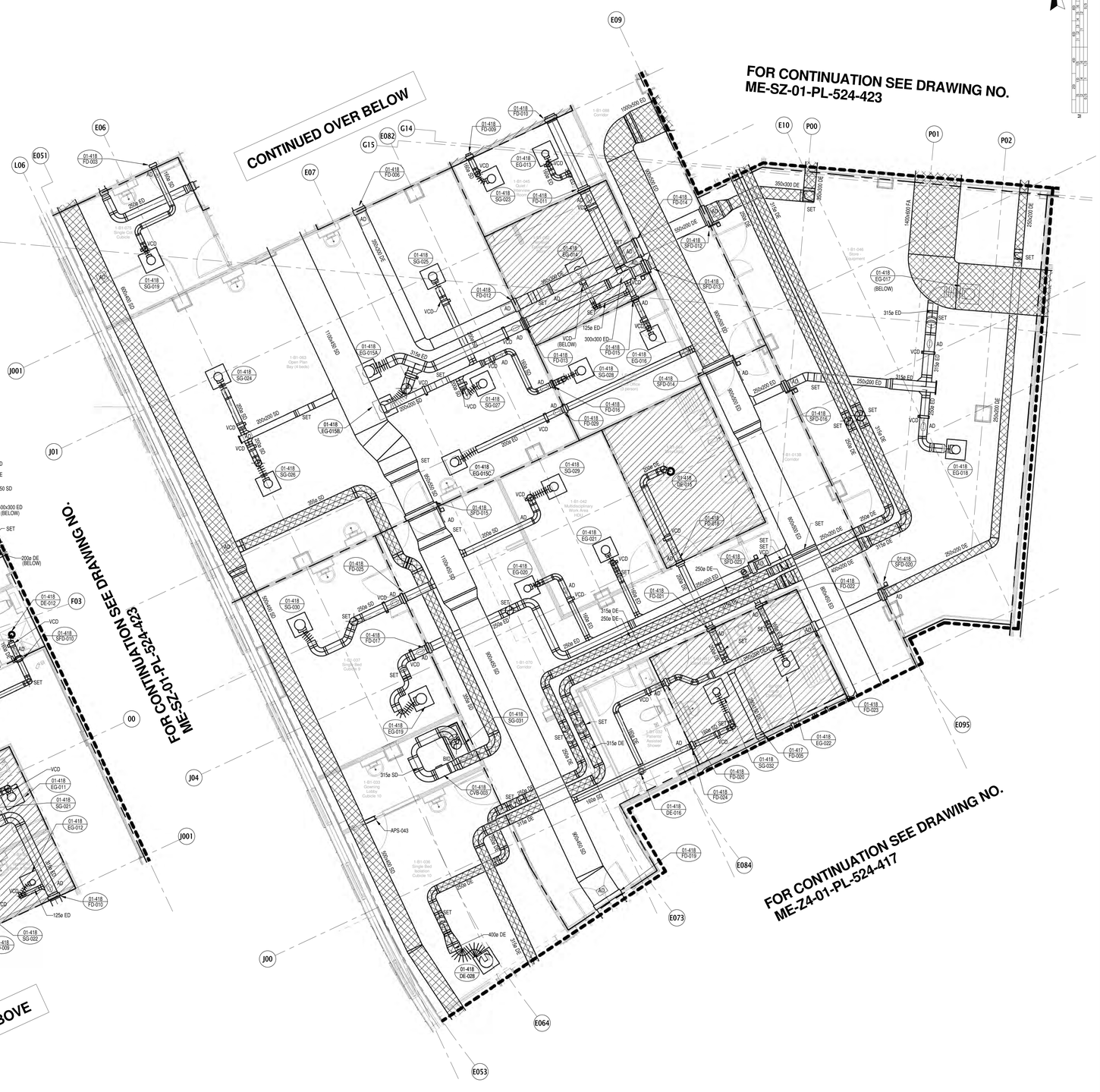
Note: page numbers in italics refer to figures; page numbers in bold refer to tables





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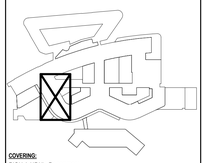
Designer Notification of Hazard Risk:

- Indicates a Residual Risk requiring a Compulsary Action
- Indicates a Residual Risk for Information
- Indicates a Residual Risk requiring a Prohibitive Action
- Indicates a Residual Risk as a Warning

Key Plan:



COVERING:
PICU & HDU's Department

Notes:

LEGEND

SD - GENERAL SUPPLY DUCT
SG-XXX - GENERAL SUPPLY GRILLE
ED - GENERAL EXTRACT DUCT
EG-XXX - GENERAL EXTRACT GRILLE
DE - DIRTY EXTRACT DUCT
DE-XXX DIRTY EXTRACT GRILLE
VCD - VOLUME CONTROL DAMPER
SFD - SMOKE FIRE DAMPER
FD - FIRE DAMPER
FC - FIRE COLLAR
AD - ACCESS DOOR
BID - BUTTERFLY ISOLATION DAMPER

Rev	Description	Date	Drn	Chk
Z2	Updated to reflect isolation room design changes	09.10.18	SD	MQ
Z1	As Built	20.11.18	CC	GM

Project

Re-provision of
RHSC and DCN at
Little France

Client

NHS Lothian

Title

First Floor Plan
PICU & HDU's Department
As-Built Ventilation Ductwork
Layout

Drawing No.

Originator	Zone	Level	Type	Content	Sequential	Revision
ME	Z4	01	PL	524	418	Z2

Scale @ A0:	Date:
1 : 50	20.11.18

Status: As Built

IHS LOTHIAN
INTEGRATED HEALTH SOLUTIONS

A46676816

DH Department of Health

Health Building Note 04-02
Critical care units

Health Building Note 04-02
Critical care units

Preface

About Health Building Notes

Health Building Notes give "best practice" guidance on the design and planning of new healthcare buildings and on the adaptation/extension of existing facilities.

They provide information to support the briefing and design processes for individual projects in the NHS building programme.

The Health Building Note suite

Healthcare delivery is constantly changing, and so too are the boundaries between primary, secondary and tertiary care. The focus now is on delivering healthcare closer to people's homes.

The Health Building Note framework (shown below) is based on the patient's experience across the spectrum of care from home to healthcare setting and back, using the national service frameworks (NSFs) as a model.

Health Building Note structure

The Health Building Notes have been organised into a suite of 17 core subjects.

Care-group-based Health Building Notes provide information about a specific care group or pathway but cross-refer to Health Building Notes on **generic (clinical) activities** or **support systems** as appropriate.

Core subjects are subdivided into specific topics and classified by a two-digit suffix (-01, -02 etc), and may be further subdivided into Supplements A, B etc.

All Health Building Notes are supported by the overarching Health Building Note 00 in which the key areas of design and building are dealt with.

Example

The Health Building Note on accommodation for adult in-patients is represented as follows:

> "Health Building Note 04-01: Adult in-patient facilities"

The supplement to Health Building Note 04-01 on isolation facilities is represented as follows:

> "Health Building Note 04-01: Supplement 1 – Isolation facilities for infectious patients in acute settings"

Health Building Note number and series title	Type of Health Building Note
Health Building Note 00 – Core elements	Support-system-based
Health Building Note 01 – Cardiac care	Care-group-based
Health Building Note 02 – Cancer care	Care-group-based
Health Building Note 03 – Mental health	Care-group-based
Health Building Note 04 – In-patient care	Generic-activity-based
Health Building Note 05 – Older people	Care-group-based
Health Building Note 06 – Diagnostics	Generic-activity-based
Health Building Note 07 – Renal care	Care-group-based
Health Building Note 08 – Long-term conditions/long-stay care	Care-group-based
Health Building Note 09 – Children, young people and maternity services	Care-group-based
Health Building Note 10 – Surgery	Generic-activity-based
Health Building Note 11 – Community care	Generic-activity-based
Health Building Note 12 – Out-patient care	Generic-activity-based
Health Building Note 13 – Decontamination	Support-system-based
Health Building Note 14 – Medicines management	Support-system-based
Health Building Note 15 – Emergency care	Care-group-based
Health Building Note 16 – Pathology	Support-system-based

Other resources in the DH Estates and Facilities knowledge series

Health Technical Memoranda

Health Technical Memoranda give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare (for example medical gas pipeline systems, and ventilation systems).

They are applicable to new and existing sites, and are for use at various stages during the inception, design, construction, refurbishment and maintenance of a building.

All Health Building Notes should be read in conjunction with the relevant parts of the Health Technical Memorandum series.

Activity DataBase (ADB)

The Activity DataBase (ADB) data and software assists project teams with the briefing and design of the healthcare environment. Data is based on guidance given in the Health Building Notes, Health Technical Memoranda and Health Technical Memorandum Building Component series.

1. Room data sheets provide an activity-based approach to building design and include data on personnel, planning relationships, environmental considerations, design character, space requirements and graphical layouts.
2. Schedules of equipment/components are included for each room, which may be grouped into ergonomically arranged assemblies.
3. Schedules of equipment can also be obtained at department and project level.
4. Fully loaded drawings may be produced from the database.
5. Reference data is supplied with ADB that may be adapted and modified to suit the users' project-specific needs.

Note

The sequence of numbering within each subject area does not necessarily indicate the order in which the Health Building Notes were or will be published/printed. However, the overall structure/number format will be maintained as described.

Executive summary

This Health Building Note provides guidance on critical care units that admit patients whose dependency levels are classified as level 2 or 3 (see 'Comprehensive Critical Care', DH 2000, for definitions of levels of critical care). However, it does not distinguish between the different requirements for level 2 and 3 patients.

It excludes facilities for the high-security isolation of patients, dedicated centres for burns patients and areas within the hospital where level 2 or 3 patients are managed on a time-limited basis.

Contents

1 Policy context

1.1 'Comprehensive Critical Care' (DH, 2000) was a pivotal publication. It introduced the concept of "critical care without walls"; identifying for the first time that a patient's clinical needs and not their location of care determined the required level and type of organ support. Patients thereafter have been described according to their required level of organ support (see levels of care on the Intensive Care Society website).

1.2 In addition 'Comprehensive Critical Care' highlighted the need for early recognition of deteriorating health and appropriate comprehensive transfer arrangements for patients to wards after recovery from critical illness. These concepts and guidance on operational service delivery such as the role of critical care networks were reinforced in 'Quality Critical Care – Beyond Comprehensive Critical Care' (DH, 2005).

1.3 NICE has subsequently issued guidance on 'Acutely ill patients in hospital' (Clinical guidelines CG50, July 2007) and 'Rehabilitation after critical illness' (Clinical guidelines CG83, 2009). Accompanying CG50, 75 acute care competencies have been detailed in 'Competencies for recognising and responding to acutely ill patients in hospital' (DH, 2009). Such guidance has led to the development of critical care outreach services.

1.4 The operational changes that have followed the release of 'Comprehensive Critical Care' have been significant. Critical care networks have developed, many of which are delivered now as managed clinical networks. The provision of mutual and collective planning of services is essential for service resilience. This means that critical care units across a conurbation will work together to meet needs.

1.5 The building blocks for commissioning of critical care services are now in place. A new dataset, Critical Care Minimum Dataset, was mandated from April 2006; annual reference cost submission followed and from 1 April 2011 a new model for commissioning of critical care services has been used. This model uses the mandated dataset and derivation of seven healthcare resources groups for critical care as the currency, but uses local tariffs ('Payment by Results Guidance for 2011–12', DH).

Mixed-sex accommodation in critical care units

1.6 Patient acuity determines the need for access to critical care, and although every effort is made to group members of the same sex together, this is frequently not possible. Nevertheless, it is imperative that the highest standards of privacy and dignity are maintained at all times.

1.7 For guidance on the justification for mixed sex accommodation in critical care units see PL/CNO/2010/3 – 'Eliminating Mixed Sex Accommodation'.

2 Service context

2.1 The Department of Health collects data on the number of critical care beds twice a year. For details see 'Census on number of critical care beds in England'.

3 Scope of guidance

3.1 This Health Building Note describes spaces that are unique to a critical care unit. It also describes any variations to common hospital spaces and clarifies requirements for these spaces, where necessary.

3.2 For a full list of space requirements see the following example schedules of accommodation for an 8-bed, 16-bed and 32-bed critical care unit. The example schedules provide a basis for sizing facilities at initial planning stages but exact requirements should be determined locally based on the number and case mix of patients, hospital policy for the provision of supplies and waste disposal, and the layout of the unit. Links to guidance on common spaces are provided from the schedules.

Example schedules of accommodation for critical care units

Version 1, published 15.09.11

				Cost guide allowances:	Circulation and communication	Engineering		
				Public	35%	23%		
				Clinical	35%	35%		
				Staff	35%	21%		

Example 1: 8-bed critical care unit

	Room name/function	Unit area allowance	Quantity	Net internal area	Circulation and communication allowance	Engineering allowance	Gross internal area	Notes
Public spaces								
	Entrance: visitors		1					
	Entrance: patients, staff and supplies		1					Separate entrance for staff and supplies is an option.
J0232	Reception desk (size based on number of places)	5.5	1	5.5	1.9	1.3	8.7	1-place reception for small/medium sized units; 2-place reception for large units (>30 beds).
J1155/J1414	Waiting area: 10 places	22.5	1	22.5	7.9	5.2	35.6	Includes children's play area and 10% wheelchair places. 1 place per bed with minimum of 10.
P0711	Mini kitchen	5.0	1	5.0	1.8	1.2	7.9	1 per unit.
	WC: independent wheelchair	4.5	1	4.5	1.6	1.0	7.1	1 per small/medium sized unit; 2 per large unit (>30 beds).
Clinical spaces								
T0214-03	Staff communication base: 2 places	13.0	1	13.0	4.6	4.6	22.1	2 places per 8 beds.
B1603	Isolation room: critical care	26.0	4	104.0	36.4	36.4	176.8	Planning and design manual specifies 20% singles (subject to case mix); in an 8-bed unit with a standard 4-bed bay arrangement 50% singles may be provided.
G0510	Gowning lobby	6.0	4	24.0	8.4	8.4	40.8	
B1610	4-bed bay: critical care	143.0	1	143.0	50.1	50.1	243.1	
M0727	Interview room: 7 places	12.0	1	12.0	4.2	4.2	20.4	1 per 10 beds.
V1635	Shower room: assisted	8.0	1	8.0	2.8	2.8	13.6	Nominal allowance. Requirement subject to case mix of unit.
Clinical support spaces								
T0535	Clean utility room	16.0	1	16.0	5.6	5.6	27.2	1 per 12 beds.
G0605	Ice-making machine bay	1.5	1	1.5	0.5	0.5	2.6	1 per unit.
L1308	Near patient testing room	8.0	1	8.0	2.8	2.8	13.6	1 per 16 beds.
Y0331	Dirty utility room for bedpan processing	12.0	1	12.0	4.2	4.2	20.4	1 per 16 beds.
P0627	Pantry/refreshment room	12.0	1	12.0	4.2	4.2	20.4	1 per unit.
W0540/1450/ 1590/1594	Storage: bulky consumables, medical gas cylinders, linen and furniture	4.0	8	32.0	11.2	11.2	54.4	4 m^2 allowance per bed. Based on a review of a number of reference sites.
W1584-06	Store: clinical equipment	24.0	1	24.0	8.4	8.4	40.8	1 for small/medium sized units; 2 for large units (>30 beds).
Y0335	Decontamination room: clinical equipment	16.0	1	16.0	5.6	5.6	27.2	1 per unit. Located adjacent to clinical equipment store.
G0171	Parking bay: imaging equipment	6.0	1	6.0	2.1	2.1	10.2	1 per small/medium sized unit; 2 per large unit (>30 beds).
G0180-01	Parking bay: resuscitation trolley	2.0	1	2.0	0.7	0.7	3.4	1 per 8 beds.
Y0642	Disposal hold: 1700 litres	8.0	1	8.0	2.8	2.8	13.6	Minimum 1500 litres per 8 beds
Y1510	Cleaners' room	8.0	1	8.0	2.8	2.8	13.6	1 for small/medium sized units; 2 for large units (>30 beds).
Staff spaces								
M0251	Office: 1-person	8.0	3	24.0	8.4	5.0	37.4	For clinical director, lead nurse and tutor.
M0278-01/M0281/ M0410/M0731	Admin area: shared use (size based on number of workstations)	6.6	5	33.0	11.6	6.9	51.5	For consultants and outreach staff.
M0727	Meeting room: 7 places	16.0	1	16.0	5.6	3.4	25.0	
H1304-01	Seminar room: 8 places	17.0	1	17.0	6.0	3.6	26.5	May be sized up and shared with other departments.
D0434-01	Rest room with mini kitchen (size based on number of seats)	1.9	8	15.2	5.3	3.2	23.7	
V0554-03/V0667-01/ V0725/V1321	Changing area: staff (size based on number of lockers)	1.4	35	49.0	17.2	10.3	76.4	Includes uniform exchange area, showers and a number of individual changing rooms. Based on 32 staff who need a locker (allowing for shift changeover), plus a 10% contingency to allow for male/female split (suggested apportionment 2/3 female to 1/3 male).
V0725	Changing room: semi-ambulant	2.0	1	2.0	0.7	0.4	3.1	Additional individual changing room to allow for male and female segregation.
V1321	Shower room: ambulant	2.5	1	2.5	0.9	0.5	3.9	Additional shower room to allow for male and female segregation.
V1010	WC: ambulant	2.0	4	8.0	2.8	1.7	12.5	Serving up to 50 staff, with additional WC to allow for gender segregation.
Total allowance				**653.7**	**228.8**	**201.0**	**1083.5**	
Optional accommodation								
W0652	Blood refrigerator bay	2.0	1	2.0				Only required if blood storage not available nearby.
L1804-03	Service room: clinical equipment	12.0	1	12.0				Only required if biomedical engineering workshop not available nearby.
G0171-02	Parking bay: mobile image intensifier	2.0	1	2.0				
P0808	Vending machine	3.0	1	3.0				In lieu of visitors' mini kitchen.
D1120	Sitting room: 7 places	12.0	1	12.0				For visitors.
D1312	Relatives' overnight stay	17.0	1	17.0				For visitors. Requirement based on case mix of patients.
V1323	Shower room: semi-ambulant: standing use	5.0	2	10.0				For visitors. Requirement based on case mix of patients.

Example schedules of accommodation for critical care units

Version 1, published 15.09.11

				Cost guide allowances:	Circulation and communication	Engineering		
				Public	35%	23%		
				Clinical	35%	35%		
				Staff	35%	21%		

Example 2: 16-bed critical care unit

	Room name/function	Unit area allowance	Quantity	Net internal area	Circulation and communication allowance	Engineering allowance	Gross internal area	Notes
Public spaces								
	Entrance: visitors		1					
	Entrance: patients, staff and supplies		1					Separate entrance for staff and supplies is an option.
J0232	Reception desk (size based on number of places)	5.5	1	5.5	1.9	1.3	8.7	1-place reception for small/medium sized units; 2-place reception for large units (>30 beds).
J1155/J1414	Waiting area: 16 places	33.0	1	33.0	11.6	7.6	52.1	Includes children's play area and 10% wheelchair places. 1 place per bed with minimum of 10.
P0711	Mini kitchen	5.0	1	5.0	1.8	1.2	7.9	1 per unit.
V0922	WC: independent wheelchair	4.5	1	4.5	1.6	1.0	7.1	1 per small/medium sized unit; 2 per large unit (>30 beds).
Clinical spaces								
T0214	Staff communication base: 4 places	19.0	1	19.0	6.7	6.7	32.3	2 places per 8 beds.
B1603	Isolation room: critical care	26.0	4	104.0	36.4	36.4	176.8	Planning and design manual specifies 20% singles (subject to case mix); in a 16-bed unit with a standard 4-bed bay arrangement 25% singles may be provided.
G0510	Gowning lobby	6.0	4	24.0	8.4	8.4	40.8	
B1610	4-bed bay: critical care	143.0	3	429.0	150.2	150.2	729.3	
M0727	Interview room: 7 places	12.0	2	24.0	8.4	8.4	40.8	1 per 10 beds.
V1635	Shower room: assisted	8.0	1	8.0	2.8	2.8	13.6	Nominal allowance. Requirement subject to case mix of unit.
Clinical support spaces								
T0535	Clean utility room	16.0	2	32.0	11.2	11.2	54.4	1 per 12 beds.
G0605	Ice-making machine bay	1.5	1	1.5	0.5	0.5	2.6	1 per unit.
L1308	Near patient testing room	8.0	1	8.0	2.8	2.8	13.6	1 per 16 beds.
Y0331	Dirty utility room for bedpan processing	12.0	1	12.0	4.2	4.2	20.4	1 per 16 beds.
P0627	Pantry/refreshment room	12.0	1	12.0	4.2	4.2	20.4	1 per unit.
W0540/1450/ 1590/1594	Storage: bulky consumables, medical gas cylinders, linen and furniture	4.0	16	64.0	22.4	22.4	108.8	4 m^2 allowance per bed. Based on a review of a number of reference sites.
W1584-06	Store: clinical equipment	24.0	1	24.0	8.4	8.4	40.8	1 for small/medium sized units; 2 for large units (>30 beds).
Y0335	Decontamination room: clinical equipment	16.0	1	16.0	5.6	5.6	27.2	1 per unit. Located adjacent to clinical equipment store.
G0171	Parking bay: imaging equipment	6.0	1	6.0	2.1	2.1	10.2	1 per small/medium sized unit; 2 per large unit (>30 beds)
G0180-01	Parking bay: resuscitation trolley	2.0	2	4.0	1.4	1.4	6.8	1 per 8 beds.
Y0646	Disposal hold: 3000 litres	12.0	1	12.0	4.2	4.2	20.4	Minimum 1500 litres per 8 beds.
Y1510	Cleaners' room	8.0	1	8.0	2.8	2.8	13.6	1 for small/medium sized units; 2 for larger units (>30 beds).
Staff spaces								
M0251	Office: 1-person	8.0	3	24.0	8.4	5.0	37.4	For clinical director, lead nurse and tutor.
M0278/M0281/ M0410/M0731	Admin area: shared use (size based on number of workstations)	6.6	13	85.8	30.0	18.0	133.8	For consultants and outreach staff.
M0727	Meeting room: 7 places	16.0	1	16.0	5.6	3.4	25.0	
H1304-02	Seminar room: 16 places	26.0	1	26.0	9.1	5.5	40.6	
D0434-03	Rest room with mini kitchen (size based on number of seats)	1.9	16	30.4	10.6	6.4	47.4	
V0554-03/V0667/ V0725/V1321	Changing area: staff (size based on number of lockers)	1.4	77	107.8	37.7	22.6	168.2	Includes uniform exchange area, showers and a number of individual changing rooms. Based on 70 staff who need a locker (allowing for shift changeover), plus a 10% contingency to allow for male/female split (suggested apportionment 2/3 female to 1/3 male).
V0725	Changing room: semi-ambulant	2.0	1	2.0	0.7	0.4	3.1	Additional individual changing room to allow for male and female segregation.
V1321	Shower room: ambulant	2.5	1	2.5	0.9	0.5	3.9	Additional shower room to allow for male and female segregation.
V1010	WC: ambulant	2.0	5	10.0	3.5	2.1	15.6	Serving up to 75 staff, with additional toilet to allow for gender segregation.
Total allowance				**1160.0**	**406.0**	**357.6**	**1923.6**	
Optional accommodation								
W0652	Blood refrigerator bay	2.0	1	2.0				Only required if blood storage not available nearby.
L1804-03	Service room: clinical equipment	12.0	1	12.0				Only required if biomedical engineering workshop not available nearby.
G0171-02	Parking bay: mobile image intensifier	2.0	1	2.0				
P0808	Vending machine	3.0	1	3.0				In lieu of visitors' mini kitchen.
D1120	Sitting room: 7 places	12.0	1	12.0				For visitors.
D1312	Relatives' overnight stay	17.0	1	17.0				For visitors. Requirement based on case mix of patients.
V1323	Shower room: semi-ambulant: standing use	5.0	2	10.0				For visitors. Requirement based on case mix of patients.

Example schedules of accommodation for critical care units

Version 1, published 15.09.11

				Cost guide allowances:	Circulation and communication	Engineering		
				Public	35%	23%		
				Clinical	35%	35%		
				Staff	35%	21%		

Example 3: 32-bed critical care unit

	Room name/function	Unit area allowance	Quantity	Net internal area	Circulation and communication allowance	Engineering allowance	Gross internal area	Notes
Public spaces								
	Entrance: visitors		1					
	Entrance: patients, staff and supplies		1					Separate entrance for staff and supplies is an option.
J0232	Reception desk (size based on number of places)	5.5	2	11.0	3.9	2.5	17.4	1-place reception for small/medium sized units; 2-place reception for large units (>30 beds).
J1155/J1414	Waiting area: 32 places	60.0	1	60.0	21.0	13.8	94.8	Includes children's play area and 10% wheelchair places. 1 place per bed with minimum of 10.
P0711	Mini kitchen	5.0	1	5.0	1.8	1.2	7.9	1 per unit.
V0922	WC: independent wheelchair	4.5	2	9.0	3.2	2.1	14.2	1 per small/medium sized unit; 2 per large unit (>30 beds).
Clinical spaces								
T0214-02	Staff communication base: 8 places	30.0	1	30.0	10.5	10.5	51.0	2 places per 8 beds.
B1063	Isolation room: critical care	26.0	8	208.0	72.8	72.8	353.6	Planning and design manual specifies 20% singles (subject to case mix); in a 32-bed unit with a standard 4-bed bay arrangement 25% singles may be provided.
G0510	Gowning lobby	6.0	8	48.0	16.8	16.8	81.6	
B1610	4-bed bay: critical care	143.0	6	858.0	300.3	300.3	1458.6	
M0727	Interview room: 7 places	12.0	3	36.0	12.6	12.6	61.2	1 per 10 beds.
V1635	Shower room: assisted	8.0	2	16.0	5.6	5.6	27.2	Nominal allowance. Requirement subject to case mix of unit.
Clinical support spaces								
T0535	Clean utility room	16.0	3	48.0	16.8	16.8	81.6	1 per 12 beds.
G0605	Ice-making machine bay	1.5	1	1.5	0.5	0.5	2.6	1 per unit.
L1308	Near patient testing room	8.0	2	16.0	5.6	5.6	27.2	1 per 16 beds.
Y0331	Dirty utility room for bedpan processing	12.0	2	24.0	8.4	8.4	40.8	1 per 16 beds.
P0627	Pantry/refreshment room	12.0	1	12.0	4.2	4.2	20.4	1 per unit.
W0540/1450/ 1590/1594	Storage: bulky consumables, medical gas cylinders, linen and furniture	4.0	32	128.0	44.8	44.8	217.6	4 m^2 allowance per bed. Based on a review of a number of reference sites.
W1584-06	Store: clinical equipment	24.0	2	48.0	16.8	16.8	81.6	1 for small/medium sized units; 2 for large units (>30 beds).
Y0335	Decontamination room: clinical equipment	16.0	1	16.0	5.6	5.6	27.2	1 per unit. Located adjacent to clinical equipment stores.
G0171	Parking bay: imaging equipment	6.0	2	12.0	4.2	4.2	20.4	1 per small/medium sized unit; 2 per large unit (>30 beds)
G0180-01	Parking bay: resuscitation trolley	2.0	4	8.0	2.8	2.8	13.6	1 per 8 beds.
Y0646	Disposal hold: 3000 litres	12.0	2	24.0	8.4	8.4	40.8	Minimum 1500 litres per 8 beds.
Y1510	Cleaners' room	8.0	2	16.0	5.6	5.6	27.2	1 for small/medium sized units; 2 for larger units (>30 beds).
Staff spaces								
M0251	Office: 1-person	8.0	3	24.0	8.4	5.0	37.4	For clinical director, lead nurse and tutor.
M0278/M0281/ M0410/M0731	Admin area: shared use (size based on number of workstations)	6.6	29	191.4	67.0	40.2	298.6	For consultants and outreach staff.
M0727	Meeting room: 7 places	16.0	1	16.0	5.6	3.4	25.0	
H1304-03	Seminar room: 32 places	45.0	1	45.0	15.8	9.5	70.2	
D0434-03	Rest room with mini kitchen (size based on number of seats)	1.8	32	57.6	20.2	12.1	89.9	
V0554-03/V0667-02/ V0725/V1321	Changing area: staff (size based on number of lockers)	1.4	148	207.2	72.5	43.5	323.2	Includes uniform exchange area, showers and a number of individual changing rooms. Based on 135 staff who need a locker (allowing for shift changeover), plus a 10% contingency to allow for male/female split (suggested apportionment 2/3 female to 1/3 male).
V0725	Changing room: semi-ambulant	2.0	2	4.0	1.4	0.8	6.2	Additional individual changing rooms to allow for male and female segregation.
V1321	Shower room: ambulant	2.5	2	5.0	1.8	1.1	7.8	Additional shower rooms to allow for male and female segregation.
V1010	WC: ambulant	2.0	8	16.0	5.6	3.4	25.0	Serving up to 150 staff, with additional toilet to allow for gender segregation.
Total allowance				**2200.7**	**770.2**	**680.8**	**3651.7**	
Optional accommodation								
W0652	Blood refrigerator bay	2.0	1	2.0				Only required if blood storage not available nearby.
L1804-03	Service room: clinical equipment	12.0	1	12.0				Only required if biomedical engineering workshop not available nearby.
G0171-02	Parking bay: mobile image intensifier	2.0	1	2.0				
P0808	Vending machine	3.0	1	3.0				In lieu of visitors' mini kitchen.
D1120	Sitting room: 7 places	12.0	1	12.0				For visitors.
D1312	Relatives' overnight stay	17.0	1	17.0				For visitors. Requirement based on case mix of patients.
V1323	Shower room: semi-ambulant: standing use	5.0	2	10.0				For visitors. Requirement based on case mix of patients.

4 Whole unit planning and design considerations

Departmental relationships

4.1 A critical care unit should be centrally located within an acute hospital development. It should be adjacent to and/or have easy access to (and be easily accessible from) imaging facilities and operating theatres. The emergency department should be adjacent and/or have easy access to the critical care unit.

4.2 The critical care unit requires close links to the main hospital pharmacy and microbiology laboratory; where a pneumatic tube system is used to transport specimens and computers are used for transmitting test results and placing prescription orders, physical proximity is less important.

Bed spaces

4.3 Each bed space should include the following:

- an electric bed capable of attaining chair and Trendelenberg positions, and fitted with a pressure-relieving mattress;
- a high-backed chair with foot elevation and tilting facility for the patient;
- a ceiling-mounted twin-armed pendant to accommodate a range of equipment and for the provision of medical gases and electrical and data connectivity;
- a clinical wash-hand basin;

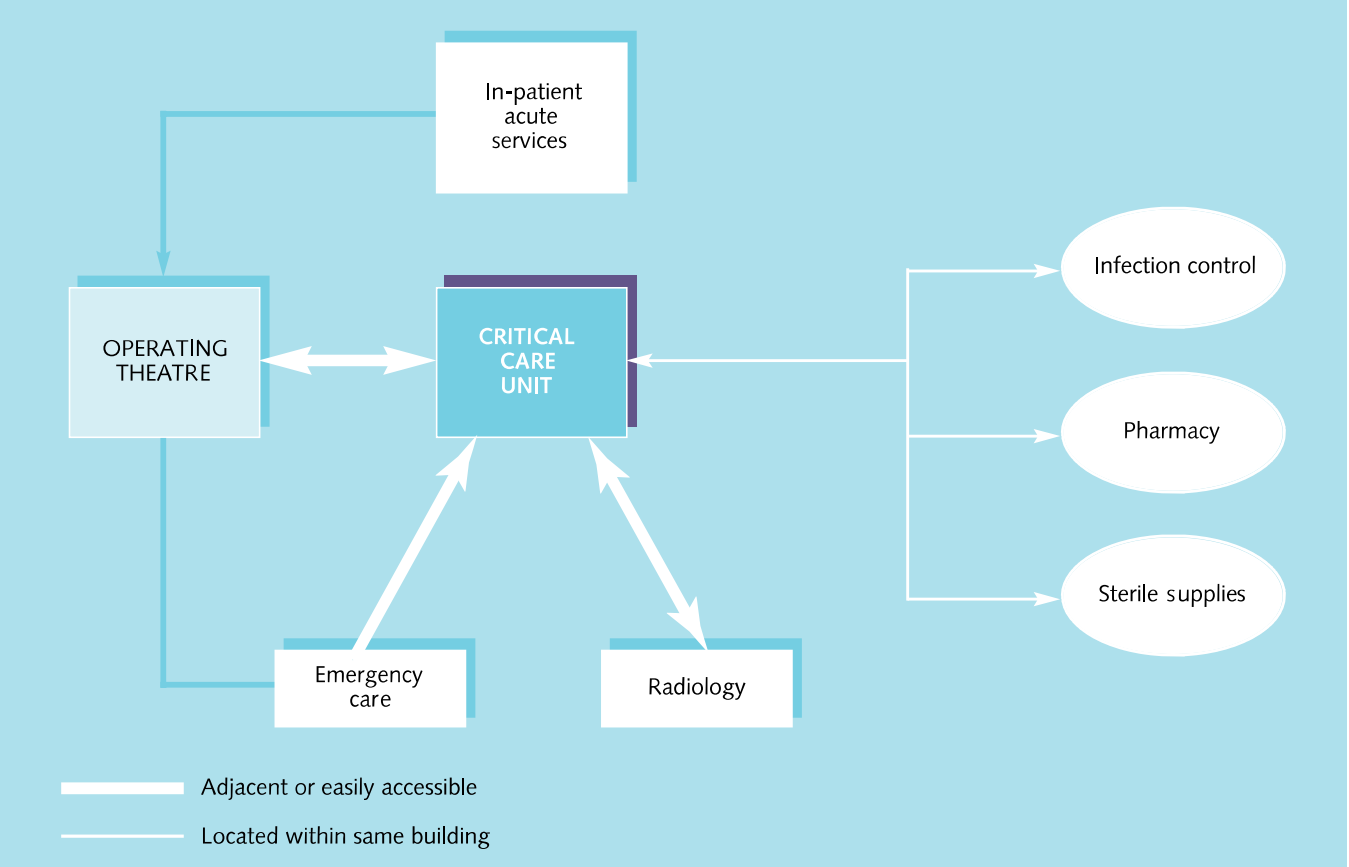


Figure 1 Departmental relationships for a critical care unit

- enclosed storage for a small quantity of consumables;
- drugs storage (wall-mounted drugs cabinet or within the patient's bedside locker);
- a ceiling-mounted hoist for lifting patients.

4.4 Storage of patients' clothes and personal effects should be dealt with in accordance with whole-hospital policy. They should not normally be kept at the bedside; however, some personal items such as family photographs can help the patient's orientation and provide emotional support.

4.5 The following outlets should be located on the pendant:

- at least 28 unswitched single socket-outlets;
- up to four data outlets, one of which should be networked to the hospital's patient record system;
- 3–4 oxygen outlets;
- two 4-bar air outlets;
- one 7-bar air outlet (where surgical equipment is used), clearly labelled with the appropriate warning;
- 2–4 medical vacuum outlets;
- anaesthetic gas scavenging points, if anaesthetic inhalation gases and/ or inhalation antibiotics are used;
- patient/staff and staff emergency call systems, including a separate switch for crash call;
- telephone outlet for internal and external calls;
- TV outlet.

4.6 The following equipment should be located on the pendant:

- computer with flat-screen monitor;
- multi-parameter patient monitoring equipment;
- 3–6 infusion pumps;
- 4–10 syringe pumps;
- blood warmer;
- feeding pump;
- ventilation and humidification equipment.

4.7 Ceiling-mounted rather than floor-mounted pendants are recommended since they avoid the need to trail cables across the floor, thereby providing better access to the patient and improved safety for staff and visitors. They are also easier to keep clean. Powered ceiling-mounted pendants enable staff of all heights to operate them easily. Care should be taken in the positioning of the pendants to ensure convenient access by staff.

4.8 The pendant should be connected to an isolated power supply and provide an uninterruptable power supply (UPS) to an agreed number of electrical outlets. IPS and UPS sockets should be colour-coded to differentiate them from one another. Additional switched and shuttered sockets, connected to ring circuits, may be provided at the bedhead for portable non-medical equipment.

4.9 The temperature within bed spaces is usually controlled by the ventilation system rather than radiators. Facilities for temperature and humidity adjustment should be provided, to parameters agreed with clinical representatives on the project team. Children should only be placed in bed spaces that provide local temperature control (due to the need to elevate the room temperature for this patient group).

4.10 The ventilation system should include mechanical cooling and provide for a range of temperatures that can be adjusted by staff, taking particular care to establish and accommodate the unusually high heat gains that may be anticipated from medical equipment. The position of ventilation grilles should minimise the risk of patients experiencing discomfort through down drafts.

4.11 The following equipment may be required at the bedside on an intermittent or continuous basis:

- mobile X-ray machine;
- haemodialysis machine;
- haemofiltration machine;
- peritoneal dialysis machine;
- EEG machines;
- electrocardiography machines;
- echocardiography machines;
- transoesophageal echocardiography machines;
- invasive cardiac output monitoring devices;
- ultrasound machines;
- gamma cameras;
- endoscopes (fibre-optic light source);

- defibrillators;
- non-invasive respiratory equipment (continuous positive airway pressure (CPAP)/bi-level positive airway pressure (BIPAP)): this may be mounted on the pendant;
- vacuum dressings.

4.12 A wall-mounted renal dialysis panel with water supply and drainage may be provided at some bed spaces to facilitate haemodialysis. Alternatively, it may be more economical to supply potable water to small water treatment units at the bed space. The specification for the water quality should be agreed with the project team.

4.13 A clock with an elapsed time control should be clearly visible from each bed space.

4.14 The bed space should be a minimum of 25.5 m^2 in order to accommodate the above equipment/ furniture. This will also allow:

- staff access to the patient from all sides of the bed;
- staff to manoeuvre the patient, themselves and equipment safely;
- five members of staff to attend to the patient in an emergency situation;
- two visitors to sit at the bedside.

4.15 All bed spaces should be capable of providing visual privacy and reasonable auditory privacy, when required. All bed spaces should have natural daylight with outside views wherever possible. Artificial lighting should be dimmable and of sufficient strength to enable surgical interventions and response to life-threatening situations at the bedside. Lighting may be provided as part of the pendant system.

4.16 Glass walls (in the case of single-bed rooms) or partitions (in the case of multi-bed areas), which can be obscured for privacy when appropriate, aid observation of patients.

4.17 A ceiling height of 3 m in bed areas is recommended in order to accommodate pendants and ceiling-mounted hoists. The position of overhead equipment requires careful consideration. The construction of the ceiling should take account of weight-bearing requirements.

5 Public spaces

Entrances

5.1 Patients and visitors should not share the same entrance, to ensure that visitors do not observe patients coming in and out of the critical care unit. Deceased patients should be transported using the patients' entrance. Staff may share an entrance with either visitors or patients. However, a dedicated entrance for visitors may provide them with a calmer, less busy environment. Supplies should be delivered via the same entrance used by staff.

5.2 The entrance for visitors requires an intercom-controlled entry system or similar linked to the reception desk and staff communication base(s). CCTV should also be considered, with monitors at the reception desk and staff communication base(s) to assist with identification of visitors out-of-hours.

5.3 Where access control measures are in place, close-proximity cards rather than swipe cards or keypads should be used, as they are easier to clean and offer better infection control.

Reception desk

5.4 The entry system for the visitors' entrance, CCTV monitor, if provided, and a telephone for internal and external calls should be located here. The reception desk should have natural surveillance of the visitors' entrance and/or point of entry to clinical areas.

Visitors' waiting area and associated facilities

5.5 On arrival, visitors will be admitted immediately to the appropriate clinical area or asked to wait in the waiting area. There should be a door between the waiting area and clinical areas, controlled by staff, to prevent visitors wandering into clinical areas. Beverage-making facilities and WCs should be available nearby. The waiting area may include a TV. A separate visitors' sitting room may be of value for those spending long periods of time within the vicinity of the critical care unit.

Visitors' overnight accommodation

5.6 Overnight accommodation for visitors may be provided within the hospital, or the hospital may have an arrangement with a nearby hotel. Where children are being treated, overnight accommodation for parents should be provided. Enlarged single bedrooms provide the option of adding an extra bed for parents to stay overnight.

6 Clinical spaces

Staff communication base(s)

6.1 Ideally, staff at the base(s) should be able to see all multi-bed spaces under their control and the entry point to clinical areas. Control of the visitors' entry system will be transferred from the reception desk to the communication base(s) at night.

6.2 Alarms to signify the failure of medical gas and power outlets within the bed spaces should be located here. Central consoles for multi-parameter patient monitoring equipment should also be located here.

6.3 A telephone for internal and external calls will be required. Task lighting should be provided for use at night to prevent disturbing patients. Each base should be partially enclosed to control noise transfer.

Isolation rooms

6.4 Single-bed rooms with lobbies are required for the isolation of patients to control the spread of infection or for the protection of immuno-suppressed patients.

6.5 Single-bed rooms should be rectangular, not L-shaped, with an entrance wide enough to allow bulky equipment to pass easily – at least a door and a half wide. Care should be taken to ensure that the door opening is sufficient to allow the passage of the bed and equipment.

6.6 The ventilation system should be designed to provide simultaneous source and protective isolation. A balanced supply and extract ventilation to each isolation room and gowning lobby is, therefore, proposed. The lobby, which functions as

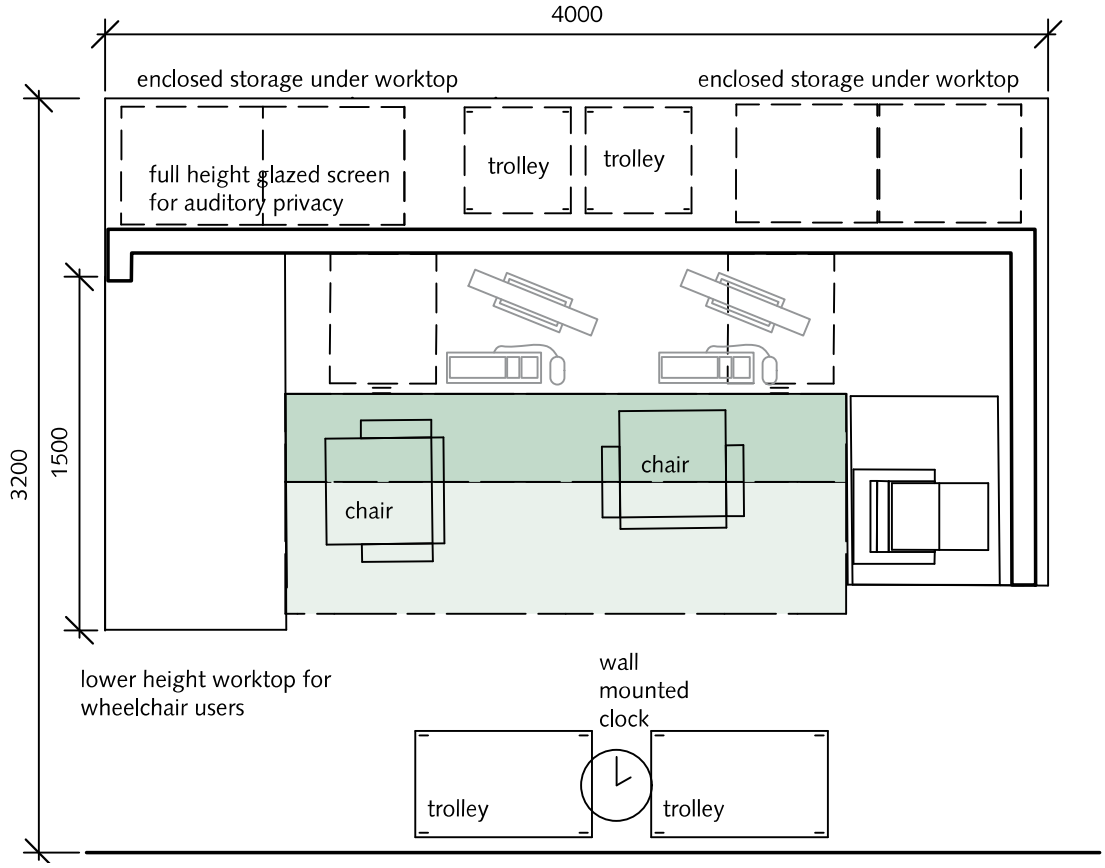


Figure 2 Critical care 2-place staff communication base

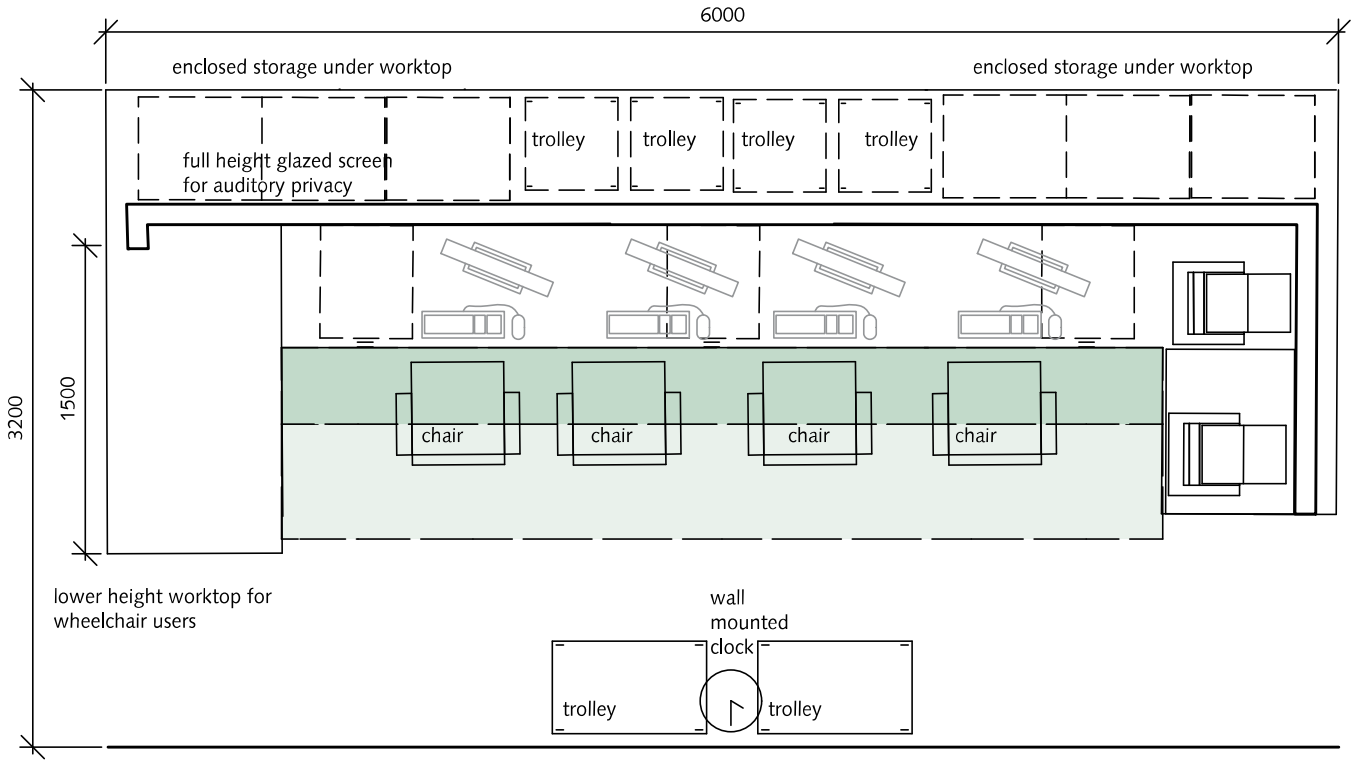


Figure 3 Critical care 4-place staff communication base

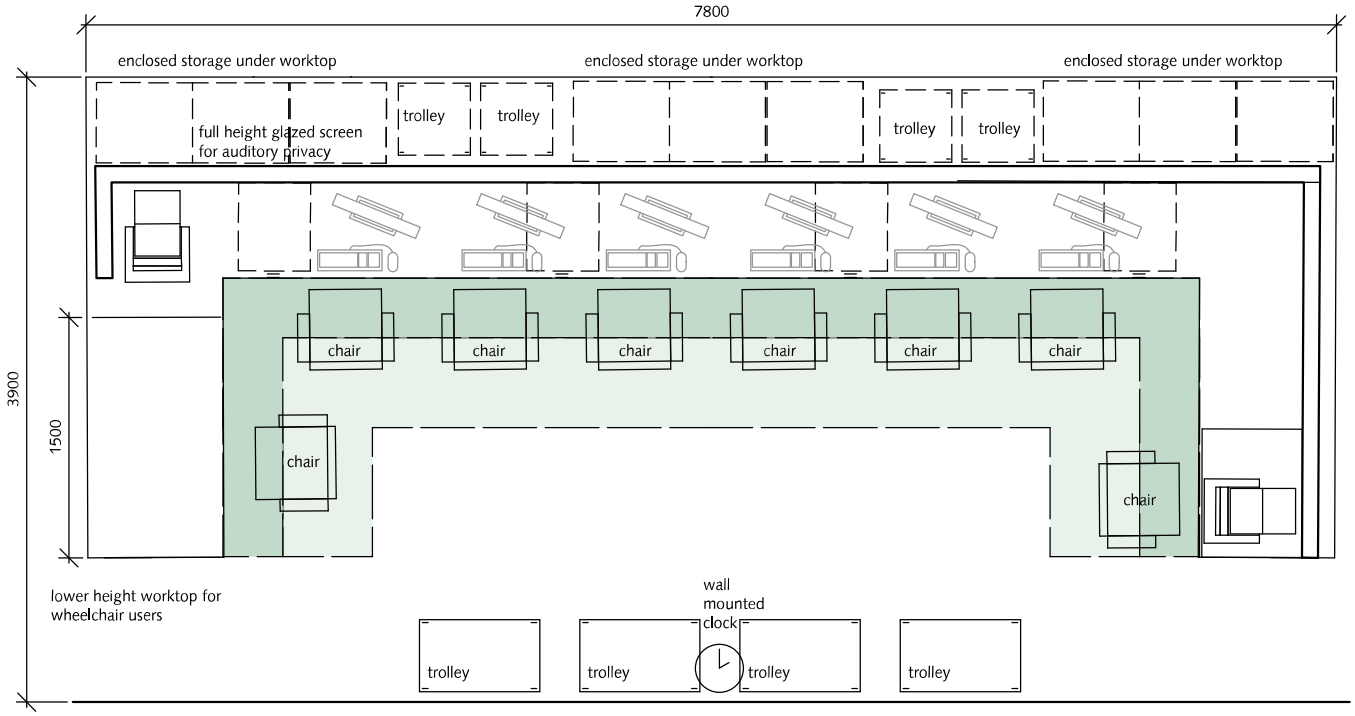


Figure 4 Critical care 8-place staff communication base

an airlock, requires a relatively high and balanced supply and extract air change rate to be effective against airborne organisms moving between circulation areas and isolation rooms.

6.7 Ceilings and windows should be sealed. Doors should be tight-fitting, with seals to minimise air transfer.

6.8 Isolation rooms should have local temperature controls that are accessible to nursing staff and may require humidity within the range 40–60% Rh, depending on the specialty.

6.9 The precise number of isolation rooms will depend on the case mix of the critical care unit. For example, units that routinely admit neutropenic haematology patients may require up to 50% of their beds to be provided as isolation rooms with lobbies. No unit should, however, have less than 20% of their beds as isolation rooms.

Multi-bed areas

6.10 A 2.5 m-wide unobstructed circulation space should be provided at the foot of each bed space. It is imperative to maintain the required bed separation for infection control reasons and to aid positioning of equipment.

6.11 The temperature in the multi-bed areas should be centrally controlled.

6.12 Requirements for scrub troughs should be determined locally based on patient case mix.

6.13 Project teams should select a curtain system that meets the following criteria:

- when the curtains are pulled around the bed space, there should be 100% visual privacy;
- it should be possible to pull the curtains back completely against the wall;

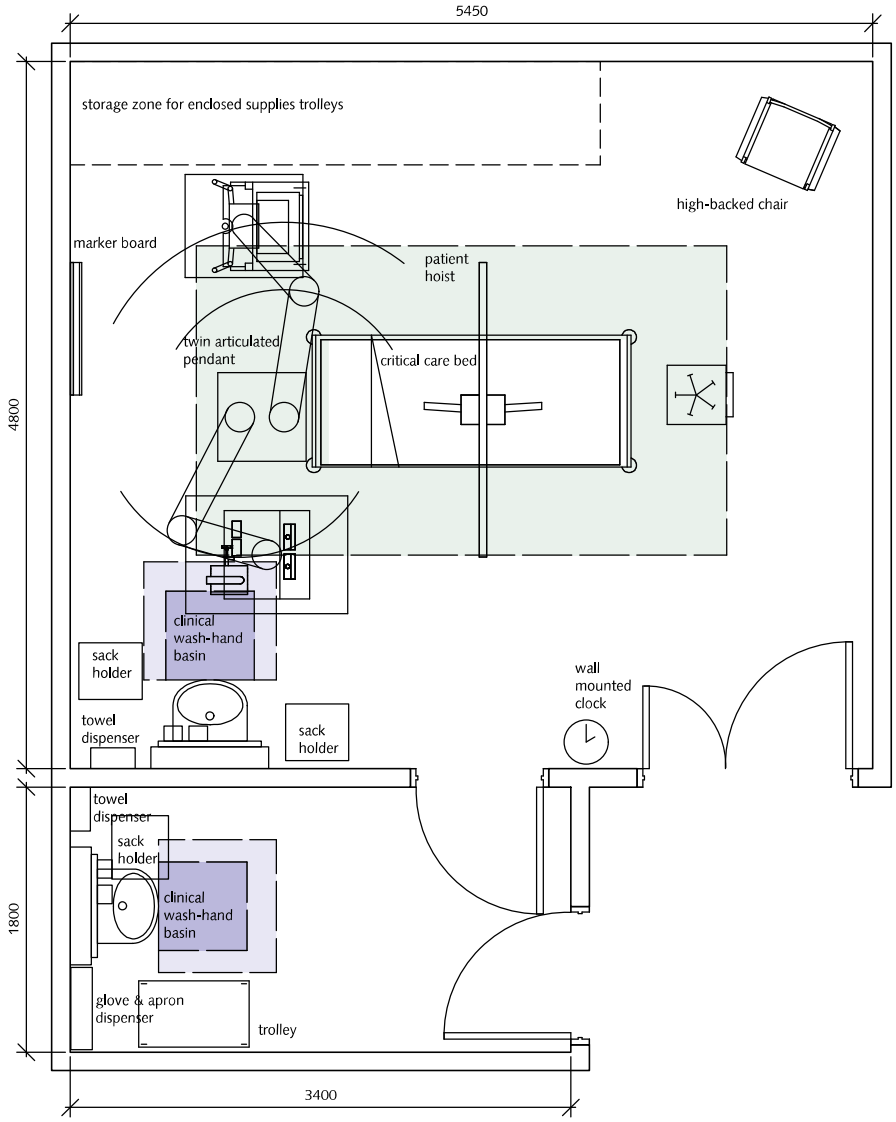


Figure 5 Critical care isolation room and lobby

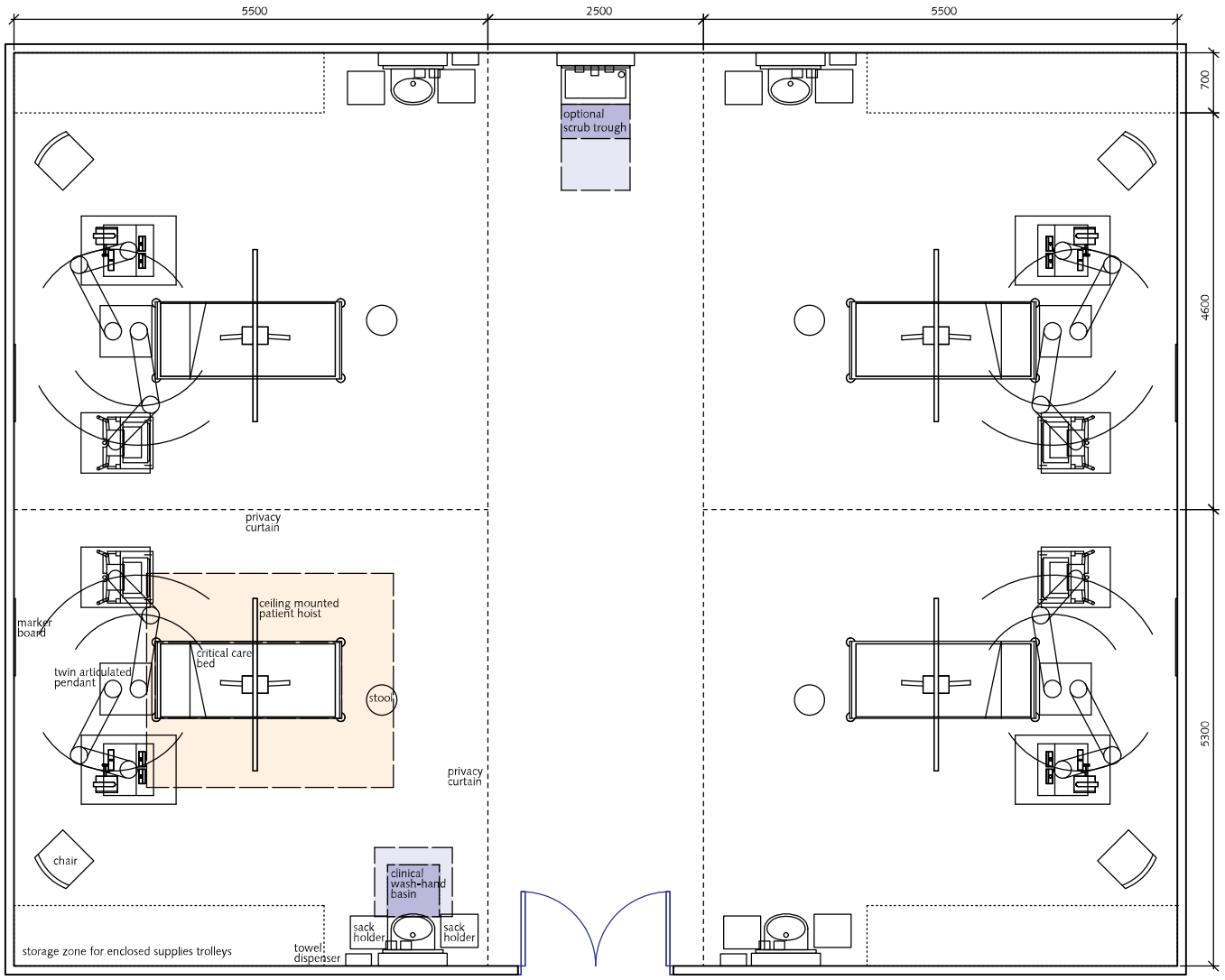


Figure 6 Critical care 4-bed bay

- the density of the curtains should reduce the level of general noise transmitted and also improve the level of auditory privacy in the bed-space;
- the curtains should be easily movable and disposable.

Interview rooms

6.14 Interview rooms should be provided within the vicinity of the bed spaces to enable staff to speak to visitors in privacy. The rooms should be in a quiet location.

7 Clinical support spaces

Ice-making machine bay

7.1 An industrial ice-making machine should be provided to facilitate hypothermic interventions. It should be located in a designated bay.

Storage for bulky consumables, medical gas cylinders, linen and furniture

7.2 The example schedules include a combined storage allowance for bulky consumables, medical gas cylinders, linen and furniture. However, these four categories of item should be stored separately. (It is assumed that non-bulky sterile supplies and consumables are held in the clean utility rooms.)

7.3 The project team should ensure that the provision of standby medical gases reflects the emergency procedures and contingency plans for the unit. The medical gas cylinder store(s) should be easily accessible from clinical areas and enclosed in fire-resisting construction.

7.4 The furniture store(s) will need to accommodate bulky equipment, including mattresses, when not in use, chairs, bariatric equipment and cots.

Clinical equipment store(s)

7.5 A dedicated area should be provided for the storage and charging of transfer equipment (transport trolley, monitors, syringes, ventilators, suction pumps). Dedicated ventilation may be required to remove gases and heat from chargers. An area for hanging endoscopes and transoesophageal echocardiography probes is also required. The clinical equipment store(s) should be within easy access of the bed areas.

Clinical equipment decontamination room

7.6 Clinical equipment should be cleaned following use prior to transfer to the clinical equipment store(s) or, if the equipment requires maintenance, to the equipment servicing room. A clinical equipment decontamination room should be provided for this purpose. This room should be adjacent to the clinical equipment store(s).

Imaging equipment bay

7.7 An open bay should be provided close to the clinical equipment store(s) for the storage of imaging equipment and protective lead aprons. A socket-outlet should be provided for charging equipment.

7.8 Lead aprons should be stored vertically to maintain their protective capability. Suitable wall brackets attached to a load-bearing wall, or mobile stands, are required for this purpose. The bay should also accommodate a mobile X-ray machine, a minimum of one ultrasound machine, and a transoesophageal echocardiography machine. A larger bay is required if mobile image intensifiers are used.

7.9 Regulations pertaining to the use of ionising radiation, such as IR(ME)R 2000 and IRR99, must be complied with.

Resuscitation trolley bays

7.10 It is essential that adequate provision is made for siting resuscitation trolleys within the critical care unit. The precise equipment positioned on these trolleys should be determined locally.

Blood refrigerator bay (optional)

7.11 A blood refrigerator will only be required if a blood store is not available nearby. If provided, the fridge should be located in a designated bay and should be networked to the central system to permit traceability of blood. The use of blood refrigerators is governed by national and local blood transfusion service regulations.

Clinical equipment service room (optional)

7.12 Facilities are required for equipment servicing as defined in equipment manufacturers' user manuals, supplemented by any formally agreed local instructions. A dedicated room should be provided in the critical care unit for this purpose if an existing biomedical engineering workshop is not located nearby. When provided as part of the critical care unit, this room should be adjacent to the clinical equipment decontamination room.

8 Staff spaces

1-person offices

8.1 The clinical director, lead nurse and Faculty of Intensive Care Medicine tutor require dedicated 1-person offices.

Admin areas

8.2 The following staff may require access to a workstation, but these may be provided in an open-plan office environment:

- clinical staff (doctors, nurses, allied health professions);
- outreach staff;
- audit clerk;
- technician;
- secretarial staff;
- IM&T staff;
- organ donation staff;
- research staff.

8.3 Workstations for clinical staff should provide quick and easy access to the patient bed areas in case of an emergency.

Seminar room

8.4 Access to a seminar room within the vicinity of the critical care unit must be provided. An intercom system should be installed between the seminar room and the clinical areas to recall staff in an emergency. The seminar room may double up as a skills laboratory, for example for training in resuscitation, using mannikins, defibrillators, and simulated body parts for venepuncture or suture practice.

Rest rooms

8.5 Staff rest rooms should be located far enough away from patient bed areas for staff to withdraw, but also close enough for them to return quickly to the patient bed areas in case of an emergency. Rest rooms require call systems to recall staff to the clinical areas in case of an emergency.

Changing areas

8.6 Space is required within the changing areas for the storage and disposal of scrub suits and footwear.

9 References

'Comprehensive Critical Care', DH 2000.

Intensive Care Society website.

'Quality Critical Care – Beyond Comprehensive Critical Care'. DH, 2005.

'Acutely ill patients in hospital'. NICE Clinical guidelines CG50, July 2007.

'Rehabilitation after critical illness'. NICE Clinical guidelines CG83, 2009.

'Competencies for recognising and responding to acutely ill patients in hospital'. DH, 2009.

Critical Care Minimum Dataset.

'Payment by Results Guidance for 2011–12', DH.

PL/CNO/2010/3 – 'Eliminating Mixed Sex Accommodation'.

'Census on number of critical care beds in England'.

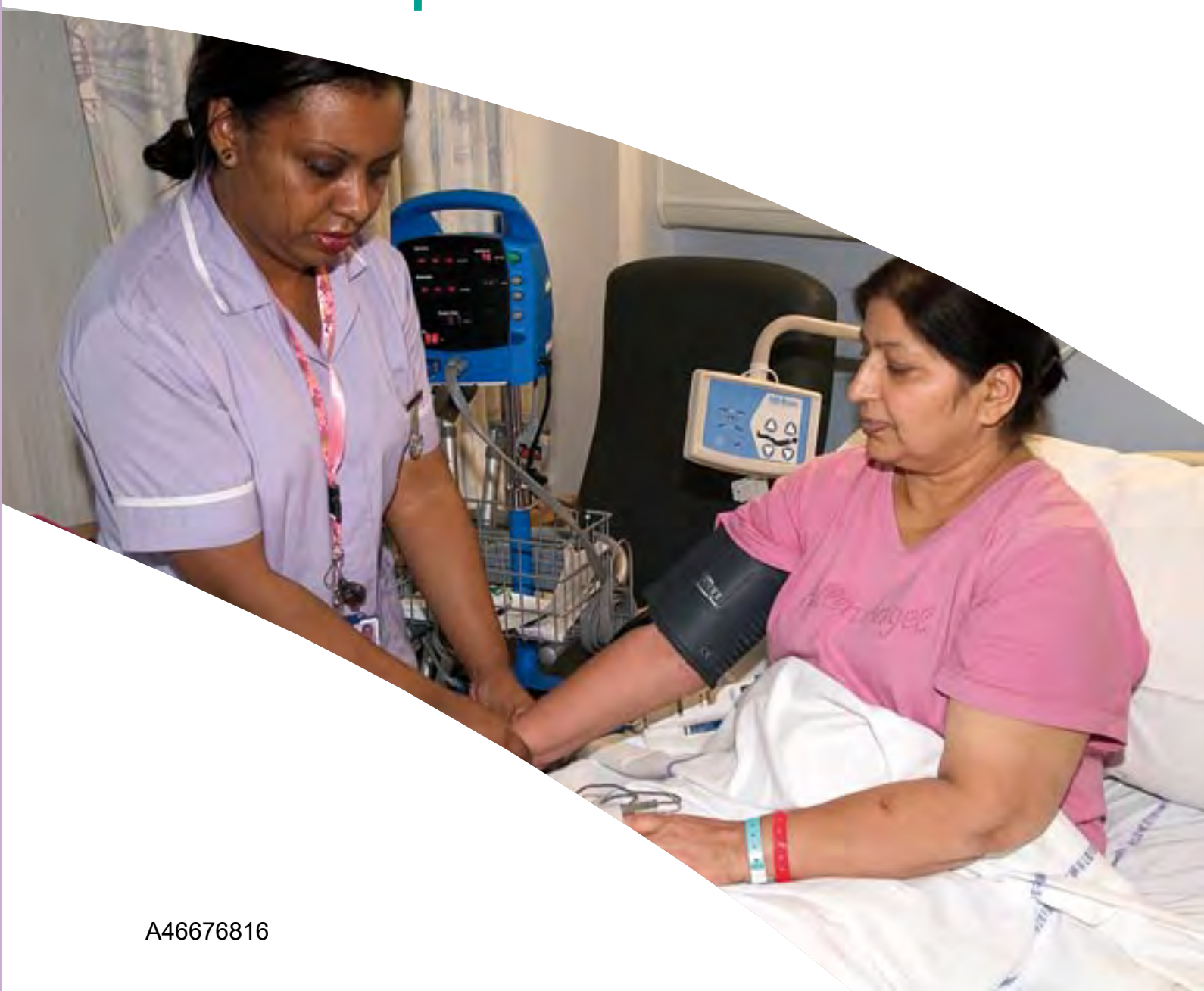
IR(ME)R 2000 (the Ionising Radiation (Medical Exposure) Regulations 2000).

IRR99 (the Ionising Radiations Regulations 1999).

Department of Health

In-patient care

Health Building Note 04-01: Adult in-patient facilities



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DH INFORMATION READER BOX

Policy	**Estates**
HR / Workforce	Commissioning
Management	IM & T
Planning /	Finance
Clinical	Social Care / Partnership Working

Document Purpose	Best Practice Guidance
Gateway Reference	13158
Title	HBN 04-01 - Adult in-patient facilities (2nd edition)
Author	DH Estates and Facilities Division
Publication Date	Dec 2009
Target Audience	PCT CEs, NHS Trust CEs, SHA CEs, Care Trust CEs, Foundation Trust CEs , Medical Directors, Directors of Nursing, PCT Chairs, NHS Trust Board Chairs, Special HA CEs, Directors of Finance
Circulation List	
Description	Health Building Note 04-01 provides best practice guidance on the planning and design of in-patient facilities for adults. It describes bed and sanitary facilities, patient support spaces, stores, utilities, administration areas and staff facilities.
Cross Ref	HBN 04-01 Adult in-patient facilities (July 2008 edition)
Superseded Docs	HBN 04-01 Adult in-patient facilities (July 2008 edition)
Action Required	N/A
Timing	**N/A**
Contact Details	Sue Taylor Estates and Facilities Division Quarry House, Quarry Hill Leeds LS2 7UE [redacted] http://www.spaceforhealth.nhs.uk
For Recipient's Use	

In-patient care
Health Building Note 04-01: Adult in-patient facilities

Delivering Same Sex Accommodation – Review of Health Building Note Guidance

The Department of Health's Delivering Same-Sex Accommodation (DSSA) programme aims to all but eliminate mixed-sex accommodation from hospitals in England by 2010. Although DSSA is primarily an operational issue, the design and layout of healthcare facilities can help support the provision of same-sex accommodation. With this in mind, the Department's Health Building Note (HBN) series of publications has been reviewed against DSSA requirements.

Amendments have been made to this document at **paragraph 3.41**.

This review makes particular reference to the letter (PL/CNO/2009/2) from the Chief Nursing Officer and Director General NHS Finance, Performance and Operations at:

www.dh.gov.uk/en/Publicationsandstatistics/Lettersandcirculars/Professionalletters/Chiefnursingofficerletters/DH_098894

Full details of the DSSA programme are at:

www.dh.gov.uk/en/Healthcare/Samesexaccommodation/index.htm

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Preface

About Health Building Notes

Health Building Notes give "best practice" guidance on the design and planning of new healthcare buildings and on the adaptation/extension of existing facilities.

They provide information to support the briefing and design processes for individual projects in the NHS building programme.

Restructuring of the Health Building Note suite

Healthcare delivery is constantly changing, and so too are the boundaries between primary, secondary and tertiary care. The focus now is on delivering healthcare closer to people's homes.

The traditional division of Health Building Notes into discrete books of information based on hospital departments is therefore no longer appropriate.

Instead, the new Health Building Note framework (shown below) is based on the patient's experience across the spectrum of care from home to healthcare setting and back, using the national service frameworks (NSFs) as a model. This structure better reflects current policy and service delivery.

New Health Building Note structure

The Health Building Notes have been organised into a suite of 17 core subjects.

Care-group-based Health Building Notes will provide information about a specific care group or pathway but will cross-refer to Health Building Notes on **generic (clinical) activities** or **support systems** as appropriate.

Core subjects will be subdivided into specific topics and classified by a two-digit suffix (-01, -02 etc), and may be further subdivided into Supplements A, B etc.

All Health Building Notes are supported by the overarching Health Building Note 00 in which the key areas of design and building are dealt with.

Example

The Health Building Note on accommodation for adult in-patients will be represented as follows:

> "Health Building Note 04-01: Adult in-patient facilities"

The supplement to Health Building Note 04-01 on isolation facilities will be represented as follows:

> "Health Building Note 04-01: Supplement A – Isolation facilities in acute settings"

New Health Building Note number and series title	Type of Health Building Note
Health Building Note 00 – Core elements	Support-system-based
Health Building Note 01 – Cardiac care	Care-group-based
Health Building Note 02 – Cancer care	Care-group-based
Health Building Note 03 – Mental health	Care-group-based
Health Building Note 04 – In-patient care	Generic-activity-based
Health Building Note 05 – Older people	Care-group-based
Health Building Note 06 – Diagnostics	Generic-activity-based
Health Building Note 07 – Renal care	Care-group-based
Health Building Note 08 – Long-term conditions/long-stay care	Care-group-based
Health Building Note 09 – Children, young people and maternity services	Care-group-based
Health Building Note 10 – Surgery	Generic-activity-based
Health Building Note 11 – Community care	Generic-activity-based
Health Building Note 12 – Out-patient care	Generic-activity-based
Health Building Note 13 – Decontamination	Support-system-based
Health Building Note 14 – Medicines management	Support-system-based
Health Building Note 15 – Emergency care	Care-group-based
Health Building Note 16 – Pathology	Support-system-based

Other resources in the DH Estates and Facilities knowledge series

Health Technical Memoranda

Health Technical Memoranda give comprehensive advice and guidance on the design, installation and operation of specialised building and engineering technology used in the delivery of healthcare (for example medical gas pipeline systems, and ventilation systems).

They are applicable to new and existing sites, and are for use at various stages during the inception, design, construction, refurbishment and maintenance of a building.

All Health Building Notes should be read in conjunction with the relevant parts of the Health Technical Memorandum series.

Health Technical Memorandum Building Component series

All Health Building Notes refer to Health Technical Memorandum Building Component documents for specifications and design guidance on building components for healthcare buildings. All Health Building Notes should therefore be read in conjunction with the relevant parts of the Health Technical Memorandum Building Component series.

Activity DataBase (ADB)

The Activity DataBase (ADB) data and software assists project teams with the briefing and design of the healthcare environment. Data is based on guidance given in the Health Building Notes, Health Technical Memoranda and Health Technical Memorandum Building Component series.

1. Room data sheets provide an activity-based approach to building design and include data on personnel, planning relationships, environmental considerations, design character, space requirements and graphical layouts.
2. Schedules of equipment/components are included for each room, which may be grouped into ergonomically arranged assemblies.
3. Schedules of equipment can also be obtained at department and project level.
4. Fully loaded drawings may be produced from the database.
5. Reference data is supplied with ADB that may be adapted and modified to suit the users' project-specific needs.

For further information please refer to the Space for Health website: www.nhs.uk/spaceforhealth.

How to obtain publications

- To find out about publications that are finalised and currently being published, look under "Publications" on the Space for Health website at: www.nhs.uk/spaceforhealth.
  NOTE that users should also check this site for latest versions of all publications, including Health Building Notes, and for any amendments to publications.
- Hard copies of published documents are also available from Space for Health.

For further information, contact Jock Graham on 0113 346 6071; email: jock.graham@coi.gsi.gov.uk.

Note

The new Health Building Notes have been progressively rolled out from spring 2007 onwards.

The sequence of numbering within each subject area does not necessarily indicate the order in which the Health Building Notes will be published/printed. However, the overall structure/number format will be maintained as described.

To find out how to access information on published documents, see the "How to obtain publications" section.

Acknowledgements

The Department of Health would like to acknowledge the help and advice kindly given by all the contributors to this guidance, including directors of nursing, infection control specialists, healthcare planners and nursing representatives from a variety of NHS trusts.

The Department of Health also wishes to express thanks to those who contributed to the en-suite shower room research project:

Armitage Venesta

Leaderflush Shapland

Ophardt Products

Hillingdon Hospital NHS Trust

Significant changes since the 1997 edition of this guidance

Health Building Note 4 (1997) 'In-patient accommodation: Options for choice' provided an evidence-based approach to the planning of facilities, which was based on providing a minimum of 50% single-bed rooms. In this respect the new edition has not changed. Further evidence has been gathered on the benefits of single-bed rooms and, in addition, an ergonomic study has established how much space is needed around the hospital bed for various tasks. The results have shown that the provision of a minimum clear space around the bed is essential in achieving an efficient and effective environment. The full report is entitled 'Ward layouts with single rooms for space and flexibility' (DH, 2005).

In addition, a study has been carried out to determine a space-efficient layout for an en-suite shower room for a single-bed room that meets the needs of the majority of patients. The study resulted in two new layouts for an en-suite shower room, both of which are referred to in this guidance.

In 2001, as part of the consumerism agenda to deliver the NHS Plan, the Departmental Cost Allowance Guides (DCAGs) were reviewed. The review concluded that an additional 2.5 m^2 per bed should be added to the schedules of accommodation for single-bed rooms and multi-bed rooms.

Since the 1997 edition the following changes have been made:

1. Single-bed rooms. The size of single-bed rooms has increased from 21 m^2 to 23.5 m^2 as a result of the review of DCAGs, which added 2.5 m^2 to each bed space.
2. Multi-bed rooms. The size of multi-bed rooms has increased from 60 m^2 to 72.5 m^2 as a result of:
    a. the 2001 review of DCAGs, which added 2.5 m^2 to each bed space;
    b. the impact of the Disability Discrimination Act, which requires that sanitary facilities should be provided for independent users and those requiring assistance from staff. As a result the assisted shower room, which now includes a WC as well as a shower and wash-hand basin, has increased in area from 4.5 m^2 to 6.5 m^2. This has increased the overall dimensions of the multi-bed room.
3. Space increase around the bed. The minimum recommended clear space around the bed is now 3600 mm (width) × 3700 mm (depth). This can be achieved within the new space allowances for single-bed rooms and multi-bed rooms.
4. En-suite sanitary facilities for single-bed rooms. The recommended new en-suite shower room layouts for a single-bed room are the same dimensions as in previous guidance but they are more flexible in terms of use and accessibility. They are suitable for ambulant and semi-ambulant patients, the majority of independent wheelchair users, and patients requiring assistance from staff.
5. Isolation suites. Single-bed rooms provide effective isolation for many patients. In some cases, however, a greater degree of isolation may be required. Health Building Note 4 Supplement 1 – 'Isolation facilities in acute settings' gives detailed guidance on isolation suites (bedroom, en-suite sanitary facilities, and lobby).
6. Dirty utility rooms. Ideally, a dirty utility room should serve no more than 15 beds. This reduces travel distances for staff, making better use of nursing time and reducing the risk of spillage and cross-contamination. A second dirty utility room on a ward is also helpful during outbreaks of illness or infectious diseases. Dirty utility rooms in previous guidance served 24 to 30 beds.
7. Schedules of accommodation. The previous Health Building Note was based on a modular approach to planning. The schedules of accommodation were presented in modules for eight-bed clusters. This guidance is based on 24 beds, which provides a typical example of an average-sized ward. Where smaller or larger wards are required, design teams can adapt the guidance to suit local clinical need.

Summary of changes in space requirements for a single-bed room since 1997

Area	HBN 04 1997 (m^2)	Healthcare Capital Investment (Consumerism) (m^2)	Difference (m^2)	Schedules of Accommodation 2003 (m^2)	HBN 04-01 2009 (m^2)	Difference (m^2)
Single-bed room	13.5	16.0		16.0	19.0	
Family and clinical support area	3.0	3.0		3.0	included above	
Sub-total	16.5	19.0	+ 2.5	19.0	19.0	0.0
En-suite shower room	4.5	4.5	0.0	4.5	4.5	0.0
Total single-bed room	**21.0**	**23.5**	**+ 2.5**	**23.5**	**23.5**	**0.0**

Summary of changes in space requirements for a multi-bed room since 1997

Area	HBN 04 1997 (m^2)	Healthcare Capital Investment (Consumerism) (m^2)	Difference (m^2)	Schedules of Accommodation 2003 (m^2)	HBN 04-01 2009 (m^2)	Difference (m^2)
4-bed room	48.0	58.0		58.0	64.0	
Clinical support area	3.0	3.0		3.0	included above	
Sub-total	51.0	61.0	+ 10.0	61.0	64.0	+ 3.0
En-suite assisted shower & wash	4.5	4.5	0.0	4.5	not included	– 4.5
En-suite assisted WC/ wash	4.5	4.5	0.0	4.5	not included	– 4.5
Assisted shower room (en-suite)	not included	not included		not included	6.5	+ 6.5
Semi-ambulant WC without luggage space (en-suite)	not included	not included		not included	2.0	+ 2.0
Total 4-bed room	**60.0**	**70.0**	**+ 10.0**	**70.0**	**72.5**	**+ 2.5**

Executive summary

This Health Building Note provides best practice guidance on the planning and design of in-patient facilities for adults. The accommodation described includes:

- bed and sanitary facilities;
- patient support facilities;
- storage facilities;
- utility facilities;
- administration area and staff facilities.

The recommended space standards for bed areas are applicable to in-patient rooms in any setting, including acute, day surgery and community facilities.

The schedules of accommodation for this Health Building Note are based on a 24-bed ward, with options for 50%, 80% and 100% single-bed rooms.

This best practice guidance essentially applies to new-build facilities. However, the principles are equally valid, and should be applied, when existing accommodation is being upgraded or new accommodation is being constructed within an existing building that may previously have been used for other purposes.

The document gives guidance on general and specific design considerations in patient and support areas. It also covers general functional design requirements and engineering services.

Example room layouts are provided in the appendices along with a comprehensive list of references.

Contents

1 Introduction

1.1 This Health Building Note, which replaces Health Building Note 4 (1997 and 2008 editions), provides guidance on the planning and design of in-patient facilities for adults.

1.2 The space standards for bed areas are applicable to in-patient rooms in any setting, including acute (critical care at levels 1 and 0[1]), day surgery and community facilities.

1.3 The schedules of accommodation for this Health Building Note are based on a 24-bed ward, with options for 50%, 80% and 100% single-bed rooms. The 24-bed ward is provided only as an example of a typical ward, although the 50% option is the recommended minimum for single-room accommodation. Planning teams should determine the number of beds per ward and the percentage of single-bed rooms based on local clinical need.

Policy background

Impact of the 2006 White Paper on in-patient accommodation

1.4 The 2006 White Paper 'Our health, our care, our say: a new direction for community services' (DH 2006) signalled a shift of care into community settings. This includes activity that can be safely and effectively provided outside the acute hospital. In-patient accommodation remains largely in acute settings, particularly for complex cases or where major surgery requiring general anaesthesia is required. However, in-patient accommodation may also be provided in community settings for those patients with less complex conditions. Planning teams will need to consider the number of in-patient beds required and where they may be most appropriately located.

Patient expectations and choice

1.5 Patients will have higher expectations of the environment in which they are to be treated and more say about how and where healthcare is provided, as reflected in 'Creating a Patient-led NHS' (DH 2005). The provision of high-quality facilities, with the option of a single-bed room, is likely to be an influencing factor on patient choice in the near future.

1.6 A key element that should be addressed in all patient accommodation is that of privacy and dignity. 'The Essence of Care' (DH 2001) identified several benchmarks of good practice, focusing on the issue of respect for the individual so that:

- patients feel that they matter all of the time;
- patients experience care in an environment that actively encompasses individual values, beliefs and personal relationships;
- patients' personal space is actively promoted by all staff;
- communication between patients takes place in a manner that respects their individuality;
- the care of patients actively promotes their privacy and dignity and respects their modesty, including gender segregation; and
- patients can access an area that safely provides privacy.

1.7 See also 'Privacy and dignity – a report by the Chief Nursing Officer into mixed sex accommodation in hospitals' (DH 2007).

Prevention of healthcare-associated infection

1.8 Planning teams should note the contents of the Health Act 2006: Code of practice for the

1 Levels of critical care as described in 'Comprehensive critical care' (DH 2000):
Level 1 Patients at risk of their condition deteriorating, or those recently relocated from higher levels of care, whose needs can be met on an acute ward with additional advice and support from the critical care team.
Level 0 Patients whose needs can be met through normal care in an acute hospital.
For higher levels of critical care see Health Building Note 57 – 'Facilities for critical care'

prevention and control of healthcare associated infections (DH 2008). This code of practice sets out criteria by which managers of NHS organisations are to ensure that patients are cared for in a clean environment and where the risk of healthcare-associated infections is kept as low as possible. The document contains a comprehensive list of the Department's guidance on the prevention of healthcare-associated infection. See www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_081927.

Scale of provision

1.9 The number of patients admitted to hospital each year depends on local workload patterns. The number of bed spaces required will be calculated from factors such as:

- data on number of admissions, number of refused admissions, number of premature discharges, bed occupancy and length of stay;
- local admissions policy;
- future developments influencing demand for acute services, for example increasing day case surgery rates, improved chronic disease management, and the potential for more care at home;
- availability of beds in other settings, for example community hospitals.

Evidence base for this guidance

1.10 Since the previous editions of this guidance (1997 and 2008), considerable work has been carried out to establish how much space is needed around a bed for patient and staff safety, accessibility and clinical need. The full report on this work, which comprised literature reviews, ergonomic studies and mock-up trials, is published in 'Ward layouts with single rooms and space for flexibility' (DH 2005).

1.11 In addition, with the need for accessibility to en-suite sanitary facilities and the implications for increasing space, an evidence-based study has been carried out to design an en-suite shower room that will meet the needs of the majority of patients without increasing current space standards. The result of this work is available through the UKHOs' "Space for Health" website at www.nhs.gov.uk/spaceforhealth.

2 General functional and design considerations

Location and departmental relationships

2.1 Historically, in-patient accommodation has been the core of the hospital. Although current trends in the delivery of health services have eliminated in-patient care for some patients who previously would have been admitted, in-patient accommodation still accounts for a significant proportion of space in a hospital.

2.2 Patients who are admitted are often acutely ill and in need of observation. One of the primary goals of designers, therefore, is to minimise the distance between patient rooms and staff workstations, and the distances between all patient rooms.

2.3 Traditionally, in-patient accommodation has been located either above the diagnostic and treatment floors of a hospital or adjacent to them. Critical care beds are prioritised to be closest to surgical or medical interventions, whereas rehabilitation and long-stay beds can be significantly further away from the core clinical services. Beds can be organised horizontally over large floor areas or stacked into towers. A recent tendency in the UK has been to put beds into multi-storey wings that are separate from diagnostic and treatment facilities. This allows more consistent planning of in-patient accommodation, increases flexibility in the way that beds can be organised, and enables maintenance and refurbishment to be carried out more easily.

2.4 The location of wards needs to ensure privacy, particularly at night. Ground-floor locations should be considered only where the adjacent environment is free of hospital traffic and publicly accessible areas. Views outside, together with access to sunshine or direct daylight, have been shown to benefit a patient's recovery. The orientation and aspect of in-patient accommodation should be prioritised when developing a hospital masterplan.

2.5 The ability to isolate components of in-patient accommodation is important for infection control, particularly during outbreaks of infectious illness. It is also important in the event of a fire or other emergency, when patients will generally be evacuated to a safe space on the same floor.

2.6 The ability to combine clusters of beds will allow for different needs over time. Support facilities can be more flexibly located.

2.7 Because in-patient accommodation is such a large component of the hospital, its departmental relationships are mostly dependent on the number and location of access points, lifts, and distance from diagnostic and treatment facilities. Small, discrete and specialist wards such as oncology will require direct access to their own specialist diagnostic and treatment centre within the whole hospital or within the same floor.

Key features of a desirable environment

2.8 Studies (Malkin J, 1992 and Scher P, 1996) have shown that the following features are necessary to provide a desirable in-patient environment:

- Space for:
  - clinical activity at the bedside
  - clinical activity elsewhere
  - storage/display of patients' possessions
  - storage of bulky equipment
  - staff support and training
  - social support of patient
- Suitability of:
  - services and supplies at the bedside for clinical activity
  - access to and within area for physically and sensory impaired people
  - services to enable personal communication by patient
  - services to enable direct admin/clinical communication from the bedside

  - a reassuring, stress reducing, environment
  - a safe and hazard free facility
- Privacy:
  - during clerking and clinical discussions between patient and staff
  - during clinical treatment
  - for bodily functions and personal care
  - for personal discussions and telephone calls
  - for staff communications
  - for staff rest and beverage breaks
- Choice, control, comfort:
  - to be alone or in company, including visitors
  - of temperature, ventilation, lighting and sound
  - of diversion, outlook, entertainment
  - with access to beverages for patients and relatives
  - with local storage of personal belongings of staff
  - with access to the outside world.

Space requirements

2.9 The provision of sufficient space in clinical areas, particularly for each bed space, is one of the most important considerations in the planning and design of in-patient accommodation. Ergonomic studies have established that most activities carried out at the bedside can be accommodated within the dimensions 3600 mm (width) × 3700 mm (depth). This represents the clear bed space and does not include space for fixed storage, preparation and worktops. Space requirements are discussed more fully in Chapter 3.

Sanitary facilities

2.10 For infection control purposes, in-patients, clinical staff and visitors should be provided with separate sanitary facilities, which should be clearly labelled. Facilities for visitors and non-clinical staff should be located close to the ward reception and waiting area. Sanitary facilities for clinical staff may be provided in association with staff changing and rest room areas. Where staff changing and rest rooms are located away from the ward, a designated WC for clinical staff should be provided. Sanitary facilities for in-patients should be located en-suite to bed areas.

2.11 All single-bed rooms and multi-bed rooms should have en-suite sanitary facilities. The increasing acuity of illness of in-patients means that a great proportion of patients may require assistance during their hospital stay. For greatest flexibility of use, all sanitary facilities in in-patient areas should be accessible and manageable by people with physical or sensory disabilities with or without assistance.

2.12 As part of the revision of this Health Building Note the Department of Health commissioned research into the size and layout of en-suite shower rooms to identify a space-efficient design that would, as far as possible, meet the needs of the majority of patients. It was acknowledged during the research that some aspects of ambulant/semi-ambulant/independent wheelchair access and assisted use are not compatible. For example, the provision of a hand-rinse basin next to the WC for independent wheelchair users would have conflicted with access for patients requiring assistance. As the number of patients requiring assistance is likely to be greater than the number of independent wheelchair users in in-patient accommodation, the primary concern should be to provide space and facilities for people requiring assistance. Certain limitations on independent access are therefore considered acceptable within a healthcare setting.

2.13 The new layout for an en-suite shower room forms the basis for the guidance and example layouts in this Health Building Note. There should also be access to a fully assisted bathroom or shower room where shower trolleys may be used. This could be shared between wards and is listed as essential complementary accommodation in the schedules of accommodation. Alternative layouts for en-suite sanitary facilities are described in Health Building Note 00-02 – 'Sanitary spaces'.

2.14 The research project to develop the new en-suite shower room design is described on the Space for Health website at www.nhs.gov.uk/spaceforhealth.

Hand hygiene

2.15 Antibacterial hand-rub dispensers should be provided at the ward entrance.

2.16 Each single-bed room should contain a clinical wash-hand basin. The basin should be located to be highly visible to staff entering and leaving the room

and convenient for them to use. The use of sensor taps may be appropriate to reduce the risk of infection. Multi-bed rooms should contain two clinical wash-hand basins, one close to the entrance to the room and the other placed in a convenient position for staff working at the other end of the room. The multi-bed room layout in Appendix 1 indicates the possible location of clinical wash-hand basins.

2.17 For further guidance on clinical wash-hand basins refer to HTM 64 – 'Sanitary assemblies' and Health Building Note 00-03 – 'Clinical and clinical support spaces'.

Isolation facilities

2.18 Single-bed rooms provide an effective facility for isolating patients with a variety of infections, such as MRSA. However, in some circumstances it may be necessary to provide a higher level of isolation, particularly for those patients with airborne diseases or for immuno-suppressed patients who may be at risk of infection from others. In these cases, an isolation suite – which includes an entrance lobby, bedroom and en-suite sanitary facilities – will be required. This is listed as optional in the schedule of accommodation for this Health Building Note. The need for and number of isolation suites should be decided locally and in consultation with local Health Protection Agency staff.

2.19 Isolation suites are described in paragraph 3.29.

Cleaning services

2.20 Recent research ('An integrated approach to hospital cleaning', DH 2007) indicates that a microfibre system for day-to-day cleaning in combination with periodic steam cleaning is an effective approach to cleaning in-patient facilities. The guidance in this Health Building Note is based on this approach. If other cleaning systems are to be adopted, design teams should give careful consideration to the facilities required in each case.

2.21 In terms of facilities, a microfibre system requires:

- space for storing the microfibre cleaning trolley and clean microfibre cloths and mops (the cleaners' room, see paragraph 3.57);
- space for holding dirty microfibre cloths (the disposal hold, see paragraph 3.59);
- laundry facilities for washing and drying used microfibre cloths.

2.22 The laundering of microfibre cloths and mops requires special conditions and dedicated facilities. The laundry process should be carefully managed. Project teams should decide locally whether laundry facilities are provided in-house or contracted out. More information on the laundering of microfibre cloths is contained in the research and development report, available through the Space for Health website at www.nhs.gov.uk/spaceforhealth.

2.23 A supply of disposable cleaning materials should also be stored for clinical staff to use when cleaning staff are not available. These may be held separately in the dirty utility room.

2.24 This Health Building Note assumes that steam cleaning equipment for periodic deep cleaning will be stored centrally and brought to the ward as required. Storage space for this equipment on the ward is not required.

Decontamination of equipment

2.25 The effective decontamination of medical devices is essential in reducing the risks to patients from HCAI (see the Health Act 2006: Code of practice for the prevention and control of healthcare associated infections). Facilities for decontaminating medical devices should be provided centrally.

2.26 Reference should be made to advice and guidance in HTM 01-01 – 'Decontamination of reusable medical devices' (DH 2007). Further information can be obtained from the Medicines and Healthcare products Regulatory Agency (MHRA) – see www.mhra.gov.uk/Safetyinformation/Generalsafetyinformationandadvice/Technicalinformation/Decontaminationandinfectioncontrol/CON019632.

2.27 Reference should also be made to Health Building Note 13 – 'Sterile services department' and Health Facilities Note 30 – 'Infection control in the built environment'.

Ward size

2.28 The schedule of accommodation for this Health Building Note is based on a ward of 24 beds.

2.29 The 24-bed ward has been selected as an example only, chiefly because this size is common throughout NHS hospitals. It also supports the assumption that an eight-bed cohort is the preferred workforce planning unit, with one

clinician and one support worker caring for each cohort, although this may vary according to the dependency level of patients in a cohort. Wards may be larger or smaller than the 24-bed example. The number of beds in each ward should be determined locally.

Observation and communication

2.30 Clinical staff should be able to observe and communicate easily with patients. Some clinicians may feel that single-bed rooms make observation more difficult, whereas others find that engagement with patients improves in a single-room environment because they are able to complete a whole episode of care privately without being disturbed by others.

2.31 Careful design can support good observation. For example, glazed walls or very large windows between rooms and corridors will enable staff to observe patients and, equally importantly, patients to see staff. Views into busy internal spaces such as circulation areas can provide a distraction for patients and are just as important as views of the outside world. Patients should have the means to obscure windows if required. For example, integral Venetian blinds can be lowered and closed to provide privacy.

2.32 In addition to observation through windows, the use of electronic surveillance equipment such as cameras may be considered. However, in order to guard against the potential invasion of privacy, patients must be able to choose whether cameras in their bedroom are switched on or off. In particular, the dignity and safety of patients with mental health conditions and patients who may be in a state of confusion should be carefully considered.

2.33 Use of a two-way speech facility as part of the help call system can be reassuring for patients and can reduce journey times for staff.

2.34 Two-way speech facilities can be made significantly more effective by including an option to enable staff to key in and out of rooms (staff presence). Smart technology allows such systems to be automated so that each member of staff wears a radio frequency identification (RFID) tag that remotely indicates their presence. This function allows staff to locate, and communicate with, each other more effectively. These facilities are particularly relevant in wards with a high

Figure 1 An example of good observation into a single-bed room

percentage of single rooms. Call systems should operate on a "follow the light" principle whereby over-door lights and discrete indicator units mounted at strategic positions (staff rest rooms etc) guide staff to the call origin. In addition this can be supplemented by the use of Wi-Fi/IP technology, which can be interfaced with other site communication facilities (for example single staff handset, which combines phone, pager, cardiac and help call facilities).

Clinical administration

2.35 Advances in IT are enabling clinicians to move away from traditional paper-based patient records towards more flexible computer-based systems. Electronic patient records (EPR) and picture archiving and communication systems (PACS) mean that a significant amount of direct clinical administration can now take place at the bedside using a computer.

2.36 Wireless and infra-red technologies provide an alternative to networked computers in fixed locations. They enable EPRs to be accessed from laptops and other mobile and hand-held devices that can move with staff between clinical spaces. Where computers are fixed in bed areas, design teams should ensure that patients will not be disturbed by the light from VDUs or by staff entering data at night-time.

2.37 This Health Building Note describes two locations for clinical administration close to the patient:

- in bedrooms: a clinical support zone with space for recording clinical data. In multi-bed rooms, one clinical support zone serving all four beds is sufficient;
- touchdown base: a workstation located close to patients but not within single rooms or multi-bed rooms. This is where EPRs can be accessed and updated. The touchdown base is at standing height with a perching stool. There should be a number of touchdown bases throughout the ward, which may be located in a variety of ways:
  - a dedicated touchdown base immediately outside each bedroom; or
  - a touchdown base shared between a pair of bedrooms; or
  - a touchdown base serving a small cluster of bedrooms.

2.38 This Health Building Note assumes that there is no central staff base, as staff will be working locally throughout the ward unit. It is recognised, however, that this is only one design solution and

Figure 2 Working at a touchdown base

that planning teams may wish to include a central staff base. For guidance on staff communication bases, refer to Health Building Note 00-03 – 'Clinical and clinical support spaces'.

2.39 The greeting of patients and visitors, and general administration, will be carried out at the ward reception desk by clerical staff. Depending on the layout of wards, the reception desk could be shared between two or more wards.

2.40 Pre-admission and post-discharge correspondence, private telephone calls and patient handover meetings may take place in the office/meeting room.

2.41 See Chapter 3 for detailed descriptions of clinical administration spaces.

Moving and handling patients

2.42 Patient moving/handling tasks are associated with the greatest proportion of musculoskeletal disorders in the health services (HSE 2001). One way of avoiding such injury is to move patients by use of a hoist, which requires sufficient space around the bed for staff to perform these tasks.

2.43 If mobile hoists are to be used, design teams should ensure that there is sufficient space within the ward to store them. Other devices for transferring patients will also need to be stored.

2.44 If ceiling-mounted hoists are preferred, design teams will need to consider the potential conflict with medical service units and patient entertainment systems. Consideration should also be given to the "parking" of the hoist sling when not in use. Where ceiling-mounted hoists are installed, there will still be a need for some mobile hoists, for example for lifting patients who may have fallen beyond the reach of the ceiling track. Design teams will need to consider adequate storage space for these.

2.45 The use of ceiling-mounted hoists in isolation suites requires careful consideration. See paragraph 3.31.

2.46 In multi-bed rooms, the hoisting of patients around the bed space may compromise their privacy and dignity. The use of hoists should be restricted to bed-to-chair/trolley/wheelchair transfers only.

2.47 The decision on the extent of lifting equipment provided will depend on several factors including the patient profile, and should be decided locally.

2.48 For further guidance on the space required for moving and handling patients see 'Ward layouts with single rooms and space for flexibility'.

Separate treatment room

2.49 In a ward of 100% single-bed rooms the provision of a separate treatment room is optional, as procedures that cannot be undertaken at the patient's bedside will take place in the appropriate departments. Wards with a combination of single-bed rooms and multi-bed rooms will require a separate treatment room. For further guidance see paragraph 3.35.

Supplies, storage and disposal

2.50 Supplies, storage and disposal are whole-hospital issues. An increasing number of UK hospitals have adopted a "just-in-time" supplies system, which involves a large centralised store on each site where all non-specialised clinical supplies are kept for regular distribution on a "top-up" basis to the different departments when required. Local policy will influence how much storage space is needed within acute wards.

2.51 Two options for delivering and storing clean supplies and consumables are:

- **Option 1: Local clean utility room**

  Each ward contains a clean utility room, which is restocked regularly from the hospital's central stores and pharmacy. Clinical supplies for individual bedrooms are held on supplies trolleys, which are topped up in the clean utility room and then parked in the clinical support area of each bedroom. Medicines are stored and prepared in the clean utility room. See Figure 3.

- **Option 2: Shared clean supply room plus local medicine store/preparation room**

  Clinical supplies are stored in a clean supply room serving a number of wards. Clinical supplies trolleys are restocked here and then returned to patient bedrooms where they are parked in the clinical support area. Medicines are stored and prepared separately in the ward's medicine store/preparation room. See Figure 4.

2.52 The schedules of accommodation for this Health Building Note are based on Option 2, that is, the provision of a shared clean supply room (essential complementary accommodation) and a local medicine store/preparation room. The provision of

Figure 3 Central store and clean utility room

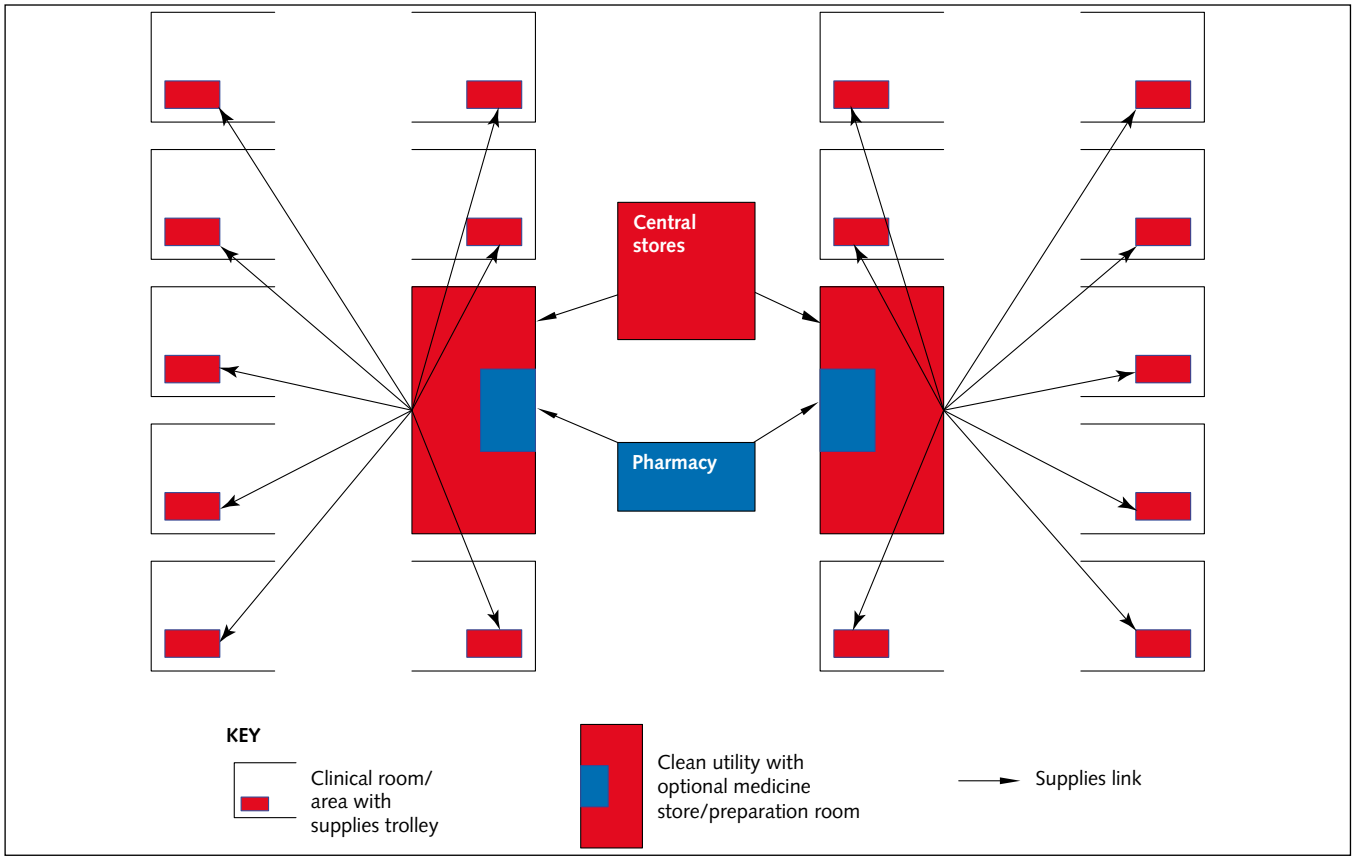
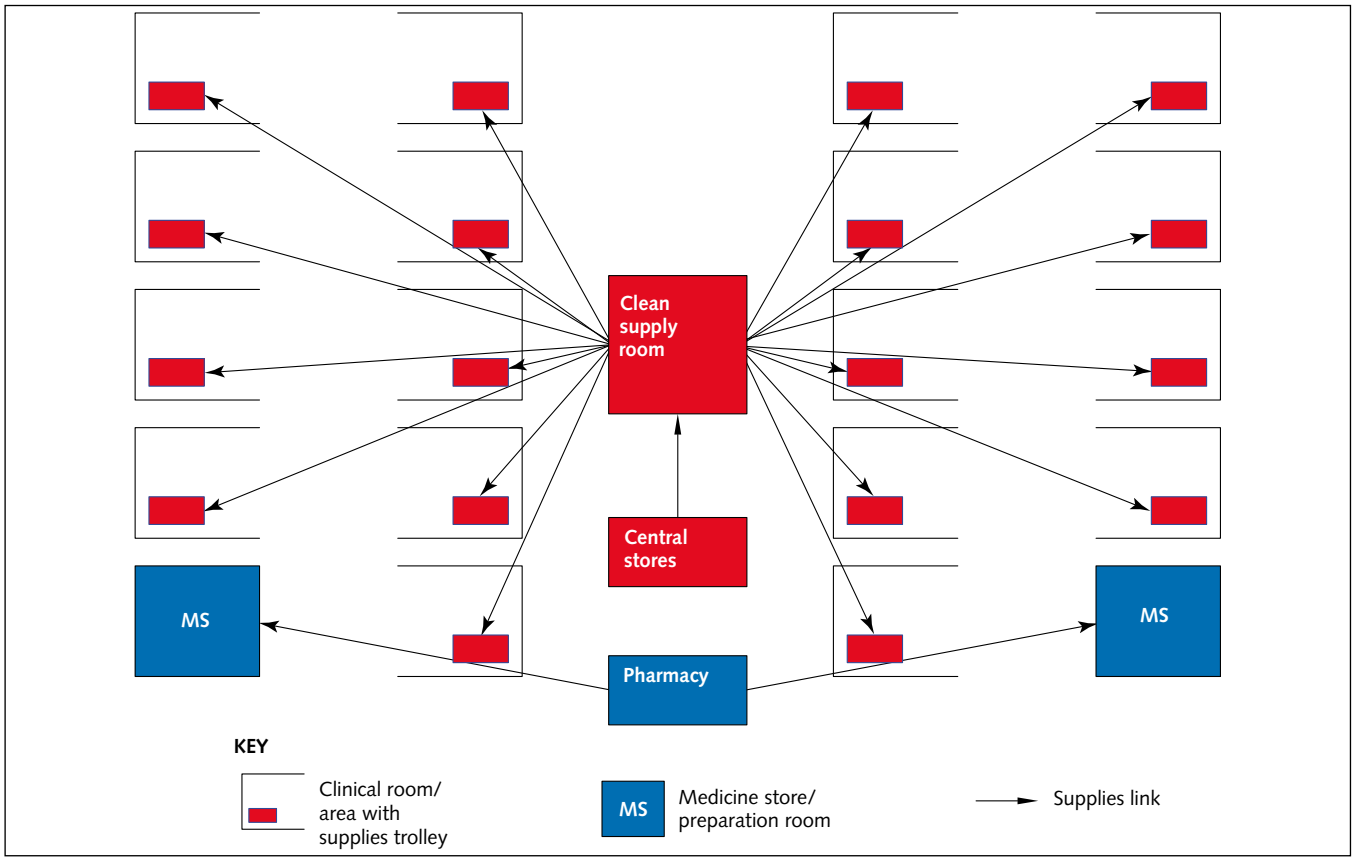


Figure 4 Clean supply room and medicine store/preparation room



a clean utility room instead of a clean supply room and medicine store/preparation room is optional.

2.53 Items for disposal will be placed in the disposal hold. Some items will be held temporarily in the dirty utility room before being transferred to the disposal room.

2.54 For further guidance refer to Health Technical Memorandum 71 – 'Materials management and modular storage'. Design teams should ensure that supplies policies and storage systems are agreed early in the design process, as they can have a significant impact on planning and room areas. See also paragraphs 3.49 and 3.54.

Dirty utility room

2.55 Ideally, a dirty utility room should serve no more than 15 beds. This reduces travel distances for staff, making better use of nursing time and reducing the risk of spillages and cross-contamination. A second dirty utility room on a ward is also helpful during outbreaks of illness or infectious diseases. The schedules of accommodation for this Health Building Note include two dirty utility rooms per 24-bed ward.

Education and training facilities

2.56 Education is important in acute wards, and appropriate facilities should be provided. Trainee clinical staff will form a proportion of staff working in acute areas. While some teaching takes place in the clinical area on a one-to-one basis or in small groups, the teaching of large groups can be an imposition on the function of the area. A seminar room, which may be shared with other wards, should be provided as essential complementary accommodation. See paragraph 3.80 for design requirements.

Lighting

2.57 Scientific evidence indicates that daylight has beneficial effects on patients (Rubin & Owens 1996), visitors and staff. It has been shown to reduce psychological problems and improve patient outcomes, and increase morale and reduce sickness levels amongst staff. An external view is also beneficial, even if limited. Windows with no significant view are preferable to no natural light at all.

2.58 All bed areas should receive natural daylight. Where artificial lighting is provided in spaces where patients are examined or treated, it should enable changes in skin tone and colour to be clearly defined and easily identified. The quality of lighting will need to be considered if video consultation is likely to take place. Lighting is also important for effective cleaning of corners and edges that can harbour dust. Adjustable task lighting should be provided at the bedhead for patients who wish to read.

2.59 Ceiling-mounted fixed luminaires should not be sited immediately above positions where people lie on a bed, couch or trolley to avoid glare. This applies to all spaces where people are consulted, examined and treated.

2.60 Refer to paragraph 4.54 for more detailed guidance.

Views from windows

2.61 Wherever possible, beds should be positioned to enable patients to have a view of the outside world, which might include landscaped gardens or a courtyard with good-quality natural planting. Sill heights of windows should be low enough to allow seated people to see outside. Views out over flat roofs and roof-top plantrooms should be avoided.

2.62 The means for patients to control curtains or blinds for privacy should be included (motorised curtains are an option for non-ambulant patients). For further guidance refer to Health Technical Memorandum 55 – 'Windows'.

Courtyards

2.63 Well-proportioned courtyards enable rooms to receive natural daylight and ventilation in addition to providing a stimulating outlook from bedrooms, day spaces and staff areas. Layout and planting can help to preserve privacy in surrounding rooms. Courtyards may also provide a suitable location for artwork.

2.64 It is desirable to provide access to courtyards wherever possible, and thresholds should be designed to facilitate access. Short lengths of handrail should be provided at strategic points around the courtyard for patients who need support. Seating should also be provided. Access for maintenance and cleaning should be sited so that patients and staff are not disturbed. Adequate water points, power points and lighting, if necessary, should be provided in all courtyards..

Courtyard, York Hospital (reproduced with the permission of the King's Fund Enhancing the Healing Environment Programme, and York Hospitals NHS Trust)

Art

2.65 There is sufficient evidence to demonstrate that appropriate art and decor reduces the physical and emotional stress of patients and staff. It can also be used to assist wayfinding. Art should be integrated into a scheme rather than added as an afterthought.

2.66 Art need not be limited to pictures on a wall. It may also include murals, prints, photographs, sculptures, decorative tiles, ceramics and textile hangings. Works of art by local artists and craftspeople may lend a special identity to the facility.

2.67 Artworks should be easy to clean and as dust-free as possible. Design teams should seek the advice of the infection control team.

2.68 For further guidance refer to 'The art of good health – A practical handbook' and 'The art of good health – Using visual arts in healthcare'.

Environmental control

2.69 As noise is such a significant issue for patients, design that separates busy activity areas and patient bed spaces and the use of sound-absorbing materials should be adopted. Partitions between areas for confidential discussions should also be sufficient to prevent overhearing.

Telephone, TV and radio facilities

2.70 It is beneficial for patients to have convenient access to telephone, TV and radio facilities. Planning teams should identify suitable systems to meet local requirements.

Finishes

2.71 The choice of finishes should form an integral part of the design process and be co-ordinated within the overall design scheme. The selection of colours and reflectances can have a significant impact on the lighting within the room and will need to be coordinated with the lighting design. Finishes

should be functional and compatible with the need for comfort, cleanliness and safety. Cleaning regimens should be considered when materials are selected. The advice of the infection control team should be sought throughout the project.

Floors

2.72 Flooring should be smooth, easily cleanable and wear-resistant. There should be coved skirtings, which allow easy cleaning and avoid microbial colonisation. The material used for skirtings should be integral with, and have properties similar to, the floor finish. In areas where frequent wet cleaning methods are employed, the flooring material should be unaffected by disinfectants.

2.73 Carpets should not be used in clinical areas. Short-pile carpets may be considered for use in offices and staff rest rooms, but not the reception area. Carpets are extremely difficult to keep clean and need to be meticulously maintained.

2.74 All flooring should be slip-resistant. Design teams might also consider the use of impact-absorbing floor finishes, which will reduce the severity of injury should a patient fall.

2.75 For further guidance on flooring refer to Health Technical Memorandum 61 – 'Flooring' and 'Safer surfaces to walk on – reducing the risk of slipping' (CIRIA 2006).

Walls

2.76 Wall finishes should be durable and able to withstand wet cleaning and the accidental impact of trolleys and mobile equipment. Especially vulnerable points should have additional protection. Smooth paint surfaces are the easiest for cleaning – eggshell or vinyl silk emulsion. A matte finish is not recommended.

2.77 Walls in kitchen, shower and toilet areas should be easily cleanable. The advice of the infection control team should be sought.

2.78 For guidance on handrails on walls in circulation areas, refer to Health Building Note 00-04 – 'Circulation and communication spaces'.

Ceilings

2.79 Adequate ceiling heights in clinical areas are crucial. The underside of a finished ceiling in bedded areas should be at least 2700 mm from the floor. There may be a difficulty in complying with ceiling heights throughout the hospital in the case of refurbishments, but within a new-build this difficulty should be overcome.

2.80 Care should be taken when calculating the correct position and weight-bearing factors for hoists and other lifting equipment, lighting, patient entertainment and data management systems.

2.81 The use of acoustic ceiling materials in corridors and public spaces such as waiting areas may be helpful in reducing noise levels.

2.82 The design team, infection control officer and facilities manager should work together to ensure that the choice of ceiling and the maintenance routines are satisfactory. Service access panels should be avoided in bedrooms wherever possible.

2.83 For further guidance refer to Health Technical Memorandum 60 – 'Ceilings'.

Doors and frames

2.84 Materials used for doors and frames should be able to withstand frequent impact from mobile equipment and should be easily cleanable. All double-swing doors should incorporate appropriate glass vision panels; however, privacy, safety and other considerations may require the panels on bedroom doors to be capable of being obscured, possibly with integral blinds.

2.85 Where necessary it should be possible to secure doors in the open position. In the case of fire doors, this should only be by means of an approved or recognised product linked to the fire alarm and detection system, which is designed to fail to safety. Magnetic door retainers should not restrict the movement of traffic.

2.86 Reference should be made to Health Technical Memorandum 55 – 'Internal doorsets', Health Building Note 00-04 – 'Circulation and communication spaces' and Health Technical Memorandum 05-01 – 'Managing healthcare fire safety'.

Windows

2.87 Guidance on types of window and on the safety aspects is available in Health Technical Memorandum 55 – 'Windows'.

2.88 In addition to the guidance and various statutory requirements, the following issues require consideration:

- daylight and natural ventilation;

- safety;
- attenuation against noise;
- user comfort;
- energy conservation;
- solar control;
- the prevention of glare; and
- the provision of a visual link with the outside world balanced with the need to obscure the views into some areas from the outside.

2.89 Windows in single-bed rooms should be openable but with safety restrictions. They should be double-glazed as a minimum to provide thermal and sound insulation.

2.90 It should be possible for cleaners to gain easy access to the inside and outside of windows.

Maintenance and cleaning

2.91 Materials and finishes should be selected to minimise maintenance and be compatible with their intended function. Building elements that require frequent redecoration or are difficult to service or clean should be avoided. Special design consideration should be given to entrances, corners, partitions, counters and other elements that may be subjected to heavy use. Wall coverings should be chosen with cleaning in mind.

Wayfinding

2.92 The use of colour and art to identify particular routes and rooms can help to reduce the number of signs required. Certain doors, for example fire exit doors, will require conventional labelling. Where signs are used they should not detract from the overall ambience, and should be simple yet sufficiently explicit to be understood without confusing.

2.93 Reference should be made to 'Wayfinding: Effective wayfinding and signing systems. Guidance for healthcare facilities'.

Security

2.94 There are a number of security issues to be considered in the planning and design of in-patient accommodation: natural and mechanical surveillance (CCTV), natural ventilation and the night-time cooling of spaces, lighting, wayfinding, access control, security of property and assets, security of drugs, and the protection of NHS staff against violence. The Local Security Management Specialist (LSMS) will be able to identify security risks and offer advice on measures that can be implemented to reduce them.

2.95 Where entryphone/intercom systems and CCTV are installed, they should be linked to the reception desk and appropriate touchdown bases to control access through the main entrance. The LSMS should be consulted on the installation of all access control systems.

Fire safety

2.96 It is important to establish during the design stage those aspects of fire safety strategy that affect the design, configuration and structure of in-patient accommodation. The design team should discuss and verify their proposals with the Trust Fire Officer and the Building Control Authority or Approved Inspector, and ensure that the design team and all other design staff are fully acquainted with the fire safety strategy for the design in terms of operation (staff responsibilities, equipment provision, and building and engineering layouts). For further guidance refer to Health Technical Memorandum 05-01 – 'Managing healthcare fire safety'.

Compliance with statutory and other requirements

2.97 This Health Building Note takes account, as far as possible, of all statutory and other requirements and guidance in force or available at the time of publication. The following is intended only as a brief summary of compliance requirements.

People with accessibility difficulties (Disability Discrimination Act 1995)

2.98 Authorities should comply with the provisions of the Disability Discrimination Act (1995) and the Building Regulations Approved Document M 'Access to and use of buildings' (ODPM 2003). See also BS 8300:2001 'Design of buildings and their approaches to meet the needs of disabled people – Code of Practice'. Design teams should also refer to Health Building Note 00-02 – 'Sanitary spaces', Health Building Note 00-03 – 'Clinical and clinical support spaces', and Health Building Note 00-04 – 'Circulation and communication spaces', as these set out the standards required specifically for healthcare

premises and are in some cases more demanding than other more general guidance. Reference should also be made to 'Wayfinding: Effective wayfinding and signing systems. Guidance for healthcare facilities'.

Manual Handling Operations Regulations 1992

2.99 Manual handling and health and safety regulations relate to lifting and turning patients and moving heavy equipment. Planning and design teams should take these into account when designing facilities. Refer also to paragraph 2.42.

The Construction (Design and Management) Regulations 2007

2.100 These regulations, and the related Approved Code of Practice, focus attention on health and safety planning and management throughout construction projects, from design concept onwards. Designers have a duty to eliminate hazards and reduce risks. Planning teams have a duty to provide project-specific health and safety information needed to identify hazards and risks.

Safety regulations

2.101 For health and safety regulations see Health Technical Memorandum 00 – 'Policies and principles'.

Environmental Protection Act 1990

2.102 See Health Technical Memorandum 07 – 'Environment and sustainability'.

3 Specific functional and design requirements

Functional relationships

3.1 A 24-bed ward may function as a stand-alone unit within which beds are grouped into two or more clusters. Alternatively, depending on the layout of in-patient floors, some bed clusters may be configured to be shared between wards to provide flexibility. See Figure 5.

3.2 Each bed cluster will be serviced by staff and support facilities, therefore access to supplies and means of disposal should ideally be local to each cluster. It is recommended that rooms be serviced by trolley, like hotels, so that staff do not need to walk far from their bed cluster unless they require access to a shared facility, for example the medicine store/preparation room. The preferred option will be to stock each room for linen, clinical consumables and disposable items, and rely on "just-in-time" and "top-up" supplies.

3.3 The reception desk will be at the entrance to a ward, together with a waiting area and facilities for visitors. The entrance to accommodation is usually controlled by staff via intercom.

3.4 Regeneration kitchens should not be situated centrally within a ward, although the food trolley bay will need to be located between the clusters.

3.5 Ward layouts will depend on local conditions and overall bed numbers.

Description of room spaces

BED AND SANITARY FACILITIES

Bed spaces

3.6 The number of activities taking place at the bedside is increasing. The period that a patient spends in hospital is shortening, and is limited to active interventions for diagnosis, treatment and immediate recovery. The level of acuity and dependence of patients once interventions begin until discharge is relatively high; movement by staff around the patient may be considerable, and there is likely to be an increasing but intermittent use of equipment and aids at the bedside. The activities and the patient's response to interventions are recorded, increasingly on computer-held databases. Relatives and visitors are encouraged to be more involved in patient care and support.

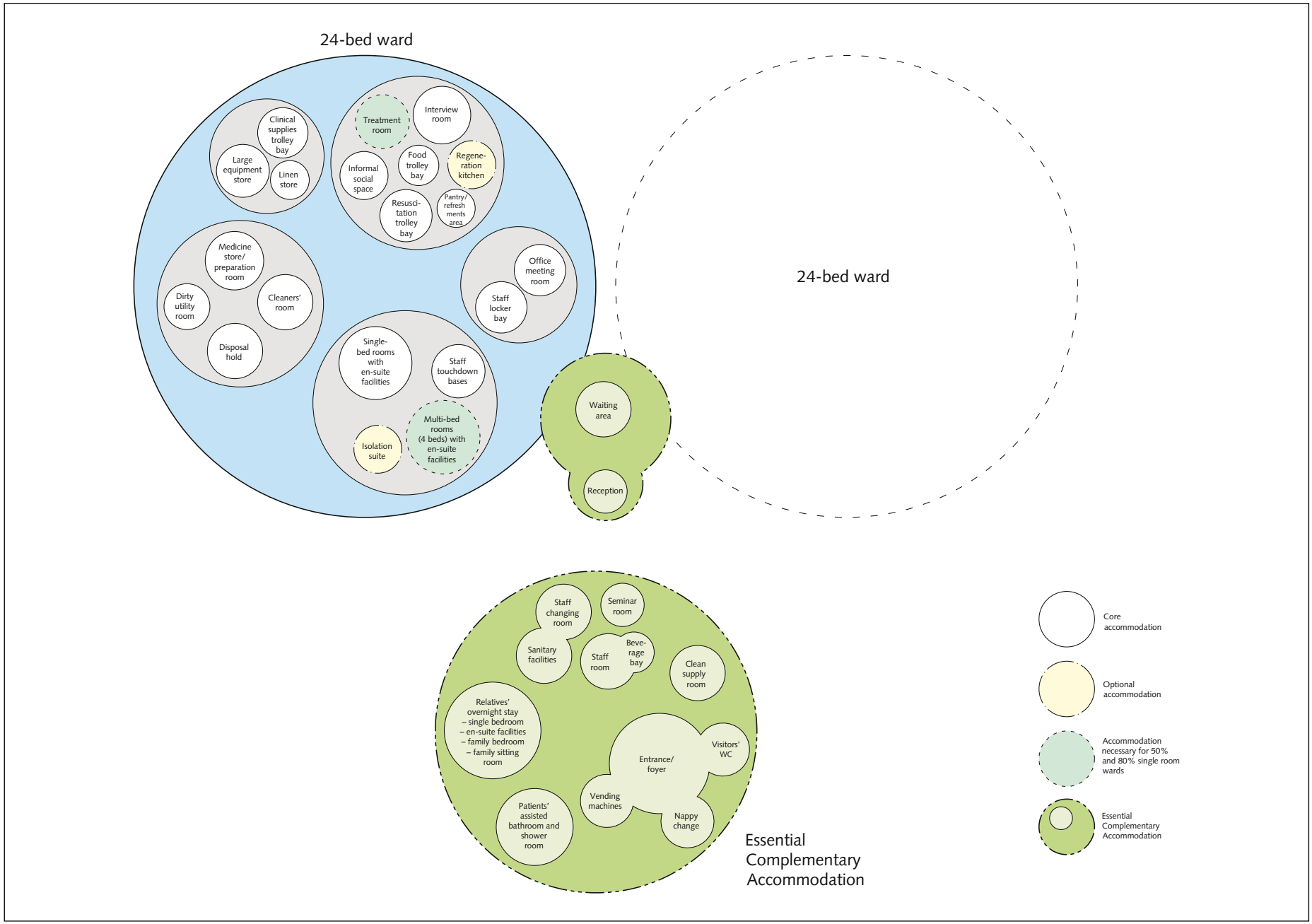
3.7 There are three distinct categories of direct activity that take place:

- clinical treatment and care:
  - admission, with the intimate discussion of personal matters;
  - specific medical and nursing interventions and observation;
  - rehabilitation;
  - informing, discussing, listening and advising both patients and relatives;
- personal care and maintenance:
  - sleeping and resting;
  - eating, drinking, washing and toileting;
  - entertainment/diversion, reading, watching the television;
  - receiving visitors;
- support activities:
  - preparation of clinical procedures;
  - maintaining records;
  - holding stores;
  - communicating;
  - developing staff skills.

3.8 The example layout for a single-bed room in Appendix 1 shows the zones to enable these activities to take place around a bed space.

3.9 The bed space should allow procedures to be carried out from either side of the bed with adequate circulation space so that medical emergency teams and equipment can gain access to

Figure 5 Functional relationships



the patient. There should be adequate space for moveable furniture and unobstructed access for wheelchairs, as well as space to accommodate overnight visitors.

3.10 The alternative to a single-bed room is a multi-bed room, in which the different activity zones move to a greater or lesser degree further away from the bedside, and may be shared to support all the beds in the multi-bed room. The preferred maximum number of beds in a multi-bed room is four. This enables the potential for better gender separation and improved privacy within a 24-bed ward comprising six four-bed rooms. It also gives each patient a corner as a "home base" and a neighbour on one side only.

3.11 All single- and multi-bed rooms should be provided with en-suite sanitary facilities and, whether in a single- or a multi-bed room, all bed spaces should be provided with:

- furniture:
  - a variable-height bed;
  - a bedside locker, with a lockable compartment for storing medication;
  - an overbed table;
  - an easy chair;
  - a bedhead luminaire;
- a co-ordinated bedhead services arrangement incorporating:
  - electrical socket-outlets;
  - luminaire control switch;
  - oxygen, medical air and vacuum outlets (refer to Health Technical Memorandum 02-01 – 'Medical gas pipeline systems');
- a patient services system (which may be incorporated into the bedhead services panel) including:
  - help call button, including two-way speech facilities (consideration might also be given to alternative call systems, such as blow devices, for patients who cannot use their hands);
  - reassurance light;
  - luminaire switch;

Kidderminster Treatment Centre (Photographer: David Whyte, Copyright: MAAP Architects Ltd)

- patient entertainment facilities including:
  - radio;
  - TV;
  - telephone;
  - headset outlet.
- Additionally, in single rooms:
  - space for storing clothes and shoes;
  - space for a relative's overnight stay bed;
  - a small refrigerator for a patient's personal use (optional).
- Facilities for staff:
  - space for clinical administration, including data outlet;
  - a clinical wash-hand basin, plus antibacterial hand-rub dispensers;
  - storage for a day's supply of linen and surgical goods/supplies.

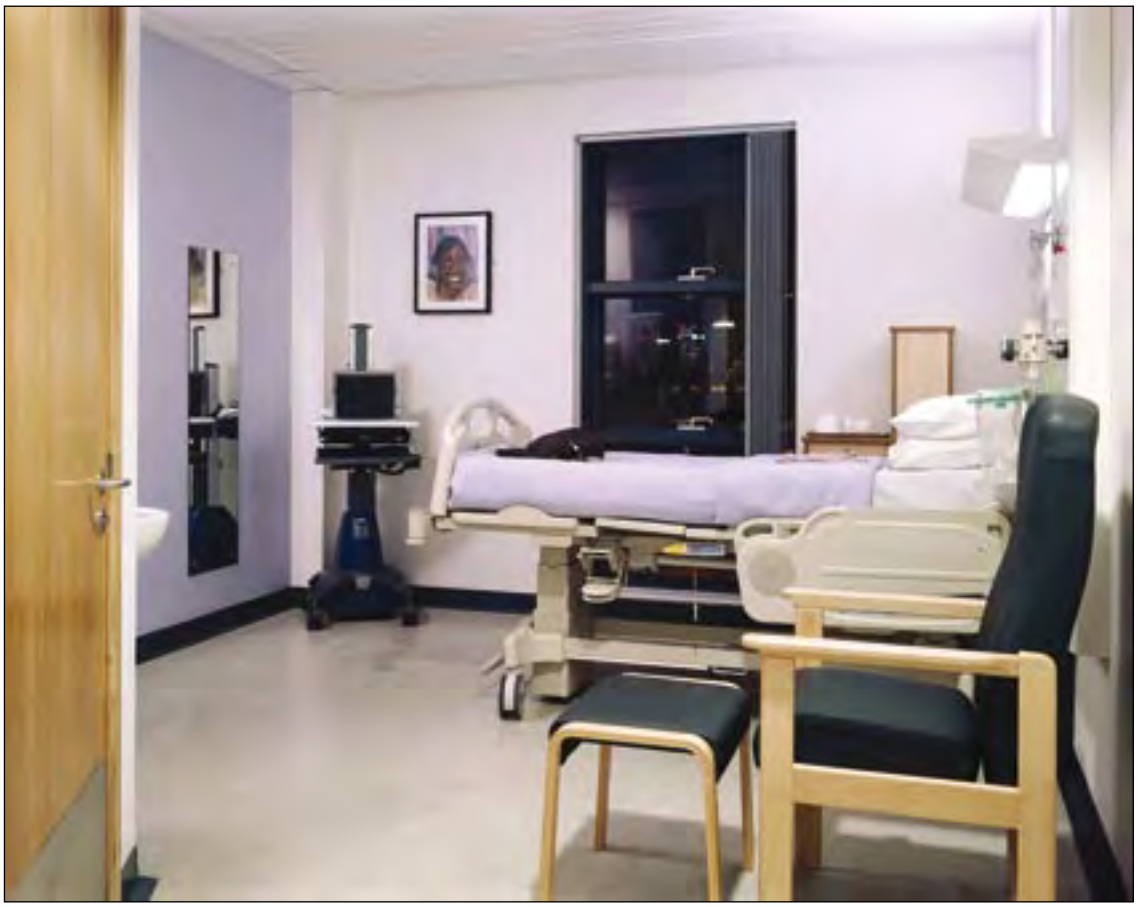
These provisions are necessary as the basis of a desirable environment.

3.12 In multi-bed rooms each bed space should be separated to provide a degree of privacy. If curtains are used they should be shadow-proof and flame-retardant. When full-height curtains are drawn, the bed space should still be well illuminated and ventilated. Curtains may be disposable. Highly-patterned curtains should be avoided, as they can cause visual disturbances in patients who are confused or heavily sedated.

3.13 Each four-bed room should include two clinical wash-hand basins for staff use. These should be located to be highly visible and convenient for staff to use, both on entering and leaving the room and when moving from one patient to another. A clinical support zone with space for a computer and storage for a day's supply of linen and clinical goods is required for each multi-bed bay. A single workstation will suffice for a group of beds.

3.14 Design teams should decide in consultation with the local fire authority whether multi-bed rooms should or should not be fitted with doors for fire safety reasons, for example to limit the spread of smoke. The infection control team should also be consulted on the use of doors in multi-bed rooms.

Brent Emergency Care and Diagnostic Centre, North West London Hospitals NHS Trust (Photographer: Lisa Payne)



Newham Gateway Surgical Centre, Newham University Hospitals NHS Trust

Design for four-bed room. MAS Project, Sherwood Forest Hospitals NHS Foundation Trust
(Swanke Hayden Connell Architects on behalf of Skanska Central Nottinghamshire Joint Venture)

3.15 Each multi-bed room should have easy access to informal social space, as the majority of patients, although highly dependent, are encouraged out of bed.

3.16 Example layouts of single and multi-bed rooms are contained in Appendix 1.

Sanitary facilities

Single room en-suite shower room

3.17 Each single-bed room should have an en-suite WC, shower and wash basin.

3.18 For detailed guidance on this en-suite and alternative designs for sanitary facilities, refer to Health Building Note 00-02 – 'Sanitary spaces'.

Multi-bed room sanitary facilities

3.19 A multi-bed room should have en-suite sanitary facilities, which can be accessed by patients without the need for them to travel or cross circulation routes. It is convenient to provide an assisted shower room (with WC, shower and wash-hand basin) and a separate ambulant WC (with hand-rinse basin), both en-suite to the bed area. Thus one person showering does not prevent others from using the WC. However, privacy and dignity should be ensured by the provision of appropriate security devices, locks etc. En-suite doors should not open directly onto immediate bed areas.

3.20 Appendix 1 provides an example layout for multi-bed room sanitary facilities. For detailed guidance on sanitary facilities for multi-bed rooms, refer to Health Building Note 00-02 – 'Sanitary spaces'.

General

3.21 Design teams should consider motion sensors for lighting in sanitary facilities. This may help to avoid the problem of fragile patients using sanitary facilities in the dark. An electronic sensor for the WC flush is also a project option.

3.22 The wet shower area of the compartment should be separated by a curtain from the remainder, which should serve as the drying area. There should not be a step between the wet and dry areas, but there is a requirement for sufficient slope of the floor to the outlet, so as to assure proper drainage and prevent spillage of water into the dry areas. The floor surface should be slip-resistant. The gradient of the floor of the wet area should ensure effective drainage to the waste outlet to prevent ponding.

3.23 The cord of the help call system should be easily identifiable, accessible from the wet area, and should descend far enough to be within the reach of a patient who has fallen or collapsed.

3.24 Ventilation should preclude excessive heat, humidity and odours.

3.25 For more detailed guidance on sanitary facilities, refer to Health Building Note 00-02 – 'Sanitary spaces'.

Assisted bathroom or shower room (Essential complementary accommodation)

3.26 In addition to en-suite facilities, an assisted bathroom or shower room is required, although this may be shared with other wards.

3.27 Patients using an assisted bathroom or shower room may arrive in a wheelchair or on a shower trolley. Staff assist the patient in bathing/showering and associated activities, and may also give treatments. In bathrooms a variable-height peninsular bath is essential. In both bathrooms and shower rooms there should be sufficient space to accommodate three staff, and to permit the manoeuvring of support equipment such as a hoist. The room should also contain a WC and wash basin.

3.28 For more detailed guidance refer to Health Building Note 00-02 – 'Sanitary spaces'.

Isolation suite (Optional accommodation)

3.29 An isolation suite comprises a single-bed room, en-suite shower room and a ventilated lobby.

3.30 For detailed guidance on isolation suites and example layouts see Health Building Note 4 Supplement 1 – 'Isolation facilities in acute settings'.

3.31 If it is proposed to install a ceiling hoist track system between an isolation room and en-suite shower room, the design should not compromise the airflow pattern between the two rooms. The design of the isolation suite works on the principle of supplying air from the lobby at high level to the bedroom and removing it at low level via a transfer grille in the en-suite door. This ensures good mixing of the air in the bedroom, with a consequent dilution of possible contaminants. The wall area above the outward-opening door that is penetrated by the track and suspension system should not therefore allow unrestricted airflow between the bedroom and en-suite at high level.

Suitably profiled filler boards and the use of brush seals will ensure an adequate resistance to flow and prevent short-circuiting.

Touchdown bases

3.32 In addition to workstations in bedrooms, space is required close to patients, but not within bedrooms, for clinical administration. The touchdown base provides a place for accessing and updating EPRs and other computer work.

3.33 For detailed guidance on touchdown bases see Health Building Note 00-03 – 'Clinical and clinical support spaces'.

PATIENT SUPPORT FACILITIES

3.34 A variety of support facilities are required for patients. For example, where multi-bed rooms are used there should also be separate rooms for treatment and for one-to-one discussions, interviews or education.

Treatment room

3.35 In wards with multi-bed bays, a treatment room will be required where clinical procedures can be carried out in private. In wards with 100% single rooms, the provision of a treatment room is optional.

3.36 Patients using the treatment room may be ambulant, in a wheelchair, on a trolley or on a bed; the door width should be sufficient to permit their passage.

3.37 Refer to Health Building Note 00-03 – 'Clinical and clinical support spaces' for detailed guidance.

Interview room

3.38 Discussions with patients and relatives may be carried out in an interview room. The room may also be used by staff for staff interviews, appraisal and counselling. Good acoustic privacy is required; refer to Health Technical Memorandum 08-01 – 'Acoustics'. Visual privacy should also be ensured through the use of blinds or curtains at the windows. Glazed panels in doors should be capable of being obscured, preferably with integrated blinds.

3.39 The designer should aim to create an environment that is cheerful, comfortable and warm. Appropriate lighting and decorative textures such as pictures and plants can help to provide a pleasant atmosphere. Finishes and furniture will have an important influence on the room. Easy chairs and coffee tables should be provided. It is important that rooms in which patients will be sitting are free from draughts.

3.40 Refer to Health Building Note 00-03 – 'Clinical and clinical support spaces' for detailed guidance.

Informal social space

3.41 For patients – whether in single-bed rooms or multi-bed bays – open yet intimate areas recognisably intended for casual meeting and talking may be all that is required to enable patients who wish to socialise without the provision of dedicated day rooms. Planning decisions should take account of patient culture and preferences in terms of privacy, modesty and same-sex accommodation. Where day rooms are provided they should be as inviting as possible, with hotel-style or domestic furnishing. It should be possible for patients to control environmental features such as lighting.

Pantry/refreshments area

3.42 The pantry/refreshments area should be equipped with facilities for:

a. the preparation of beverages and light snacks;

b. the filling of patients' water jugs;

c. storage of dry goods, and a limited amount of crockery and cutlery;

d. refrigeration of perishable food.

3.43 An industrial-grade mechanical dishwasher is required in order to meet the rinse cycle temperatures required for infection control purposes. Separate facilities for washing-up and wash-handing are required. Crockery and cutlery used for main meals is returned to the central washing-up service. There should be adequate storage for jugs.

3.44 For further guidance refer to Health Building Note 00-03 – 'Clinical and clinical support spaces'.

Regeneration kitchen (Optional accommodation)

3.45 A regeneration kitchen will be required where the local catering policy requires food to be delivered to a department for regeneration and then distributed to a number of wards. The design of the regeneration kitchen should be determined by the catering contractor.

Parking bay: food trolley

3.46 A bay is required for parking the food trolley while meals are distributed to patients.

Resuscitation trolley bay

3.47 Emergency equipment – such as the resuscitation trolley, which includes a defibrillator, medical gas cylinder and portable suction machine – should be parked in a bay where it is accessible from the bedrooms, but should not obstruct circulation areas.

STORAGE SPACES

3.48 Store rooms are a costly means of providing storage, as they require internal circulation space. Storage in relatively shallow cupboards or doored alcoves opening directly from circulation areas may be more convenient and cheaper. The latter is particularly useful for goods for which stocks are maintained by an exchange trolley service. Cupboards in corridors may need to be recessed so that the doors, when open, do not obstruct movement in the corridor.

Clean supply room (Essential complementary accommodation)

3.49 This room provides storage for sterile supplies and consumables for a number of wards. Supplies trolleys are brought here for restocking. For detailed guidance on the clean supply room see Health Building Note 00-03 – 'Clinical and clinical support spaces'.

Clinical supplies trolley

3.50 Clean and sterile goods for daily use will be held on trolleys, at the point of use in bedrooms.

Large equipment store

3.51 This store is required for bulky items of equipment, bed accessories and therapy aids. Open shelving, hanging rails and hooks as well as free-standing space for heavy equipment such as hoists and weighing machines is required. Sockets may be useful for equipment that needs charging. Disposable items delivered in bulk packages to the clinical area will require storage.

3.52 Design teams may decide that more than one large equipment store is required. A number of local stores adjacent to single-bed rooms or multi-bed rooms might be more efficient.

Linen store

3.53 For infection control purposes, clean linen should be kept in a closed store rather than on open trolleys. Local policy will determine whether linen is stored in single-bed rooms or in a central store.

UTILITIES

Medicine store/preparation room

Large equipment store

3.54 The medicine store/preparation room is required for the storage and preparation of all the medicines to be used on the ward. This will include controlled drugs, medicines requiring refrigeration, and consumables such as syringes and needles. Rechargeable syringe drivers and infusers may be stored here. For detailed guidance refer to Health Building Note 00-03 – 'Clinical and clinical support spaces'.

bedpans etc. Such equipment may generate significant noise levels, and care should be taken to eliminate this. Colour-coded disposal bags for the bagging of waste materials should be kept here.

3.56 For detailed guidance refer to Health Building Note 00-03 – 'Clinical and clinical support spaces'.

Cleaners' room

3.57 The cleaners' room is the base from which domestic service staff provide the immediate day-to-day cleaning service.

3.58 For detailed guidance refer to Health Building Note 00-03 – 'Clinical and clinical support spaces'.

Disposal hold

3.59 The disposal hold is the temporary storage point for all items of supplies and equipment which have to be removed for cleaning, reprocessing or destruction, for example clinical and non-clinical waste and sterile services department items.

3.60 The waste disposal of used items should be consistent with the current hospital policy for the disposal of clinical waste.

3.61 For detailed guidance refer to Health Building Note 00-03 – 'Clinical and clinical support spaces'.

Switchgear cupboard

3.62 A departmental switchcupboard housing the main isolators and distribution switchgear should be:

a. accessible directly from the circulation area (access space may be part of the circulation area);

b. sited away from water services;

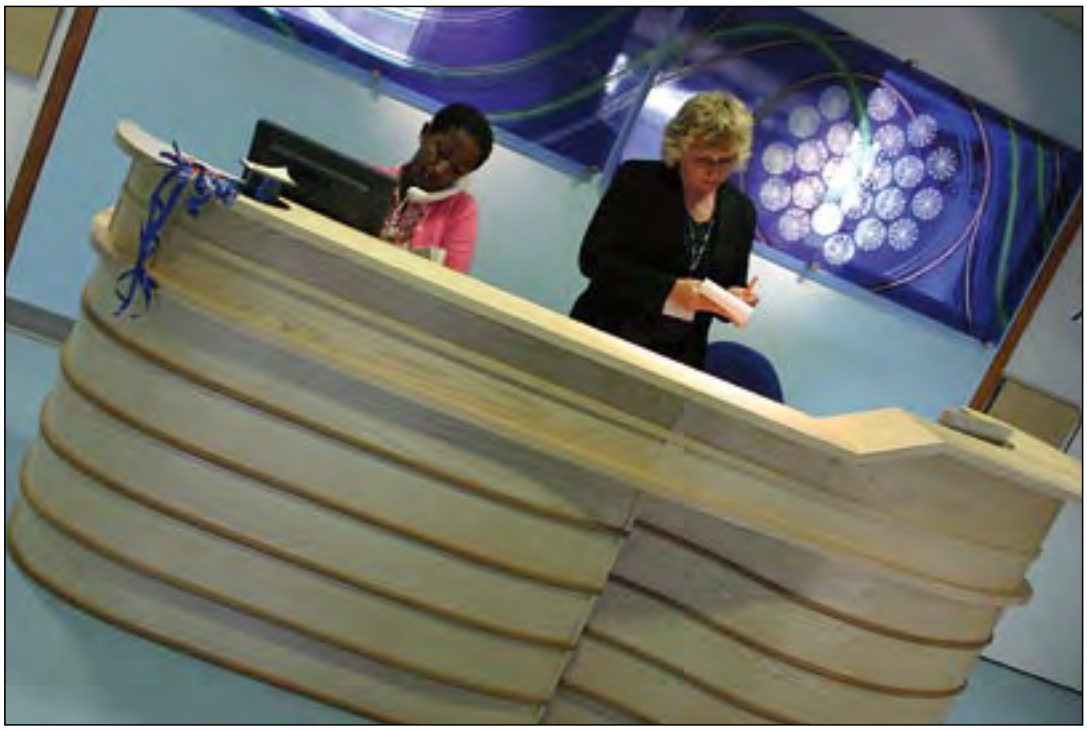
c. lockable.

3.63 Where possible, the cupboard should be sited within the department. There should be clear and safe access for maintenance staff, and care should be taken to ensure that safety is not compromised, during maintenance, from passing traffic or the opening of adjacent doors.

ADMINISTRATION AREAS AND STAFF FACILITIES

Reception and waiting area (Essential complementary accommodation)

3.64 The reception desk should be in a prominent position at the entrance to the ward. The counter needs to be stepped so that a person in a wheelchair can see and speak easily to the receptionist. The desk requires sufficient working space for a receptionist and one other who will welcome patients, relatives and staff, and undertake the local clerical and administrative duties. The reception



Reception desk at East Somerset NHS Trust (Reproduced with the permission of the King's Fund Enhancing the Healing Environment Programme, and East Somerset NHS Trust)

desk and waiting area may be shared between wards.

3.65 The reception desk will be linked by computer to all areas. Space is required for a computer terminal and associated equipment, including a printer. The reception desk should be designed to allow natural surveillance of all entrances and waiting areas and, where possible, corridors leading to treatment rooms. CCTV should be installed in all reception and waiting areas.

3.66 A seated area should be provided near the reception desk for patients, relatives and visitors waiting to be received. Access to visitors' WCs, nappy change facilities and vending machines is required. The waiting area may also serve as additional informal day space for patients.

Office/meeting room

3.67 This office is a multi-purpose office, but is likely to be used principally by clinical staff to complete notes on discharged patients, hold patient handover meetings, undertake telephone calls and for staff discussions.

3.68 It should be located close to bed areas and sized to accommodate two computer workstations, a table and eight to ten people. A cupboard or shelves for storing a limited amount of stationery should be provided.

3.69 There is no separate medical staff or ward manager's office.

Staff locker bay

3.70 Staff will require local lockers to hold small personal belongings while on duty. It may be convenient to locate lockers within or adjacent to the staff room/beverage bay where provided.

3.71 In wards that contain the staff changing facilities, staff will have easy access to the lockers in the changing rooms and a separate locker bay will not be necessary.

Staff WC

3.72 A WC is required for clinical staff working on the ward. In wards that contain the staff changing facilities, staff will have easy access to sanitary facilities and a separate WC will not be necessary.

Staff changing room (Essential complementary accommodation)

3.73 Facilities are required for staff changing, clothes storage, showers and sanitary facilities. These facilities may be shared between several wards. Estimates of the amount of changing space and locker provision should take into account the numbers of full-time and part-time staff, including trainees and students.

3.74 Separate changing rooms for males and females are needed, each with their own shower rooms, WCs, shaving point, power points for hair dryers and a large, well-illuminated mirror with a shelf. The sanitary and shower facilities should be self-contained, full-height rooms to provide maximum privacy. The provision of cubicle partitions is not an acceptable alternative.

3.75 Access control should be fitted to all staff changing and sanitary facilities.

3.76 Refer to Health Building Note 00-03 – 'Clinical and clinical support spaces'.

Staff rest room (Essential complementary accommodation)

3.77 Rest room facilities are required where staff can relax and take beverages. These may be shared between several wards. Rest rooms should have windows and a pleasant outlook and be comfortably furnished.

3.78 The rest room should include a beverage bay with facilities for preparing beverages for staff, for washing and storing crockery and cutlery, for storing a limited quantity of dry goods, and for the refrigerated storage of milk etc.

3.79 Refer to Health Building Note 00-03 – 'Clinical and clinical support spaces'.

Seminar room (Essential complementary accommodation)

3.80 It is assumed that a designated education centre with conference facilities for multi-disciplinary use will be available on site.

4 General engineering principles

Introduction

4.1 This chapter provides general guidance on the engineering, technical and environmental aspects of healthcare building design. Specific guidance in relation to in-patient facilities for adults is shown in **bold**.

4.2 Consultation should take place at project and design team level to ensure understanding of key issues, healthcare delivery and the appropriate standards for healthcare engineering services.

4.3 Designers should ensure that they read this publication as a whole, since further engineering guidance may be outlined in and cross-referenced within other sections.

4.4 The Health Technical Memorandum series is supported by an overarching publication, 'Policies and Principles – Best Practice Guidance for Healthcare Engineering' (Health Technical Memorandum 00), which covers the following issues:

a. overview of engineering services guidance;

b. statutory and legislative requirements;

c. professional support;

d. operational policy;

e. training and workforce development;

f. emergency procedures and contingency planning;

g. training, information and communications;

h. maintenance;

j. engineering services.

4.5 Guidance on specific types of engineering services can be found within the Health Technical Memorandum '0' series of documents as follows:

a. Decontamination (Health Technical Memorandum 01);

b. Medical gases (Health Technical Memorandum 02);

c. Ventilation systems (Health Technical Memorandum 03;

d. Water systems (Health Technical Memorandum 04;

e. Fire safety (Health Technical Memorandum 05);

f. Electrical services (Health Technical Memorandum 06);

g. Environment and sustainability (Health Technical Memorandum 07);

h Specialist services (Health Technical Memorandum 08);

j. other existing HTM 2000 series guidance documents.

Space requirements for services and plant

4.6 A high level of availability of engineering plant and services is critical to the ability of the facility to function safely and efficiently. It is therefore essential that the building design should incorporate adequate space for the full range of building services and the requirements for installation and maintenance of plant, ductwork, pipework and cabling.

4.7 Space for plant and services should provide:

a. easy and safe means of access;

b. secure accommodation protected from unauthorised access;

c. adequate space around the plant services to permit inspection maintenance and replacement.

4.8 Guidance on spatial requirements for engineering plant and services is contained in Health Technical Memorandum 00 – 'Policies and principles – best practice guidance for healthcare engineering'. Further useful information regarding the provision

of space for plant is contained in BSRIA Technical Note TN 9/92, and for building services distribution systems in BSRIA Technical Note TN 10/92.

4.9 With the exception of drainage and some heating pipework, engineering services should not be brought from the above-ceiling space of a floor below. Service distribution to a particular area should be contained within service spaces on that floor.

4.10 Plantrooms, particularly for air-conditioning and ventilation, should be located as close as possible to the areas they serve, thus minimising the amount of space necessary to accommodate large ducts.

4.11 Care should be taken to ensure that noise and structure-borne vibration cannot be transmitted beyond the plantroom. Further guidance on acoustics and vibration can be found in Health Technical Memorandum 08-01 – 'Acoustics'.

Decontamination

4.12 Decontamination is the combination of processes (including cleaning, disinfection and sterilization) used to render a re-usable item safe for further use on patients and handling by staff. The effective decontamination of re-usable surgical instruments is essential in minimising the risk of transmission of infectious agents. Further guidance is set out in Health Technical Memorandum 01-01 – 'Decontamination of reusable medical devices' (Parts A and B plus guidance for specific facilities).

Mechanical services

Piped medical gases

4.13 Piped medical gases should be designed in accordance with the requirements of Health Technical Memorandum 02-01 – 'Medical gas pipeline systems'.

Heating

4.14 General space heating requirements may be met by a variety of systems including radiators and radiant panels, or within the air-conditioning system. Designers should ensure that the most appropriate method is employed with regard to the healthcare environment being provided.

4.15 Where heat emitters are used, the surface temperature should not exceed 43ºC. Exposed heating pipework, accessible to touch, should be encased and/or insulated. Further information is given in Health Guidance Note '"Safe" hot water and surface temperatures'. Particular care should be taken when providing systems within mental health facilities.

4.16 Care should be taken to ensure that heat emitters do not adversely affect the local temperature conditions of adjacent storage and preparation areas.

4.17 Where used, radiators should be located under windows or against exposed walls. There should be space between the top of the radiator and the windowsill to prevent curtains reducing the output. There should be adequate space underneath to allow cleaning equipment to be used.

4.18 Where appropriate, heating controls should be provided to modulate heating circuit flow temperatures in accordance with external temperature. Radiators or radiant panels may also be used to offset building fabric heat losses in mechanically ventilated spaces. The system should be designed to ensure that the heating and ventilation systems operate in a coordinated manner and do not cause the space to overheat. Heat emitters in single-bed rooms should be provided with controls so that patients can adjust the room temperature.

4.19 Ceiling-mounted heating panels can operate at higher surface temperatures than 43ºC as long as the surface is not easily accessible. Heating panels should preferably run around the perimeter of the building. Panels should not be located over beds, patient trolley positions, or in other locations where they might radiate directly onto a patient or member of staff for a prolonged period.

4.20 Ceiling panels should be selected to aesthetically match the adjacent ceiling, and should be sealed to the adjacent ceiling by means of a gasket of similar.

Ventilation

4.21 For areas where it is absolutely necessary to install mechanical ventilation, ventilation systems should be designed in accordance with the requirements of Health Technical Memorandum 03-01 – 'Specialised ventilation for healthcare premises'.

4.22 Air movement induced by mechanical ventilation should be from clean to dirty areas, where these areas can be defined. The design should allow for adequate flow of air into any spaces having only mechanical extract ventilation, via transfer grilles in

doors or walls. However, such arrangements should avoid the introduction of untempered air and should not prejudice fire safety or privacy.

4.23 Local exhaust ventilation (LEV) will be required where exposure (by inhalation) to substances hazardous to health cannot be controlled by other means. The Health and Safety Executive publishes guidance notes, updated annually, on occupational exposure limits (Guidance Note EH40 – 'Occupational Exposure Limits') for the control of exposure by inhalation of substances hazardous to health. The limits specified form part of the requirements of compliance with the Control of Substances Hazardous to Health Regulations 2002 (COSHH).

4.24 Further guidance on the design of LEV systems may be found in Health Technical Memorandum 03-01.

Hot and cold water systems

4.25 Hot and cold water storage and distribution systems should be designed in accordance with the requirements of Health Technical Memorandum 04-01 – 'The control of *Legionella*, hygiene, "safe" hot water, cold water and drinking water systems'.

4.26 Exposed hot-water pipework, accessible to touch, should be encased or insulated. Special care should be taken when facilities are being provided for older, confused or mental health patients.

Building management systems

4.27 All engineering plant and equipment associated with the internal environment should, where possible, be controlled, monitored and regulated by a building management system (BMS) in accordance with the provisions of Health Technical Memorandum 2005 – 'Building management systems'.

4.28 Requirements for the monitoring and control of plant and systems are also covered in the Health Technical Memorandum that relates to the particular plant or system.

Internal drainage

4.29 A system of soil and waste drainage including anti-siphon and ventilation pipework should be provided in accordance with BS EN 12056.

4.30 Where plastic pipework materials are used, suitable intumescent collars should be fitted when breaching fire compartments, and acoustic wrapping should be applied where drainage runs above wards and other sensitive areas.

4.31 The gradient of branch drains should be uniform and adequate to convey the maximum discharge to the stack without blockage. Practical considerations such as available angles of bends, junctions and their assembly, as well as space constraints, will normally limit the gradient to about 1:50 (20 mm/m).

4.32 For larger pipes, for example 100 mm in diameter, the gradient may be less, but this will require high-quality workmanship if an adequate self-cleaning flow is to be maintained. **Bedpan washers or macerators should discharge with a short branch to a vertical stack or horizontal drain. The waste pipe should not be installed above or close to heating or hot-water mains. If a bedpan washer or macerator discharges to a 100 mm drain, frequently used large-volume appliances should be situated upstream of its connection to provide additional flushing.**

4.33 Provision for inspection, rodding and maintenance should ensure "full bore" access and be located outside user accommodation. The location of manholes within the building should be avoided.

4.34 To prevent the ingress of bacteria, waste outlets from distillation plant and refrigerators should be connected outside of the department, should not be directly connected to the drainage system, and should discharge via a trapped tundish or gully.

4.35 Drainage/waste systems from air-conditioning units should be installed to prevent Legionnaires' disease and other bacteria back-feeding.

Acoustics

4.36 Consideration should be given at the earliest opportunity to the requirements for privacy and the impact of any intrusive noise that may affect the function of the healthcare facility. Guidance in relation to functional relationships is given in Health Technical Memorandum 08-01 'Acoustics'.

Fire safety

4.37 Fire safety standards in healthcare premises need to be high owing to the vulnerability of occupants. The policy in respect of fire safety is set out in Health Technical Memorandum 05-01 – 'Managing healthcare fire safety'. The design team should satisfy itself that the design meets the

objectives of this guidance or provide a fire-engineered solution that achieves similar objectives.

4.38 It is important to establish during the design stage those aspects of fire strategy that may affect the planning of a project. At appropriate stages of the design process, the appropriate design team members should discuss their proposals with the relevant Building Control/Approved Inspector, and ensure that the project team and all other planning staff are fully acquainted with the fire strategy for the design. This will include operational aspects (staff responsibilities etc), equipment provision, and building and engineering layouts.

Fire detection and control systems

4.39 Fire detection, alarm and control systems are an integral part of the overall fire plan for a building. Close coordination between the architect and design engineer is essential to ensure that compartmentation, high-risk processes, dangerous goods and other fire-related risk issues are fully understood and embraced in the fire management solution.

4.40 For guidance see the 'Firecode' suite of documents (Health Technical Memorandum 05).

Electrical services

General

4.41 Electrical installations should comply with the current edition of BS 7671 IEE Wiring Regulations together with Guidance Note 7 (Special Locations) and Health Technical Memorandum 06-01 – 'Electrical services supply and distribution'. See also 'Medical Electrical Installation Guidance Notes' (MEIGaN; MHRA).

4.42 Prior to final design, a full assessment should be made of the risk, function, occupation, equipment and resilience requirements for the area. This will influence the extent and location of services, the availability of alternative electrical supply distribution and the need for local standby supplies if appropriate.

Electromagnetic compatibility

4.43 Care should be taken to avoid mains-borne and electrical radio frequency interference affecting diagnostic and monitoring equipment, computers or other sensitive electronic equipment. Guidance on the avoidance and abatement of electrical interference is given in Health Technical Memorandum 06-01 – 'Electrical services supply and distribution'.

Main intake switchgear and distribution boards

4.44 The main electrical supply should be part of the whole site/building network, and should provide adequate capacity for both normal and all assessed business-critical needs.

4.45 Main intake and distribution equipment should be sited away from patient areas and areas where access would disrupt normal communication routes.

4.46 Careful consideration should also be given to the impact from flooding, pipework leaks and mechanical damage.

Emergency electrical supplies

4.47 Emergency electrical provision should comply with the requirements of Health Technical Memorandum 06-01.

Small power distribution systems

4.48 Depending upon the capacity of the emergency generator installation and risk assessment (see paragraphs 4.44–4.46), it may be appropriate to provide separate essential and non-essential small power distribution systems.

4.49 Adequate provision should be made in circulation areas, for example corridors and lobbies, to allow the use of domestic cleaning equipment having flexible cords up to 9 m long.

Lighting systems

4.50 Lighting services, including lighting controls, should comply with CIBSE 'Code for Lighting'; Guide LG2: 'Hospitals and Health Care Buildings'; and Guide F: 'Energy Efficiency in Buildings'.

4.51 In areas where VDUs are in use, lighting should be designed to comply with the guidance given in CIBSE Guide 7: 'Office lighting'.

4.52 To achieve energy efficiency, lighting systems should be designed to:

a. maximise use of natural daylight;

b. avoid unnecessarily high levels of illumination;

c. incorporate efficient luminaires, control gear and lamps;

d. incorporate effective controls.

4.53 Lighting and the appearance of luminaires should be coordinated with architectural design. In particular there should be collaboration to ensure that decorative finishes are compatible with the colour-rendering properties of lamps and that the spectral distribution of the light source is not adversely affected. See also 'Lighting and colour for hospital design – a report on an NHS funded research project' (Dalke et al, 2004). Refer to CIBSE 'Code for Lighting' for minimum recommended daylight factors.

4.54 Light switches should be provided in easily accessible positions and at appropriate locations in corridors and general circulation areas. In areas with multiple luminaires, switches should permit the selection of luminaires appropriate to the area requiring illumination.

4.55 Where local circumstances permit, the provision of time switches or occupancy controls using infrared, acoustic or ultrasonic detectors should be encouraged. Additionally, low-energy or ultra-low-energy lighting should be considered as the primary lighting source.

4.56 Safety escape lighting should be provided on primary escape routes in accordance with the provisions of Health Technical Memorandum 06-01, Health Technical Memorandum 05-02 – 'Firecode' and the CIBSE Lighting Guide LG2 – 'Hospitals and Health Care Buildings'.

4.57 It is essential that fluorescent lighting in all areas where medicines or containers are processed, including stores, is derived from lamps having suitable colour-rendering characteristics.

Help call systems

4.58 Help call systems should comply with the requirements of Health Technical Memorandum 08-03 – 'Bedhead services'.

4.59 Patient/staff call points should be provided in all spaces where a patient/attendee may be left alone temporarily – for example consulting, examination and treatment rooms and WCs.

4.60 Staff emergency call points are for a member of staff to call for assistance from another member of staff. They should be provided in all spaces where staff consult, examine and treat attendees/patients. Call facilities may also be provided on hand-held devices.

4.61 The help call systems may be hard-wired or secure wireless or secure radio systems.

4.62 Where considered necessary, staff crash call points may be specifically provided for members of staff to call the crash team. This is not required as a standard installation, and needs to be specified for individual rooms where the patient is at high risk of suffering a cardiac arrest.

4.63 A visual and audible indication of the operation of each system should be provided to give responding staff unambiguous identification of the call source, with a repeater unit in a suitable location.

Security

4.64 Measures should be incorporated in the design of all NHS buildings to help protect the safety of staff, patients and visitors and the security of the premises. Security systems will require a local risk assessment and crime prevention survey to be carried out for both daytime and out of hours, to include swipe cards, smart cards, CCTV and other available technological solutions. The project team should discuss security with the local police crime prevention officer and the trust's nominated local security management specialist (LSMS) at an early stage in the design process.

4.65 See the Directions to NHS Bodies on Security Management Measures 2004 (Amendment) Directions 2006 and 'A Professional Approach to Managing Security in the NHS' (NHS Security Management Service, 2003).

4.66 The local fire officer and LSMS should be consulted concurrently to avoid the possibility of the demands of security and fire safety conflicting.

IT and telephone wiring systems

4.67 The IT and telephone infrastructure within the facility may be determined by existing systems within the building. However, where possible, a structured wiring system as described in Heath Guidance Note 'Structured cabling for IT systems' should be provided. This will permit a unified approach to the provision of cabling for:

a. voice systems;

b. data systems;

c. imaging systems;

d. alarm systems.

4.68 While this "universal" cabling system is initially more expensive than separate voice and data systems, the long-term cost of ownership may prove beneficial.

4.69 In determining the nature of the IT system to be provided, it is necessary to identify:

a. areas to be served;

b. whether structured cabling will be used;

c. what density of outlets is to be provided (not fewer than two per workstation);

d. whether wiring will be on a "flood" or "as required" basis.

Bedhead services and entertainment systems

4.70 Allowance should be made for the introduction of television and radio systems in waiting areas, to create a relaxing atmosphere, staff rest areas, and in locations where it would be beneficial in masking sound transfer.

4.71 Other services should be provided in accordance with Health Technical Memorandum 08-03 'Bedhead services'.

Pneumatic tube transport systems

4.72 If a new pneumatic tube system is to be installed, significant investigation needs to be undertaken to ensure that the system will meet the needs of the whole or that part of the hospital site. For further guidance on the design of pneumatic tube systems, see Health Technical Memorandum 2009.

Lifts

4.73 Lifts may be required in order to comply with the requirements of the DDA or Part M of the Building Regulations. For further guidance on the design of lift installations, see HTM 2024.

Controlled Drugs storage

4.74 Controlled Drugs cupboards within wards or clinical areas should be fitted with a red lamp indicating when the cupboard is unlocked. A repeater lamp should be sited outside the doorway of the room in which the cupboard is located. If appropriate, a secondary repeater should be taken to a permanently staffed station.

4.75 The normal power supply for each cupboard should be backed up by a small integral battery to cover the short period between mains failure and the generator becoming available.

4.76 To assist in keeping their contents secure, controlled drugs cupboards should be fitted with a seven-lever mortice lock designed to meet BS 3621.

Sustainability and energy efficiency

4.77 The environment in which people live and work has a key influence on their health. Environmental considerations should therefore be taken into account when building or adapting facilities. The minimising of environmental impact by ensuring that energy is only used necessarily and efficiently is considered in this guidance with respect to:

a. natural daylighting;

b. natural ventilation;

c. night set-back;

d. building regulations;

e. heat recovery;

f. water conservation;

g. minimising solar gain.

4.78 Efforts should be made to maximise the use of natural lighting. Passive solar design (PSD) should be employed to ensure that, as far as possible, areas such as wards, recovery units and offices are located where they can benefit from natural daylight, while other areas, for example stores, WCs and utility rooms, are located towards the core of the facility.

4.79 Areas where glare may be a problem, for example rooms where VDUs are routinely used, should similarly be located away from direct natural daylight.

4.80 Natural ventilation of rooms should be employed wherever possible and appropriate. Design should incorporate measures for minimising solar heat gains, which, if controlled, will avoid the need for mechanical ventilation. Measures to minimise the need for cooling should include locating temperature-sensitive accommodation away from south-facing fascias, shading windows, and using reflecting glass where appropriate and cost-effective.

4.81 Energy-using systems including heating, ventilation, cooling and lighting should be controlled to minimise consumption. Consideration may be given to utilising the thermal properties of the building when the facility is not in

use, for example at night or weekends, where circumstances permit.

4.82 Energy recovery systems should be employed when possible, and particularly on ventilation systems.

4.83 For further guidance on energy efficiency, see Health Technical Memorandum 07-02 – 'Encode: making energy work in healthcare'.

Commissioning and maintenance

4.84 It is important that, on completion of an installation and prior to hand-over, the performance of engineering services and equipment is fully commissioned to validate their function and achievement of performance.

4.85 The final acceptable performance details should be recorded and, together with full manufacturers' details, made available to users and the maintenance organisation before the facilities are handed over.

4.86 Once the facilities are operational, the overall performance should again be further performance tested when full operational conditions are achieved. This will check that the interface between systems has not been compromised and that the systems operate to the designed criteria.

4.87 Risk management, operational procedures and contingency plans should be fully evaluated with staff to ensure that, in the event of an emergency, procedures can be put in place to maximise the safety of patients, staff and visitors. Opportunities should be taken to practise these procedures when it is safe to do so, in order that staff remain fully conversant with what is required of them and can fully appreciate the issues involved.

5 Cost information

Introduction

5.1 For all types of health building, it is important that building costs and revenue expenditure are best-value and consistent with acceptable standards. In applying this guidance, the need for economy should always be of prime concern. Where appropriate, space should be shared between similar activities taking place at different times. However, this solution should not be detrimental to the proper functioning of the spaces involved, nor to the needs of users.

Departmental Cost Allowance Guides

5.2 Departmental Cost Allowance Guides (DCAGs) related to this Health Building Note are officially notified in 'Quarterly Briefing', published by the Department of Health (see www.dh.gov.uk). For a full listing of all DCAGs see 'Healthcare Capital Investment' on the Space for Health website at www.nhs.uk/spaceforhealth.

5.3 The attention of the project team is drawn to the Capital Investment Manual (CIM – Business Case Guide; www.dh.gov.uk). This aims to reduce planning work and to encourage the production of sound business case support of both capital and revenue expenditure. Capital works estimates should be based, wherever applicable, on industry norms, such as DCAGs plus a percentage to cover on-costs.

5.4 The DCAGs for this Health Building Note reflect the total building, engineering and accommodation requirements for adult in-patient facilities located on an acute hospital site, where common services are shared. Costs are based on a typical two-storey new-build unit on a greenfield site with no planning constraints.

5.5 DCAGs are exclusive of VAT, building and planning fees and all local authority charges, and are based on a location factor of 1.00.

On-costs

5.6 An allowance for on-costs (such as communication space, external works, external engineering services and abnormals) should be added to the DCAGs. Abnormals will largely be determined by site characteristics (such as an inner-city location or poor ground conditions) and by the condition or type of any building to be refurbished.

5.7 Project teams should assess all likely on-cost implications of individual sites and schemes at the earliest opportunity.

Locational factors

5.8 Locational factor adjustments should be applied to works costs (that is, DCAGs plus established on-costs) to take account of local market conditions. For further information, see 'Quarterly Briefing' (www.dh.gov.uk).

Schedules of accommodation

5.9 The schedules of accommodation show a notional whole department, which highlights the scope for sharing accommodation. The examples are not to be taken as ideal provision for any particular project.

5.10 The examples are as follows:

- Example 1: 24-bed ward, 50% single-bed rooms;
- Example 2: 24-bed ward, 80% single-bed rooms;
- Example 3: 24-bed ward, 100% single-bed rooms.

5.11 The schedules of accommodation for this document may be updated from time to time. For the latest version check the latest version of this publication on the Space for Health website at www.nhs.uk/spaceforhealth.

Dimensions and areas

5.12 The critical dimensions of an area are determined by the spatial requirements of any activities to be carried out within it. Space requirements for various generic activities appear in Health Building Notes 00-02 – 'Sanitary spaces', 00-03 – 'Clinical and clinical support spaces' and 00-04 – 'Circulation and communication spaces'.

5.13 Planning teams should have data available at the earliest stages of a project to enable the approximate assessment of sizes involved. Areas used for the purpose of establishing cost allowances are listed in the schedules of accommodation. These areas do not represent recommended sizes and should not be regarded as specific individual entitlements.

5.14 The efficient planning of a building may necessitate a variation to the areas given. For example, in the refurbishment/conversion of older property:

- rooms tend to be larger than the areas given;
- some rooms may be too small or in the wrong location for efficient use;
- circulation space tends to form a larger than normal proportion of the total area.

Circulation spaces

5.15 All internal corridors, small vertical ducts, spaces occupied by partitions/walls and other space for circulation, are costed in the DCAGs. Provision is also made for a 5% planning zone and 3% engineering zone adjacent to the external walls.

5.16 Circulation figures included in the DCAGs are those anticipated for new-build facilities. Where constraints are encountered, for example in refurbishment/conversion of older types of property, this figure may increase.

Communication spaces

5.17 Hospital "streets", staircases and lifts (linking spaces) are not included in the DCAGs. Costs related to these elements, along with a suitable space allowance, should be made in the on-costs.

Land costs

5.18 DCAGs are exclusive of all land costs and associated fees. However, costs associated with land costs should be included in business case submissions (as detailed in the Capital Investment Manual) and may therefore have an important impact on the overall cost viability of a scheme.

Engineering services

5.19 The following engineering services are included in the cost allowances (see Chapter 4 and Activity DataBase for further information). Primary engineering services are assumed to be conveniently available at the boundary of the department.

5.20 Mechanical services:

- heating – low-pressure hot water system;
- ventilation – mechanical supply to, and extraction from, clinical areas, and other areas requiring mechanical ventilation such as WCs and showers (excludes ventilation plant, such as air handling units or extract fans);
- cold water – central supply to service points including drinking water (excludes storage tanks);
- hot water – supply from a central system (excludes storage and generation);
- piped medical gases – oxygen, nitrous oxide and medical air (400 kPa).

5.21 Electrical services:

- departmental distribution boards;
- general lighting, as required by task;
- examination lighting (examination lamps);
- staff location system;
- help call systems;
- emergency luminaires, as appropriate;
- socket-outlets and other power outlets for fixed and portable equipment;
- supplementary equipotential earth bonding;
- uninterruptible power supply (UPS) and equipment;
- fire, security, and Controlled Drug cupboard alarm systems;
- TV/radio wireways;
- telephone internal cabling distribution and outlets (excludes handsets);
- data wireways;
- building management system.

5.22 Equipment (Group 1):

- Controlled Drugs cupboards;
- dishwasher;
- impulse clocks.

Example schedules of accommodation for Health Building Note 04-01 - 'Adult in-patient facilities'

Version 3, published June 2010

New system of separate allowances for circulation, communication and engineering space applied

ADB code	Room name/function	Unit area allowanc	Example 1: 24-bed ward, 50% sing bed rooms Quantity	Example 1 Total area	Example 2: 24-bed ward, 83% sing bed rooms Quantity	Example 2 Total area	Example 3: 24-bed ward, 100% sing bed rooms Quantity	Example 3 Total area	Paragraph referenc	Notes
	Clinical spaces									
	Bedroom & sanitary spaces									
B0305	Single-bed room	19 0	12	228.0	20	380.0	24	456.0	Para 3 6-3.16, Appendix 1	
V1645	Shower room: en-suite: chamfered	4.5	12	54 0	20	90 0	24	108.0	Para 3.17	
B0405	Multi-bed room: 4 beds	64 0	3	192.0	1	64 0			Para 3 6-3.16, Appendix 1	
V1121	WC: semi-ambulant: in-patient	2.0	3	6.0	1	2.0			Para 3.19, Appendix A	Area reduced from 2 5 as excludes luggage space.
V1635	Shower room: assisted: in-patient	6.5	3	19 5	1	6.5			Para 3.19	Area reduced from 8 as assisted bathroom provided.
V1736	Bathroom: assisted	15 0	1	15 0	1	15 0	1	15 0	Para 3 26	
	Support facilities									
M0330	Office/meeting room: 10 places (including 2 workstations)	16 0	1	16 0	1	16 0	1	16 0	Para 2.40, 3 67	1 per 24 beds.
T0151	Touchdown base	2.0	6	12 0	6	12 0	6	12 0	Para 2 37, 3 32	1 per 4 beds.
X0145	Treatment room: double-sided couch access	16 0	1	16 0	1	16 0			Para 2.49, 3 35	1 per 24 beds if multi-bed bays used.
M0724	Interview room: 4 places (including 1 wheelchair place)	8.0	1	8.0	1	8.0	1	8.0	Para 3 38	1 per 24 beds.
M0731	Breakout space: patients	6.0	3	18 0	3	18 0	3	18 0	Para 3.41	1 per 8 beds.
P0627	Ward pantry	12 0	1	12 0	1	12 0	1	12 0	Para 3.42	1 per 24 beds. Larger than pantry/refreshment area as includes larger fri machine and additional storage.
G0180	Parking bay for resuscitation equipment	2.0	1	2.0	1	2.0	1	2.0	Para 3.4, 3.46	1 per 24 beds.
G0180	Parking bay for food trolley	2.0	1	2.0	1	2.0	1	2.0	Para 3.47	1 per 24 beds.
G0180	Parking bay for mobile hoist	2.0	1	2.0	1	2.0	1	2.0	none	1 per 24 beds.
	Ward storage allowance			18 0		18 0		18 0	Para 3 51	0.75 sqm per bed.
W1584	*Clinical equipment store*									
W1585	*General store*									
W1594	*Linen store*									
T0540	Medicine store/preparation room	8.0	1	8.0	1	8.0	1	8.0	Para 2 51, 3 54	1 per 24 beds.
Y0331	Dirty utility room for bedpan processing	12 0	2	24 0	2	24 0	2	24 0	Para 2 55, 3 55	1 per 12 beds.
Y1510	Cleaners' room	8.0	1	8.0	1	8.0	1	8.0	Para 2 20, 3 57	1 per 24 beds.
	Staff spaces									
	Staff support									
V0653	Locker bay: 12 small lockers	1.5	2	3.0	2	3.0	2	3.0	Para 3.7	1 per 12 beds.
V1010	WC: ambulant	2.0	1	2.0	1	2.0	1	2.0	Para 3.72	1 per 24 beds.
	Net internal area (NIA)			**665.5**		**708.5**		**714.0**		
	Circulation allowance		25 0%	166.4	27 5%	194.8	31 0%	221.3		
	Communication allowance		10 0%	66 6	10 0%	70 9	10 0%	71.4		
	Engineering space allowance		25 0%	166.4	27 0%	191.3	28 0%	199.9		
	Gross internal area (GIA)			**1064.8**		**1165.5**		**1206.7**		

	Essential complementary accommodation									
	Entrance and reception									
J0232	Reception (size based on number of places)	5.5	2	11.0	2	11.0	2	11.0	Para 3 3, 3.64	2 places per 24 beds.
	Waiting area (size based on number of places)	1.7	6	10 2	6	10 2	6	10 2	Para 3 3, 3.64	1 per 4 beds. Allowance includes more than one type of ADB room. For d area allowance see HBN 00-03.
J1152	*Waiting area*									
J1413	*Children s play area*									
V1121	WC: semi-ambulant	2.5	1	2.5	1	2.5	1	2.5	Para 3 66	1 per 24 beds.
V0922	WC: independent wheelchair	4.5	0.5	2.3	0.5	2.3	0.5	2.3	Para 3 66	1 per 48 beds.
	Additional clinical spaces									
W1475	Clean supply room allowance			8.0		8.0		8.0	Para 2 51, 3.49	0.34 sqm per bed.
Y0642 or Y0646	Disposal hold allowance			6.0		6.0		6.0	Para 3 59	0.25 sqm per bed.
	Staff support									
D0434	Staff rest and mini kitchen (size based on number of seats)	1.8	3	5.4	3	5.4	3	5.4	Para 3.77	3 for 8 staff (maximum staff on shift). Space allowance should be combin neighbouring wards to create a viable staff rest room. For d see HBN 00-03.
H1304	Seminar room: 24 places (including 1 wheelchair place)	32 0	0.4	12 0	0.4	12 0	0.4	12 0	Para 2 56, 3 80	1 per 64 beds.
	Communal changing area (size based on number of lockers)	1.4	18	25 2	18	25 2	18	25 2	Para 3.73	Twice number of lockers as staff on shift plus 10% contingency (rounded allowance should be combined with neighbouring departmer and female changing rooms. Allowance include For details of unit area allowance s
V0554	*Staff communal changing room*									
V0725	*Semi-ambulant changing room*									
V1321	*Shower room: ambu ant*									
V0667	*Uniform exchange*									
V1010	WC: ambulant	2.0	1	2.0	1	2.0	1	2.0	Para 3.73	1 for up to 20 lockers.
	Net internal area (NIA)			**84.6**		**84.6**		**84.6**		
	Optional accommodation									
V1131	Nappy changing room	5.0	1	5.0					Para 3 66	Optional addition to waiting space.
P0808	Vending machine	3.0	1	3.0					Para 3 66	Optional addition to waiting space.
G0510	Lobby to isolation room	5.0	1	5.0					Para 3 29	
B0308	Isolation room	19 0	1	19 0					Para 3 29	In lieu of standard single-bed room provision.
T0535	Clean utility room	16 0	1	16 0					Para 2 51	Alternative to clean supply and medicine store/preparation room.
V1635	Shower room: assisted	8.0	1	8.0					Para 3 26	Alternative to assisted bathroom in wards with multi-bed bays.
M0727	Sitting room: 7 places (including 1 wheelchair place)	12 0	1	12 0					Para 3.41	Alternative to patient breakout space.
NA	Regeneration kitchen								Para 3.45	Project specific. Requirements by catering contractor.

Note 1	**Relationship of schedule to ADB room names** The ADB room codes listed may not carry a title, in ADB, identical to the room function in the schedules. Use of the appropriate ADB room code will, however, result in the correct room being accessed
Note 2	**Relationship of schedule to ADB for scalable rooms (i.e. those for which a recommended room size in ADB does not exist)** ADB room code relates to one example size of this space and does not reflect space requirements of these schedules. Projects will scale up/down according to schedule.
Note 3	**Essential complementary accommodation** Accommodation to which the department needs access but may be shared with nearby departments.
Note 4	**Optional accommodation** Accommodation which is not expected in all departments, but, dependent on local policy, may be needed in addition to or instead of the rooms listed in the schedule.
Note 5	**Circulation allowance** The circulation allowance is based upon the study and calculations contained within 'Ward layouts with single rooms and space for flexibility' (DH, May 2005).
Note 6	**Engineering space allowance** For the purposes of calculating the engineering space allowances it has been assumed that each ward is located on an acute (multi-purpose) hospital site with a GIA of 25,000 sqm. For larger or smaller facilities, or where there needs to be largely dedicated enginee allowances will vary, generally downwards as GIA increases.
Note 7	**Status of defined metrics** All of the defined metrics (calculations for quantifying spaces) in the notes column have been included as a reasonable basis for initial briefing. They are not intended as and should not be considered requirements.

Appendix 1 – Example bedroom layouts

Introduction

Single-bed room

The layout for a single-bed room in this appendix is an example only. Its purpose is to illustrate how the different elements of the room – bed space, en-suite, clinical support zone, and family zone – can be brought together. Other configurations are possible.

In the design of the example layout, the following issues have been considered:

- clear space around the bed (3600 mm × 3700 mm);
- position of the en-suite shower room;
- bedroom door width into the room;
- location of the clinical wash-hand basin;
- provision of support facilities including space for a fold-down divan;
- sightlines from the corridor (at the doorway).

It is assumed that conventional bedhead services are used, although the use of ceiling- or wall-mounted pendant fittings is possible.

The en-suite – comprising WC, washbasin and shower – is shown with a chamfered profile. For a rectangular layout, refer to Health Building Note 00-02 – 'Sanitary spaces'.

The location of the en-suite can have a significant impact on the bedroom in terms of floor area, views to and from the bed, and support facilities such as the touchdown base. Four layouts, each showing a different location for the en-suite, have been included for illustrative purposes.

Multi-bed room

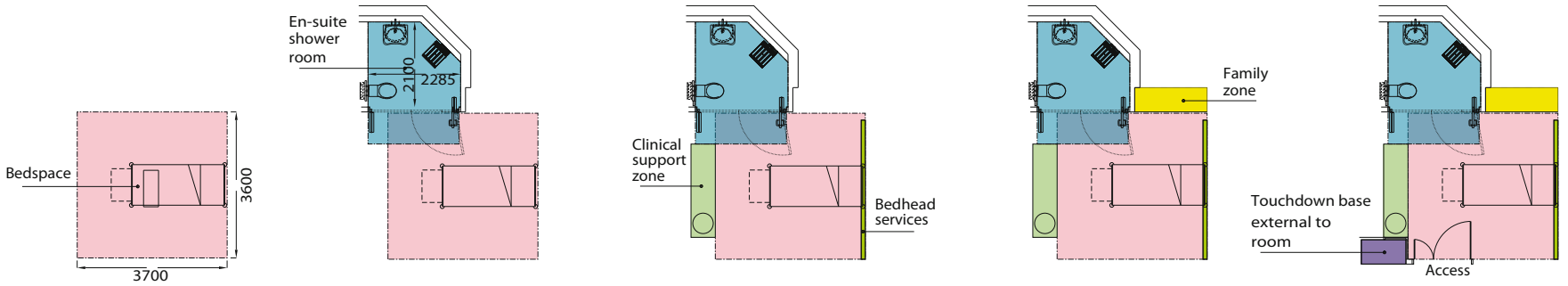
The layout for a multi-bed room is an example only. It shows a four-bed room with an assisted shower room and a second semi-ambulant WC, both en-suite. Full details of these en-suite facilities are contained in Health Building Note 00-02 – 'Sanitary spaces'.

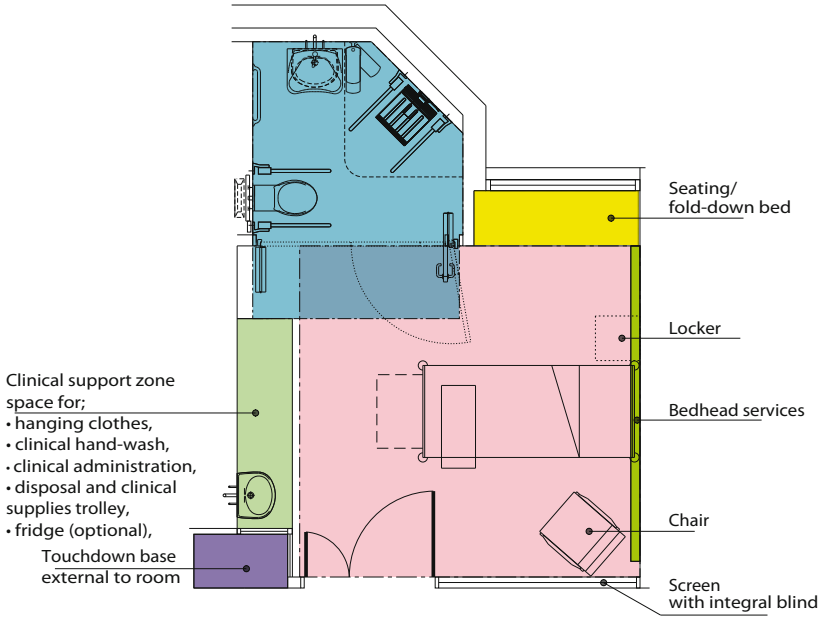
An en-suite with fully opening wall cannot be used in this layout because of the loss of privacy in a multiple-occupancy room. Each en-suite has an outward-opening single-leaf door.

The two en-suites are located inboard, forming a recess at the entrance to the bed areas, providing some privacy to the bed areas.

Two clinical wash-hand basins are located centrally, one next to the room entrance and the other on the outside wall. There is room for one clinical support zone.

Example layout for a single-bed room





Bedspace
This is the clear space required for access around the bed for:
- moving and handling of patients
- patient transfers into and out of bed (including ceiling-mounted hoists)
- clinical activity including resuscitation
- bed making
- manoeuvring the bed in and out of the room
- manoeuvring equipment

Note: it does not include space for built-in or fixed furniture. It does include space for door swings.

En-suite shower room
The space required for the en-suite includes not only the enclosed area but also the temporary manoeuvring space for assisting a patient on both sides of the WC which overlaps the bed space.

Clinical support zone
This includes space for clinical support, hand-washing, clinical administration, storage and space for movable equipment such as supply or disposal trolleys.
Note: This space does not overlap the clear bed space.

Social (family) support zone
Space can be provided for overnight stay either as built-in furniture or space for demountable bed or recliner. This should not impede access to the bedside or into the room. The illustration shows one of the options. Alternatives include window seat and wall-mounted fold-down bed settee.

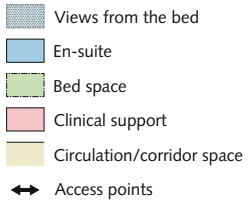
Touchdown base (nurses' workstation)
Clinical nursing stations or "touchdown" bases will be provided adjacent to individual rooms, paired rooms or clusters of rooms. These are best located near to room entrances so that it is possible to observe the patient from outside the room. The location of these workstations should not obstruct the primary circulation space and will be dependent on the location of the room entrance.

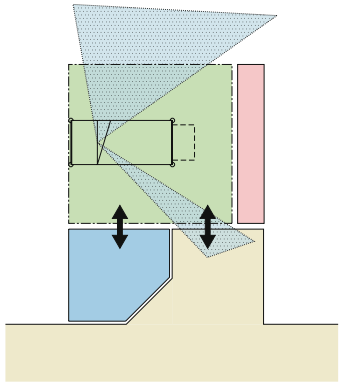
Note: This layout is not intended as a design solution but defines spatial requirements only

En-suite location

The location of the en-suite has a major influence on the subject room in terms of:

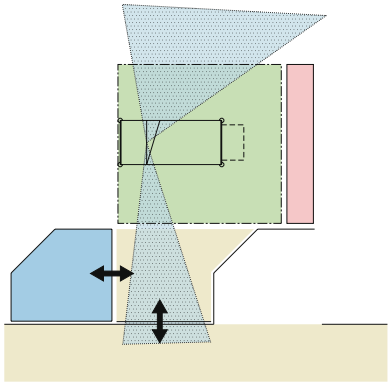
- Access points
- Support facilities including the nurse "touchdown" base
- Views to and from the bed
- Privacy
- Floor area





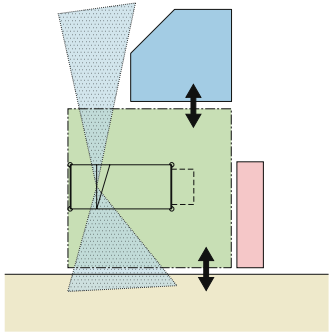
Internal en-suite

a) Access to en-suite and to the room are on the same side and this determines the minimum width of the room.
b) Views of the bed from the corridor are restricted.
c) External views are maximised.
d) Privacy for the patient is maximised especially for views into the en-suite.
e) There are two options for support services: external wall or partition wall.
f) Bed turning can be accommodated adjacent to the bedroom, which increases the circulation space but minimises corridor width.
g) The door position can be optimised to increase or decrease space within the room.
h) A nurse "touchdown" base can be accommodated adjacent to the bedroom door.



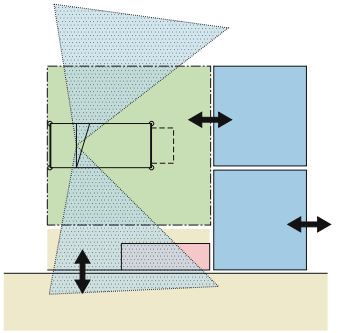
Internal adjacent en-suite

a) Access to en-suite and to the room are on the same side and this determines the minimum width of the room.
b) Views of the bed from the corridor are improved in comparison to the inboard option.
c) External views are maximised.
d) Privacy for the patient is reduced. Entry to the en-suite can be seen from the corridor.
e) There are two options for support services: external wall or partition wall.
f) To accommodate bed turning, either the corridor or the bedroom doors will need to be wider.
g) The bedroom door position is fixed.
h) Accommodating the nurse "touchdown" base is difficult without adding additional width to the corridor.



External en-suite

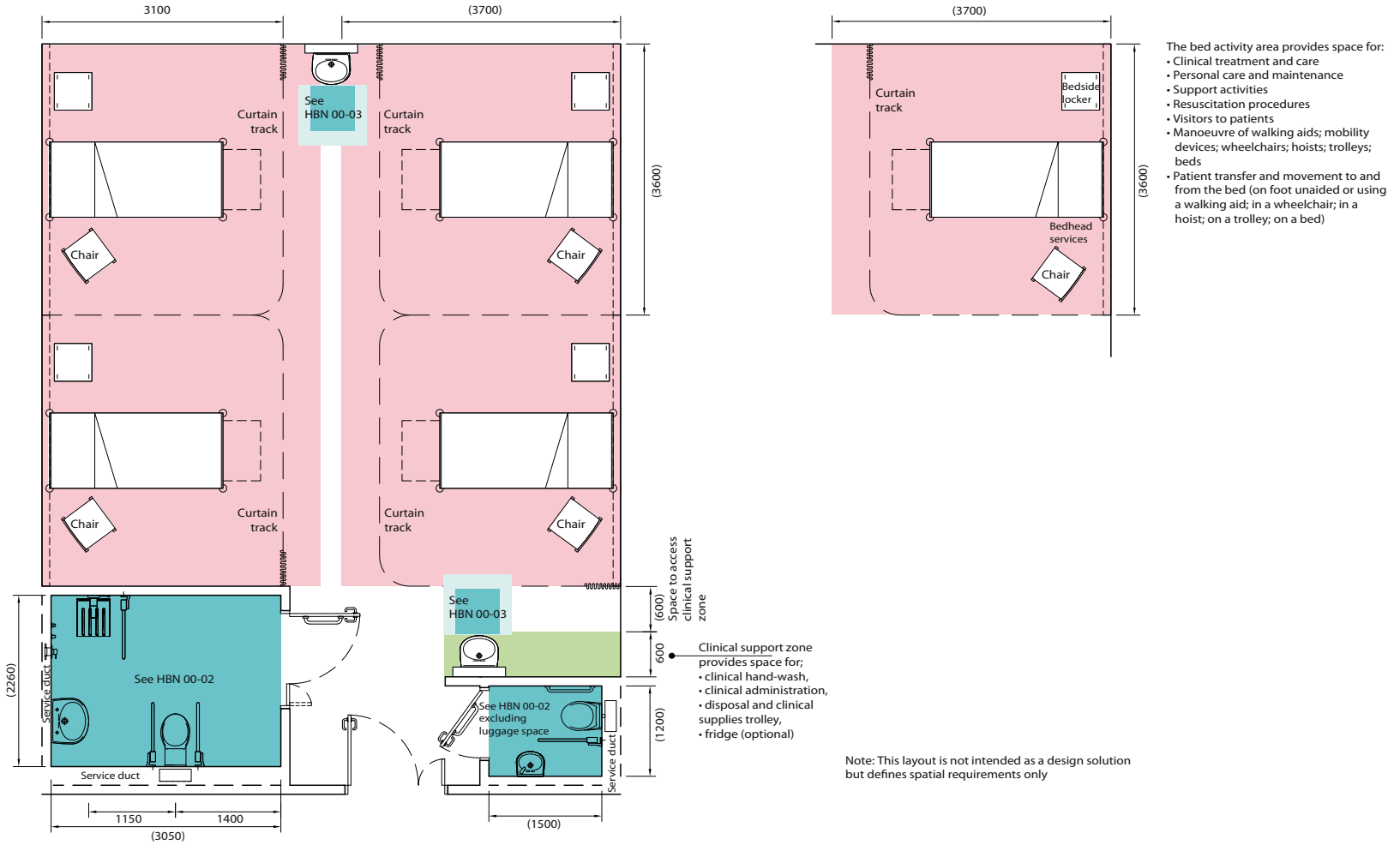
a) Access to room and en-suite are on opposite sides, which is less restrictive on room width.
b) View of the bed from the corridor is maximised.
c) External views are minimised.
d) Privacy for the patient is minimised and entry into the en-suite can be observed from the corridor.
e) There are three options for support services: part external wall, part corridor partitions and room partitions.
f) To accommodate bed turning, either the corridor or the bedroom doors will need to be wider.
g) The bedroom doors can be located flexibly on the corridor wall.
h) A nurse "touchdown base" can be accommodated adjacent to the bedroom door.



In-between en-suite

a) Interlocking en-suites increases overall width and depth of the room.
b) Views of the bed from the corridor are maximised.
c) External views are maximised.
d) Privacy for the patient is minimised and entry into the en-suite can be observed from the corridor.
e) There are two options for clinical support services: external wall or corridor partitions. This will be influenced by whether the en-suite is "nested" on the external or internal wall.
f) To accommodate bed turning, either the corridor or the bedroom doors will need to be wider.
g) The bedroom doors can be located flexibly on the corridor wall.
h) A nurse "touchdown" base can be accommodated adjacent to the bedroom door.

Example layout for a multi-bed room



NOTE: Whilst the evidence base for the layout of this multi-bed room (as set out in 'Ward layouts with single rooms for space and flexibility') was based on optimum space standards, there has been a move towards providing minimum space standards, therefore some dimensions may have been marginally reduced.

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ROYAL HOSPITAL FOR CHILDREN, EDINBURGH
THEATRE AIR CHANGE RATES & ROOM PRESSURE VERIFICATION

Area:	Theatre Suite	**AHU:**	Various
Client:	Mercury Engineering	**Client Contact:**	Ryan Waddell
Hospital:	Royal Hospital for Children, Edinburgh	**Report No:**	A12250
Site Address:	Little France Crescent, Edinburgh	**Theatre Condition:**	Good
Date of Test:	1st - 5th July 2019	**Date of Last Test:**	n/a
Test Engineer & Report Preparation:	Ian Stewart	**Signature:**	[redacted]
H&V Approval:		**Signature:**	
Client Reviewed by:		**Signature:**	

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ROYAL HOSPITAL FOR CHILDREN EDINBURGH

INDEX

ROYAL HOSPITAL FOR CHILDREN EDINBURGH

Section 1 – Theatre 30

Conventional Theatre only.

Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,320	5,130	119	191.62	26.77	25
Anaesthetic	810	882	109	50.57	17.44	15
Prep (lay-up)	324	378	117	33.08	11.43	>10
Disposal	756	810	107	37.60	43.56*	>20

Comments:
The theatre room volume includes the Scrub Up (28.82m³).
***The disposal room is shared with theatre 31 and the air change rates includes the grille related that that system which is extracting 828m³/hr.**

Room Pressures

Room Reference	SHTM Room Pressure (Pa)	Recorded Room Pressures (Pa)
Theatre	+25	+31
Anaesthetic	>10	+13
Prep	+25	+31
Disposal	-5	-8

ROYAL HOSPITAL FOR CHILDREN EDINBURGH

Section 2 – Theatre 31

UCV & Conventional Theatre.

UCV Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,147	5,512	133	192.05	28.70	25
Anaesthetic	810	896	111	51.50	17.40	15
Prep (lay-up)	324	378	105	32.54	11.62	>10
Disposal	756	828	109	37.60	43.56*	>20

Comments:
The theatre room volume includes the Scrub Up (29.71m³).
***The disposal room is shared with theatre 30 and the air change rates includes the grille related that that system which is extracting 810m³/hr**

Conventional Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,147	5,368	129	192.05	27.95	25
Anaesthetic	810	954	118	51.50	18.52	15
Prep (lay-up)	324	392	121	32.54	12.05	>10
Disposal	756	778	103	37.60	42.23*	>20

Comments:
The theatre room volume includes the Scrub Up (29.71m³).
***The disposal room is shared with theatre 30 and the air change rates includes the grille related that that system which is extracting 810m³/hr**

Room Pressures

Room Reference	SHTM Room Pressure (Pa)	Recorded Room Pressures (Pa) UCV Mode	Recorded Room Pressures (Pa) Conventional Mode
Theatre	+25	+33	+26
Anaesthetic	>10	+13	+13
Prep	+25	+33	+26
Disposal	-5	-8	-5

ROYAL HOSPITAL FOR CHILDREN EDINBURGH

Section 3 – Theatre 32

UCV & Conventional Theatre.

UCV Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,147	5,472	132	195.80	27.95	25
Anaesthetic	810	817	101	51.09	15.99	15
Prep (lay-up)	324	371	114	34.33	10.81	>10
Disposal	756	799	106	37.30	43.56*	>20

Comments:
The theatre room volume includes the Scrub Up (30.28m³).
***The disposal room is shared with theatre 33 and the air change rates includes the grille related that that system which is extracting 828m³/hr**

Conventional Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,147	5,515	133	195.80	28.17	25
Anaesthetic	810	911	112	51.09	17.83	15
Prep (lay-up)	324	450	139	34.33	13.11	>10
Disposal	756	824	109	37.30	42.23*	>20

Comments:
The theatre room volume includes the Scrub Up (30.28m³).
***The disposal room is shared with theatre 33 and the air change rates includes the grille related that that system which is extracting 828m³/hr**

Room Pressures

Room Reference	SHTM Room Pressure (Pa)	Recorded Room Pressures (Pa) UCV Mode	Recorded Room Pressures (Pa) Conventional Mode
Theatre	+25	+43	+37
Anaesthetic	>10	+14	+15
Prep	+25	+43	+37
Disposal	-5	-8	-6

ROYAL HOSPITAL FOR CHILDREN EDINBURGH

Section 4 – Theatre 33

UCV & Conventional Theatre.

UCV Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,320	4,954	115	191.53	25.86	25
Anaesthetic	810	828	102	49.98	16.57	15
Prep (lay-up)	324	378	117	36.25	10.43	>10
Disposal	756	828	110	37.30	43.62*	>20

Comments:
The theatre room volume includes the Scrub Up (26.67m³).
***The disposal room is shared with theatre 32 and the air change rates includes the grille related that that system which is extracting 799m³/hr.**

Conventional Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,320	4,968	115	191.53	25.94	25
Anaesthetic	810	1,044	129	49.98	20.89	15
Prep (lay-up)	324	468	144	36.25	12.91	>10
Disposal	756	828	110	37.30	44.29*	>20

Comments:
The theatre room volume includes the Scrub Up (26.67m³).
***The disposal room is shared with theatre 32 and the air change rates includes the grille related that that system which is extracting 824m³/hr.**

Room Pressures

Room Reference	SHTM Room Pressure (Pa)	Recorded Room Pressures (Pa) UCV Mode	Recorded Room Pressures (Pa) Conventional Mode
Theatre	+25	+35	+31
Anaesthetic	>10	+16	+16
Prep	+25	+34	+28
Disposal	-5	-7	-6

ROYAL HOSPITAL FOR CHILDREN EDINBURGH

Section 5 – Theatre 34

Conventional Theatre only.

Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,320	4,561	106	149.00	30.61	25
Anaesthetic	810	893	110	50.50	17.68	15
Prep (lay-up)	324	392	121	33.20	11.81	>10
Disposal	756	911	120	37.00	46.89*	>20

Comments:
The theatre room volume includes the Scrub Up (27.81m³).
***The disposal room is shared with theatre 35 and the air change rates includes the grille related that that system which is extracting 824m³/hr.**

Room Pressures

Room Reference	SHTM Room Pressure (Pa)	Recorded Room Pressures (Pa)
Theatre	+25	+30
Anaesthetic	>10	+14
Prep	+25	+30
Disposal	-5	-10

ROYAL HOSPITAL FOR CHILDREN EDINBURGH

Section 6 – Theatre 35

Conventional Theatre only.

Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,320	4,723	109	171.88	26.77	25
Anaesthetic	810	936	116	50.57	17.44	15
Prep (lay-up)	324	385	119	33.08	11.43	>10
Disposal	756	824	109	37.60	46.89*	>20

Comments:
The theatre room volume includes the Scrub Up (30.18m³).
***The disposal room is shared with theatre 34 and the air change rates includes the grille related that that system which is extracting 911m³/hr.**

Room Pressures

Room Reference	SHTM Room Pressure (Pa)	Recorded Room Pressures (Pa)
Theatre	+25	+31
Anaesthetic	>10	+15
Prep	+25	+31
Disposal	-5	-10

ROYAL HOSPITAL FOR CHILDREN EDINBURGH

Section 7 – Theatre 36

UCV & Conventional Theatre.

UCV Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,147	5,396	130	190.46	28.33	25
Anaesthetic	810	882	109	51.63	17.08	15
Prep (lay-up)	324	382	118	31.59	12.09	>10
Disposal	1,476	1,530	104	32.73	46.75	>20

Comments:
The theatre room volume includes the Scrub Up (29.81m³).

Conventional Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,147	4,795	116	190.46	25.18	25
Anaesthetic	810	1,044	129	51.63	20.22	15
Prep (lay-up)	324	472	146	31.59	14.94	>10
Disposal	1,476	1,469	99	32.73	44.88	>20

Comments:
The theatre room volume includes the Scrub Up (29.81m³).

Room Pressures

Room Reference	SHTM Room Pressure (Pa)	Recorded Room Pressures (Pa) UCV Mode	Recorded Room Pressures (Pa) Conventional Mode
Theatre	+25	+37	+30
Anaesthetic	>10	+14	+15
Prep	+25	+31	+29
Disposal	-5	-5	-7

ROYAL HOSPITAL FOR CHILDREN EDINBURGH

Section 8 – Theatre 37

UCV & Conventional Theatre.

UCV Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,147	5,339	129	192.95	27.67	25
Anaesthetic	810	864	107	50.84	17.40	15
Prep (lay-up)	324	385	119	38.44	11.62	>10
Disposal	756	810	107	38.23	42.85*	>20

Comments:
The theatre room volume includes the Scrub Up (30.22m³).
***The disposal room is shared with theatre 38 and the air change rates includes the grille related that that system which is extracting 828m³/hr**

Conventional Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,147	4,982	120	192.95	25.82	25
Anaesthetic	810	922	114	50.84	18.14	15
Prep (lay-up)	324	432	133	38.44	11.24	>10
Disposal	756	774	102	38.23	42.56*	>20

Comments:
The theatre room volume includes the Scrub Up (30.22m³).
***The disposal room is shared with theatre 38 and the air change rates includes the grille related that that system which is extracting 853m³/hr**

Room Pressures

Room Reference	SHTM Room Pressure (Pa)	Recorded Room Pressures (Pa) UCV Mode	Recorded Room Pressures (Pa) Conventional Mode
Theatre	+25	+26	+25
Anaesthetic	>10	+15	+14
Prep	+25	+26	+25
Disposal	-5	-10	-10

ROYAL HOSPITAL FOR CHILDREN EDINBURGH

Section 9 – Theatre 38

UCV & Conventional Theatre.

UCV Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,147	5,493	132	200.98	27.33	25
Anaesthetic	810	828	102	51.71	16.01	15
Prep (lay-up)	324	382	118	31.35	12.19	>10
Disposal	756	828	110	38.23	42.85*	>20

Comments:
The theatre room volume includes the Scrub Up (31.64m³).
***The disposal room is shared with theatre 37 and the air change rates includes the grille related that that system which is extracting 810m³/hr**

Conventional Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,147	5,195	125	200.98	25.85	25
Anaesthetic	810	925	114	51.71	17.89	15
Prep (lay-up)	324	504	156	31.35	16.08	>10
Disposal	756	853	113	38.23	42.56*	>20

Comments:
The theatre room volume includes the Scrub Up (31.64m³).
***The disposal room is shared with theatre 37 and the air change rates includes the grille related that that system which is extracting 774m³/hr**

Room Pressures

Room Reference	SHTM Room Pressure (Pa)	Recorded Room Pressures (Pa) UCV Mode	Recorded Room Pressures (Pa) Conventional Mode
Theatre	+25	+35	+28
Anaesthetic	>10	+14	+14
Prep	+25	+34	+28
Disposal	-5	-10	-10

ROYAL HOSPITAL FOR CHILDREN EDINBURGH

Section 10 – Theatre 39

UCV & Conventional Theatre.

UCV Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,147	5,566	133	194.10	28.68	25
Anaesthetic	810	882	109	54.29	16.25	15
Prep (lay-up)	324	389	120	32.71	11.89	>10
Disposal	756	767	101	37.87	46.21*	>20

Comments:
The theatre room volume includes the Scrub Up (29.76m³).
***The disposal room is shared with Angio theatre and the air change rates includes the grille related that that system which is extracting 983m³/hr**

Conventional Air Change Rates

Room Reference	Design Volume m³/hr	Recorded Air Volume m³/hr	Design %	Room Volume m³	Recorded ac/hr	SHTM 03-01 Air Change Rates ac/hr
Theatre	4,147	5,000	121	194.10	25.76	25
Anaesthetic	10	925	114	54.29	17.04	15
Prep (lay-up)	324	425	131	32.71	12.99	>10
Disposal	756	806	107	37.87	47.24*	>20

Comments:
The theatre room volume includes the Scrub Up (29.76m³).
***The disposal room is shared with Angio theatre and the air change rates includes the grille related that that system which is extracting 983m³/hr**

Room Pressures

Room Reference	SHTM Room Pressure (Pa)	Recorded Room Pressures (Pa) UCV Mode	Recorded Room Pressures (Pa) Conventional Mode
Theatre	+25	+40	+35
Anaesthetic	>10	+16	+15
Prep	+25	+39	+35
Disposal	-5	-8	-9

WORKING FOR A HEALTHIER FUTURE

Services Report P2739
Date of witnessing: 2nd- 9th July 2019
Additional measurements 3rd October 2019

Witnessing of theatre re-balancing and validation summary report

Royal Hospital for Children and Young People and Department of Clinical Neurosciences.

A46676816

REPORT TO CLIENT

WITNESSING OF THEATRE RE-BALANCING AND SUMMARY OF VALIDATION WORK

ON BEHALF OF

NHS LOTHIAN
ROYAL HOSPITAL FOR CHILDREN AND YOUNG PEOPLE AND DEPARTMENT OF CLINICAL NEUROSCIENCES
LITTLE FRANCE CRESENT
EDINBURGH
EH16 4TJ

REPORT NUMBER: P2739

REPORT ISSUED: 4TH OCTOBER 2019

VERSION: FINAL REPORT

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Introduction

IOM were appointed by NHS Lothian Health Board to validate the critical ventilation systems at the new Sick Children's Hospital at Edinburgh Royal Infirmary. We were provided with a list of critical areas and associated critical air handling units for the site.

The validation process involves undertaking a number of measurements and checks with the overall purpose of ensuring that the whole system operates correctly and meets the requirements of SHTM 03-01 or standard agreed as part of the design process.

Validation reports for each system are being prepared and will be sent to the Health Board.

Background

The validation work commenced on site on the 17 h June 2019 and it was anticipated it would take approximately 2 weeks. During the first week it became clear that significant amounts of work were still being undertaken to the M+E services on site and the first week was beset with delays to our work from plant interruptions and systems not controlling properly (e.g. temperature control in theatres which meant we were unable to achieve required test conditions). Our work therefore took longer than anticipated. During the course of the validation, it also became apparent that some systems were not performing to the correct standard.

There were shortcomings in many 'critical' areas including theatres, HDU areas, isolation rooms and the air handling units (AHU's) serving those areas.

The shortcomings in the HDU areas were identified relatively early in our work but we were advised that there was a derogation in place to reduce the number of air changes required by the client. However, later it appears there was some confusion over the scope of the derogation and the shortcomings in the HDU areas were the subject of discussion between the Health Board and the PFI supply chain. We were made aware that some changes were to be made in the short term to bolster up the performance of HDU areas with a longer term solution being proposed involving an additional AHU and ductwork installations.

During the first week of our work we did an initial round of testing to isolation rooms. We were planning to test these facilities in 'maintenance mode' but the backup system was not fully operational so that final test could not be done at the time and still has not been possible as the backup system is not operational.

Any issues identified in normal mode were being addressed by Multiplex and we were confirming acceptable performance as we re-tested. The exception to this was the individual isolation rooms which were part of the AHU supply to the HDU areas. As large scale adjustments were being made to areas supplied on that AHU system to HDU areas it would have been likely to affect these individual isolation rooms. It was agreed that these rooms would be re-tested on completion of the balancing. Now that the short term system changes have been deferred, once the system settings are restored, it will be necessary to re-test these rooms.

Issues with operating theatres also began to emerge during the second week. There was an expectation/pressure to have these items corrected alongside our validation work. We were formally requested to move into a phase of witnessing planned adjustments to theatre air systems to bring them up to the required standards. This involved IOM, H+V commissioning and Medical Air Technology MAT (where needed for UCV canopies) working alongside each other to make adjustments and agree the numerical values of any

measurements taken; and to come to a consensus that the theatre performance was acceptable for them to be put into use.

Work method

IOM and H+V commissioning re-measured the systems which had shortcomings. During this work it became apparent that for a number of theatres that the volume of the scrub had not been included in the calculation for air supply rates and as such the commissioning engineers had been commissioning to incorrect values. Each theatre was subject to a thorough re-measurement to establish an agreed spacial volume.

Both parties used their own calibrated instruments. All parties relied on H+V to take duct traverse readings and get the supply air volumes to the theatres to the correct level. Thereafter joint readings were taken to establish grille volume readings and pressure differentials around the suite.

There was a slightly different approach on taking balometer readings. IOM used back pressure compensation on their balometer as the equipment manufacturers state that more accurate readings are obtained in this mode. H+V were unable to alter their balometer to use that facility. IOM readings were higher than H+V's, so it was accepted that if satisfactory readings were obtained by H+V then the IOM readings would exceed theirs and also be satisfactory.

Where UCV canopy quadrants were out of balance, correct supply air volumes were set for the system prior to MAT being invited to test the canopies.

In theatres with UCV canopies all grille and differential pressure readings were taken in both modes.

Operating Theatres

As stated earlier, the theatres on site were formally validated by IOM as part of the overall validation exercise. It became apparent as work progressed that there were some elements of their performance that were unsatisfactory and would need further work before theatre spaces were deemed suitable for use. The validation reports are in production, however, the Health Board were facing a tight deadline to be able to open the facility. The Health Board requested all parties to undertake a programme of testing, adjustment and measuring to come to a consensus that the theatre airflows and pressure cascades were satisfactory for safe use of the facility.

Detailed results for the theatres are attached in Appendix 1

Theatre 32 results are not included here as after re-balancing the required results were not achieved It is proposed to re-test theatre 32 during week commencing 15th July and it may be possible to include results in the final version of this report.

Isolation Suites

Positive pressure ventilated lobby (PPVL) isolation suites consist of 3 rooms, a lobby, bedroom and en suite. They can generally be used for source and protective isolation.

The PPVL isolation suites were initially validated during w/com 20th June 2019 and a summary was provided to the health Board w/com 1st July. Since that date, rooms which did not meet the requirements have been adjusted and re-tested. At the date of this report out of all PPVL isolation suites there was only one room (Room 3-C1.1-004) which was a borderline fail and still needed to be adjusted.

A summary of the results for the isolation rooms is listed below:

Room Designation	Facility type	Room No	Bedroom Ach rate	Lobby to corridor pressure (pa)	Comment
Single bed isolation room 1	PPVL	1-H2-021	13.0	13.0	requires 10 ac/hr supply and 10pa
Single bed isolation room 5	PPVL	3-C1.4-072	13.0	20.0	requires 10 ac/hr supply and 10pa
Single bed isolation room 1	PPVL	3-C1.4-052	12.6	12.0	requires 10 ac/hr supply and 10pa
Single bed isolation room 2	PPVL	3-C1.4-049	11.5	10.1	requires 10 ac/hr supply and 10pa
Single bed isolation room 3	PPVL	3-C1.4-043	12.4	12.3	requires 10 ac/hr supply and 10pa
Single bed isolation room 4	PPVL	3-C1.4-040	11.6	12.1	requires 10 ac/hr supply and 10pa
Single bed isolation room	PPVL	3-C1.3-008	13.3	12.0	requires 10 ac/hr supply and 10pa
Single bed isolation room	PPVL	3-C1.1-040	9.4	13.0	requires 10 ac/hr supply and 10pa
Single bed isolation room	PPVL	3-C1.1-036	11.5	11.4	requires 10 ac/hr supply and 10pa
Single bed isolation room	PPVL	3-C1.1-033	10.0	11.0	requires 10 ac/hr supply and 10pa
Single bed isolation room	PPVL	3-C1.1-004	10.8	11.0	requires 10 ac/hr supply and 10pa
Single bed isolation room 5	PPVL	1-L1-068	10.1	10.5	requires 10 ac/hr supply and 10pa
Single bed isolation room	PPVL	1-G-A2-072	10.3	10.5	requires 10 ac/hr supply and 10pa

Single bed isolation room 17	PPVL	2-L2-039	12.2	11.9	requires 10 ac/hr supply and 10pa
Single bed isolation room 16	PPVL	2-L2-135	10.3	14.4	requires 10 ac/hr supply and 10pa

High Dependency areas.

Testing of the high dependency areas identified that the air change rates and pressure cascades did not meet the requirements. In early discussion with the Health Boards Technical Advisors (Mott MacDonald) we were advised that there was derogation in place which reduced the requirements from 10 ac/hr to 4.

The test information was summarised in an initial briefing to the Health Board during w/com 2nd July.

It later transpired that there was some confusion on the detail of the derogation and the Construction supply chain and the Health Board began working on both an interim solution to improve the situation and a longer term permanent solution.

The final results for the high dependency areas were as follows.

Area/Room	Room No	Supply Ac/hr rate	Extract Ac/hr rate	Pressure Differential	Comment
HDU 4 bed bay	1-B1-009	3.4	1.3	8 pa	requires 10 ac/hr supply and 10 pa
HDU 4 bed bay	1-B1-031	3.1	1.3	0.5 and 3.2 pa(2 doors)	requires 10 ac/hr supply and 10 pa
HDU 4 bed bay	1-B1-063	3.2	1.9	+1.5 pa	requires 10 ac/hr supply and 10 pa
HDU single bed cubicle	1-B1-037	3.4	1.5	+ 6.3 pa	requires 10 ac/hr supply, design pressure tba
NNU 3 cot bay	1-B1-065	4.2	1.5	4.3pa to corridor	requires 10 ac/hr supply, design pressure tba
NNU single cot cubicle	1-B1-035	3.2	2.4	-2.3pa to NNU	requires 10 ac/hr supply, design pressure tba
Area/Room	**Room No**	**Supply Ac/hr rate**	**Extract Ac/hr rate**	**Lobby to corridor pressure**	**Comment**
Single bed isolation cubicle 10	1-B1-036	N/A	9.8	9.5	-ve pressure room. Requires 10 ac/hr supply, design pressure tba.
Single bed isolation cubicle 15	1-B1-026	N/A	9.3	8.0	-ve pressure room. Requires 10 ac/hr supply, design pressure tba.

Single bed isolation cubicle 19	1-B1-017	N/A	11.1	12.0	-ve pressure room. Requires 10 ac/hr supply, design pressure tba
Single bed isolation cubicle 20	1-B1-016	N/a	4.6	45.0	-ve pressure room. Requires 10 ac/hr supply, design pressure tba

tba- to be advised

Recovery areas

The recovery areas have been tested as part of the validation work. The SHTM requires 15 air changes supply and extract to these areas and the room pressure would be expected to be relatively neutral to adjacent areas. The results from our tests are shown below. The test results show that many areas do not meet the requirements and in particular the extract rates for all areas are weak. The overall supply and extract systems should be re-balanced to achieve the required results.

Area/Room	Description	Room No	Supply Ac/hr rate	Extract Ac/hr rate	Pressure Differential
Recovery - DCN	Main area	1-P1-109	11.8	10.2	Recovery to corridor, +1 pa and - 1pa (2 doors)
Recovery - DCN	side room	1-P1-025	18.6	13.8	Room to recovery - 0 pa
Recovery - DCN	side room	1-P1-026	13.5	12.6	Room to recovery, +1pa
Recovery - Paeds	Main area	1-P1-029	18.6	13.8	Room to adjacent spaces, -1.6pa and -1.2 pa (2 doors)
Recovery - Paeds	side room	1-P1-030	19.2	12.4	Room to recovery, +2pa
Recovery - Paeds	Side room	1-P1-031	12.4	14.4	Room to recovery, +2pa

Other Issues

The thrust of the validation and witnessing work was to establish whether facilities were fit to use. During the course of the work, it has become apparent that there are other issues with the completed facility which do not meet the requirements of the SHTM or are defects which need to be attended to in due course.

Some initial findings were notified to the Health Board on 27th June. The validation and witnessing exercises have identified some additional items which may need to be addressed depending on the agreed design standard. We have been asked to identify any issues to be included on an issues log to allow all parties to decide who the responsible parties are and on how these should be resolved. The key additional items identified are listed in Appendix 2.

Summary and conclusions

SHTM 03-01 Part A, section 8 describes Validation as 'A process of proving that the system is fit for purpose and achieves the operating performance originally specified. It will normally be a condition of contract that "*The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life.*"

In the case of the critical ventilation systems at the Hospital for Sick Children at Edinburgh Royal infirmary, this is not currently the case.

In particular:

- Theatre 32 needs to be finally witnesses – see appendix 3 for theatre 32
- There is one PPVL isolation room that needs adjustment
- Isolation rooms supplied by the HDU AHU will need to be re-tested once improvement works are completed
- The isolation rooms need to be tested in 'maintenance' mode.
- The ventilation to the HDU areas needs to be altered to meet the required standard.
- There are a number of recovery areas where the supply rates are below requirements
- All recovery areas need the extract rates improving to meet requirements.

The Health Board should therefore insist on further remedial works being undertaken by the PFI supply chain.

Some of the remedial works could be very disruptive to operations so consideration should be given to having some of the work completed prior to occupation.

The Health Board should also consider employing a subject matter expert to ensure that remedial work takes place to a satisfactory standard and to ensure where necessary the Board has the necessary expertise to ensure the supply chain is held to account to meet the contractual responsibilities.

Appendix 1 – Theatre performance data.

The following data was collected as part of the theatre performance improvement and witnessing work with H+V. The final results for Theatre 32 have not been established at this time.

Theatre 30

Remedial works to theatre 30 included:

- Balancing of the 4 grilles to the theatre
- Improvement of extract rate in the dirty utility to meet requirements
- Increasing the extract air in the anaesthetic room to achieve 15 ac/hr/hr.

A summary of the final results are shown below:

Air volumes and air changes

Room	Measured air volume (l/s)	Air changes	Meets requirements?
Theatre supply	1425	26.8	Y
Prep supply	105	11.4	Y
Anaesthetic supply	245	17.4	Y
Anaesthetic extract	261	18.5	Y
Dirty utility extract*	421*	40	Y
Theatre LL extract	377		No figure in SHTM
Scrub extract	103		failed smoke visualisation 27/09/2019
Open door protection	944	N/A	Yes – needs 750 l/s

*Includes extract from a grille supplied by the adjacent theatre

Pressure Differentials

From	To	Measured pressure	Meets requirements **
Theatre	Corridor	24	Y
Theatre	Anaesthetic	13	Y
Theatre	Dirty utility	37	Y
Theatre	Prep	0	Y
Prep	Corridor	24	Y
Anaesthetic	Corridor	11	Y
Corridor	Dirty Utility	8	Y

**The SHTM states (in Notes applicable to Table A2, Part A): 'Nominal room pressures are given to facilitate setting up of pressure relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not critical, provided the desired airflow rates and movement are achieved'.

Theatre 31

Remedial works to theatre 31 on site undertaken by H+V commissioning and MAT as follows:

- Increasing AHU supply volumes to meet requirements in conventional mode
- Increasing the supply volume to the prep room to meet the requirements.

The results are set out below:

UCV Canopy

Test	Result	Comment
2m av. Velocity above 0.38m/s	Pass	
Quadrant balance not exceeding +/- 6%	Pass	
1m velocity – no cells below 0.2m/s	Pass	
Filter integrity/Particle count	Pass	
Entrainment	Pass	

Air volumes and air changes

Room	Measured air volume (l/s)	Air changes	Meets requirements?
Theatre supply (UCV)	1885	35.3	Y
Theatre supply (conv)	1865	35.0	Y
Prep supply(SPS)	103	11.4	Y
Anaesthetic supply	254	17.8	Y
Anaesthetic extract	237	16.6	Y
Dirty utility extract*	448*	42.9	Y
Theatre LL extract	382		No figure in SHTM
Scrub extract	103		failed smoke visualisation 27/09/2019
Open door protection	1380 – worst case (conv)	N/A	Y – needs 750 l/s

*Includes extract air from a grille supplied by the adjacent theatre

Pressure Differentials

From	To	Measured pressure	Meets requirements **
Theatre	corridor	24	Y
Theatre	Anaesthetic	13	Y
Theatre	Dirty utility	31	Y
Theatre	Prep	0	Y
Prep	Corridor	25	Y
Anaesthetic	Corridor	11	Y
Corridor	Dirty Utility	6	Y

**The SHTM states (in Notes applicable to Table A2, Part A): 'Nominal room pressures are given to facilitate setting up of pressure relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not critical, provided the desired airflow rates and movement are achieved'.

Theatre 33

Remedial works to theatre 33 on site undertaken by H+V commissioning and MAT as follows:

- Re balancing canopy to eliminate failing cells at 1m and out of balance quadrants.
- Increasing the extract volume to the dirty utility room to meet the requirement for 410 l/s. ac/hr/hr.
- Increasing the supply and extract volumes to the anaesthetic room to achieve 15 ac/hr/hr.
- Increasing the prep room supply volume to achieve 100l/s and 10 ac/hr/hr

The results are set out below:

UCV Canopy

Test	Result	Comment
2m av. Velocity above 0.38m/s	Pass	
Quadrant balance not exceeding +/- 6%	Pass	
1m velocity – no cells below 0.2m/s	Pass	
Filter integrity/Particle count	Pass	
Entrainment	Pass	

Air volumes and air changes

Room	Measured air volume (l/s)	Air changes	Meets requirements?
Theatre supply (UCV)	1376	25.9	Y
Theatre supply (conv)	1380	25.9	Y
Prep supply (SPS)	105	10.4	Y
Anaesthetic supply	230	16.5	Y
Anaesthetic extract	247	17.8	Y
Dirty utility extract*	452*	43.6	Y
Theatre LL extract	374		No figure in SHTM
Scrub extract	105		failed smoke visualisation 27/09/2019
Open door protection	897 – worst case (UCV mode)	N/A	Y – needs 750 l/s

*Includes extract air from a grille supplied by the adjacent theatre

Pressure Differentials

From	To	Measured pressure	Meets requirements **
Theatre	corridor	31	Y
Theatre	Anaesthetic	15	Y
Theatre	Dirty utility	24	Y
Theatre	Prep	0	Y
Prep	Corridor	31	Y
Anaesthetic	Corridor	14	Y
Corridor	Dirty Utility	6	Y

**The SHTM states (in Notes applicable to Table A2, Part A): 'Nominal room pressures are given to facilitate setting up of pressure relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not critical, provided the desired airflow rates and movement are achieved'.

Theatre 34

Remedial works to theatre 34 on site undertaken by H+V commissioning as follows:

- Balancing of the theatre grilles to within 10%
- Resolving the lack of air in the theatre to provide open door protection
- The broken blade to a pressure stabiliser has been replaced.
- The anaesthetic room extract rate has been increased to meet requirements.

A summary of the results are shown below:

Air volumes and air changes

Room	Measured air volume (l/s)	Air changes	Meets requirements?
Theatre supply	1267	25.7	Y
Prep supply (SPS)	109	11.8	Y
Anaesthetic supply	248	17.7	Y
Anaesthetic extract	235	16.8	Y
Dirty utility extract*	463*	46.1	Y
Theatre LL extract	384		No figure in SHTM
Scrub extract	90		failed smoke visualisation 27/09/2019
Open door protection	793	N/A	Yes – needs 750 l/s

*Includes extract from a grille supplied by the adjacent theatre

Pressure Differentials

From	To	Measured pressure	Meets requirements **
Theatre	Corridor	25	Y
Theatre	Anaesthetic	10	Y
Theatre	Dirty utility	40	Y
Theatre	Prep	0	Y
Prep	Corridor	27	Y
Anaesthetic	Corridor	14	Y
Corridor	Dirty Utility	23	Y

**The SHTM states (in Notes applicable to Table A2, Part A): 'Nominal room pressures are given to facilitate setting up of pressure relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not critical, provided the desired airflow rates and movement are achieved'.

Theatre 35

Remedial works to theatre 35 on site undertaken by H+V commissioning as follows:

- Resolving the lack of air in the theatre to provide open door protection
- Increasing supply air volume to the prep room.
- The anaesthetic room extract rate has been increased to meet requirements.

The theatre grille readings to the theatre seem to be fluctuating over time and there were discrepancies in readings from the 2 different air capture hoods being used.

We have taken the worst case readings which meet requirements but it would be useful if the underlying reasons for pressure fluctuation in the supply AHU and to establishing whether a change in controls set up would help address this.

A summary of the results are shown below:

Air volumes and air changes

Room	Measured air volume (l/s)	Air changes	Meets requirements?
Theatre supply	1312	27.5	Y
Prep supply(SPS)	109	11.9	Y
Anaesthetic supply	225	16.0	Y
Anaesthetic extract	229	16.3	Y
Dirty utility extract*	573*	54.9	Y
Theatre LL extract	350		No figure in SHTM
Scrub extract	102		failed smoke visualisation 27/09/2019
Open door protection	860	N/A	Yes – needs 750 l/s

*Includes extract from a grille supplied by the adjacent theatre

Pressure Differentials

From	To	Measured pressure	Meets requirements **
Theatre	Corridor	34	Y
Theatre	Anaesthetic	19	Y
Theatre	Dirty utility	35	Y
Prep	Corridor	31	Y
Prep	Theatre	0	Y
Anaesthetic	Corridor	13.5	Y
Corridor	Dirty Utility	10*	Y

*Figure corrected from previous report

**The SHTM states (in Notes applicable to Table A2, Part A): 'Nominal room pressures are given to facilitate setting up of pressure relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not critical, provided the desired airflow rates and movement are achieved'.

Theatre 36

Remedial works to theatre 36 on site undertaken by H+V commissioning as follows:

- Increasing AHU supply volumes to meet requirements
- Increasing the extract volume to the dirty utility room to meet the requirement for 410 l/s.

The results are set out below:

UCV Canopy

Test	Result	Comment
2m av. Velocity above 0.38m/s	Pass	
Quadrant balance not exceeding +/- 6%	Pass	
1m velocity – no cells below 0.2m/s	Pass	
Filter integrity/Particle count	Pass	
Entrainment	Pass	

Air volumes and air changes

Room	Measured air volume (l/s)	Air changes	Meets requirements?
Theatre supply (UCV)	1498	28.4	Y
Theatre supply (conv)	1331	25.2	Y
Prep supply (SPS)	106	12.0	Y
Anaesthetic supply	245	17.1	Y
Anaesthetic extract	235	16.4	Y
Dirty utility extract*	412*	45.4	Y
Theatre LL extract	411		No figure in SHTM

Scrub extract	95		failed smoke visualisation 27/09/2019
Open door protection	825 – worst case (conv)	N/A	Y – needs 750 l/s

*Includes extract air from a grille supplied by the adjacent theatre

Pressure Differentials

From	To	Measured pressure	Meets requirements **
Theatre	corridor	33	Y
Theatre	Anaesthetic	20	Y
Theatre	Dirty utility	42	Y
Theatre	Prep	0	Y
Prep	Corridor	28	Y
Anaesthetic	Corridor	12	Y
Corridor	Dirty Utility	8	Y

**The SHTM states (in Notes applicable to Table A2, Part A): 'Nominal room pressures are given to facilitate setting up of pressure relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not critical, provided the desired airflow rates and movement are achieved'.

Theatre 37

Remedial works to theatre 37 on site undertaken by H+V commissioning and MAT as follows:

- Increasing AHU supply volumes to meet requirements
- Increasing the extract volume to the dirty utility room to meet the requirement for 410 l/s.
- Increasing the extract volume to the anaesthetic room to achieve 15 ac/hr/hr.
- Checking canopy balance which had one quadrant as a borderline pass at + 6%

The results are set out below:

UCV Canopy

Test	Result	Comment
2m av. Velocity above 0.38m/s	Pass	
Quadrant balance not exceeding +/- 6%	Pass	
1m velocity – no cells below 0.2m/s	Pass	
Filter integrity/Particle count	Pass	
Entrainment	Pass	

Air volumes and air changes

Room	Measured air volume (l/s)	Air changes	Meets requirements?
Theatre supply (UCV)	1483	27.7	Y
Theatre supply (conv)	1383	25.8	Y
Prep supply (SPS)	113	10.6	Y
Anaesthetic supply	277	19.6	Y
Anaesthetic extract	269	19.0	Y
Dirty utility extract*	504*	47.5	Y
Theatre LL extract	411		No figure in SHTM
Scrub extract	100		failed smoke visualisation 27/09/2019
Open door protection	872 – worst case (conv)	N/A	Y – needs 750 l/s

*Includes extract air from a grille supplied by the adjacent theatre

Pressure Differentials

From	To	Measured pressure	Meets requirements **
Theatre	corridor	22	Y
Theatre	Anaesthetic	9.5	Y
Theatre	Dirty utility	28	Y
Theatre	Prep	0	Y
Prep	Corridor	18	Y
Anaesthetic	Corridor	11	Y
Corridor	Dirty Utility	9	Y

**The SHTM states (in Notes applicable to Table A2, Part A): 'Nominal room pressures are given to facilitate setting up of pressure relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not critical, provided the desired airflow rates and movement are achieved'.

Theatre 38

Remedial works to theatre 38 on site undertaken by H+V commissioning as follows:

- Increasing AHU supply volumes to meet requirements
- Increasing the air volume to the prep room
- Increasing the extract volume to the dirty utility room to meet the requirement for 410 l/s.
- Increasing the extract volume to the anaesthetic room to achieve 15 ac/hr/hr.

The results are set out below:

UCV Canopy

Test	Result	Comment
2m av. Velocity above 0.38m/s	Pass	
Quadrant balance not exceeding +/- 6%	Pass	
1m velocity – no cells below 0.2m/s	Pass	
Filter integrity/Particle count	Pass	
Entrainment	Pass	

Air volumes and air changes

Room	Measured air volume (l/s)	Air changes	Meets requirements?
Theatre supply (UCV)	1526	27.3	Y
Theatre supply (conv)	1443	25.8	Y
Prep supply (SPS)	120	13.8	Y
Anaesthetic supply	250	17.4	Y
Anaesthetic extract	251	17.4	Y
Dirty utility extract*	536*	50.5	Y
Theatre LL extract	441		No figure in SHTM
Scrub extract	122		failed smoke visualisation 27/09/2019
Open door protection	880 – worst case (conv)	N/A	Y – needs 750 l/s

*Includes extract air from a grille supplied by the adjacent theatre

Pressure Differentials

From	To	Measured pressure	Meets requirements **
Theatre	corridor	37	Y
Theatre	Anaesthetic	19	Y
Theatre	Dirty utility	50	Y
Theatre	Prep	0	Y
Prep	Corridor	38	Y
Anaesthetic	Corridor	15	Y
Corridor	Dirty Utility	10	Y

**The SHTM states (in Notes applicable to Table A2, Part A): 'Nominal room pressures are given to facilitate setting up of pressure relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not critical, provided the desired airflow rates and movement are achieved'.

Theatre 39

Remedial works to theatre 39 on site undertaken by H+V commissioning and MAT as follows:

- Increasing AHU supply volumes to meet requirements
- Increasing the extract volume to the anaesthetic room to achieve15 ac/hr/hr.
- Checking canopy balance which had one quadrant out of balance by 13%.

The results are set out below:

UCV Canopy

Test	Result	Comment
2m av. Velocity above 0.38m/s	Pass	
Quadrant balance not exceeding +/- 6%	Pass	
1m velocity – no cells below 0.2m/s	Pass	
Filter integrity/Particle count	Pass	
Entrainment	Pass	

Air volumes and air changes

Room	Measured air volume (l/s)	Air changes	Meets requirements?
Theatre supply (UCV)	1546	28.7	Y
Theatre supply (conv)	1388	25.8	Y
Prep supply(SPS)	116	12.8	Y
Anaesthetic supply	244	17.4	Y
Anaesthetic extract	226	16.1	Y
Dirty utility extract*	436*	42.4	Y
Theatre LL extract	373		No figure in SHTM
Scrub extract	106		failed smoke visualisation 27/09/2019
Open door protection	909 – worst case (conv)	N/A	Y – needs 750 l/s

*Includes extract air from a grille supplied by the adjacent theatre

Pressure Differentials

From	To	Measured pressure	Meets requirements **
Theatre	corridor	36	Y
Theatre	Anaesthetic	22	Y
Theatre	Dirty utility	61	Y
Theatre	Prep	0	Y
Prep	Corridor	36	Y
Anaesthetic	Corridor	15	Y
Corridor	Dirty Utility	11	Y

**The SHTM states (in Notes applicable to Table A2, Part A): 'Nominal room pressures are given to facilitate setting up of pressure relief dampers, the calculation process, and the sizing of transfer devices. In practice, the resultant pressures are not critical, provided the desired airflow rates and movement are achieved'.

Appendix 2 - Other Issues

Listed below are other issues identified as part of the validation and witnessing work. Further details of relevant SHTM/HBN references will be provided as part of the issues log. Items identified are:

- There is a very limited amount of extract in the theatre corridors. Corridors are not at 0 pascal's absolute pressure and the excess air is holding fire doors open and in some cases reducing pressure differentials from theatres to corridors. The installation does not meet required 7 ac/hr/hr (SHTM03-01 part A appendix 2 Table A2)

- There is a large amount of cabling, plastic containment and electrical connectors inside the AHU. In some cases these electrical connectors are very close to filters and the moving parts of the thermal wheels. SHTM 03-01 part A para 1.41 states: 'The equipment built into the ventilation system and its ductwork should be of a type that will neither cause nor sustain combustion'. This arrangement also gives rise to potential electrical faults to cause smoke within the airstream and makes the units difficult to clean effectively. In addition, use of soapy water in cleaning the AHU's can impact on the electrical connections. Where this has happened on other sites the Trust insisted this was removed before the hospital went live due to fire and smoke risk within the AHUs (this was a new high profile NHS emergency hospital and detail of the site can be obtained from IOM).

- There is evidence of excess usage of flexible spiral ductwork in theatre ceilings. SHTM 03-01 part A paras 5.54 and 5.55 state that 'flexible ductwork should never exceed 1m in length' and 'never be used in lieu of a bend'. In addition it should be constructed to meet fire precautions recommended in BS8313. There are several cases where the length of ducting exceeds 1m and is used as bends. Theatre 35 is an example where in one case an 's' bend is formed of flexible ductwork to one of the 4 theatre grilles. The material did not appear to be of a fire rated quality.

- It is believed that the air supply volumes to the theatres were incorrectly calculated by the designers as they did not include the scrub bay volume into the volume calculation for the theatre. Although adjustments have been made to overcome this it has eroded the amount of spare plant capacity/motor speed variation available to overcome additional system pressure drops caused by blocked filters, which occurs with normal use as they get dirty

- The design of some of the supply ductwork to theatres is sub optimal. In some cases the 4 ducts to UCV canopies are off different ducts from the plant areas and the link in points for anaesthetic and prep rooms are not well located. This is likely to leave the UCV's to be vulnerable to the quadrants going out of balance over time. It is an out of balance design.

- There is limited access for maintenance to some parts of the UHU's. As they are regularly located side by side in pair's one whole side of the unit is in accessible. The supply motor located adjacent to the control panel in each AHU looks extremely difficult to change in the event of a failure which could result in excessive down times to Theatres. This is exacerbated by theatres having to operate in pairs due to the dirty utility extract arrangements.

- We have concerns about use of pressure control on the AHU outputs in systems with UCV's. The use of pressure sensors downstream of the AHU and upstream of

UCV canopy theatres has been shown at other hospitals to cause fluctuating or hunting airflows within the UCV canopy. The use of airflow sensors appears to enable a much more stable situation with far less fluctuation

- The extract grilles in scrub areas should have been located at low level to encourage a suitable clean air path and route for any aerosols created to be away from users and also reducing the risk of aerosol from becoming airborne around the theatre suite

- The air system design for dirty utility rooms was for one grille supply volume to ramp up supply when the adjacent theatre was not in use. This has not been achieved in the installation so both theatres must run when one is in use. This represents a complete waste in energy and means that 2 theatres will be unusable in the event of a failure or shutdown of plant.

- The UCV in Theatre 39 was operational and there was no alarm on the surgeon's panel when the supply AHU was not running. Similarly in theatre 34 the surgeon's panel indicated system healthy when the AHU was not running. The cause/effect and alarm indication of each theatre should be re-tested to confirm correct operation

- Supply grilles in anaesthetic rooms are relatively close to the low level extract which can short circuit the clear airflow pathway across the patient in that room.

- There is no user control or indicator panel in the Angio procedure room which allows users to control the plant or indicates whether the plant is operational.

- The noise levels in some rooms are higher than recommended by SHTM 03-01. Although the excess noise is limited, it would not be expected in a new development.

- Several isolation rooms on one AHU. HBN 04-01 supplement 1 (2013) Para 2.37 states that ideally each isolation suite should have its own supply and extract system. Several isolation rooms are supplied by certain air handling units. Although there is a maintenance mode on some rooms, the failure of one of the key AHU's will result in a significant impact on the number of isolation rooms available. In addition, although not yet tested, it is understood that the maintenance mode arrangements were not designed to keep the room air changes and pressures to the full Health Building Note (HBN) requirements.

- We have concerns regarding the thermal wheels used on theatre systems. During the course of our work we have issues when they have been operating. For example it is considered that the high rotational speed will overcome the relatively small purge section and transfer extract air into the supply air path. It is recognised even by manufacturers that thermal wheels have inherent leakage of air between sections so it is unusual for them to be used in theatre systems. We believe the manufacturers should be asked to attend site and witness/confirm that the units are correctly installed and controls are properly set up.

- There are some volume control dampers (VCD's) in theatres which are not accessible for adjustment. (e.g. Theatre 34 – the two grilles nearest to anaesthetic/prep wall). Proper access is needed to these for future adjustments.

- There is insufficient access for cleaning to some parts of the system (e.g. inlets) and multiple access hatches are too small for cleaning/maintenance activities

- Some duct traverse test points are in poor locations (e.g theatre 30 close to a bend) and in some cases holes are not plugged/capped.

- There is a surplus drip tray in most AHU's (possibly where a humidifier was removed). The drip tray drain is not blanked off

- The filter pleat orientation incorrect on top row of final filters and there is some evidence of bypass on pre filters (e.g. Theatre 36).
- The theatre AHU inspection lights on theatre 32 do not operate when the unit is isolated. This would be the case when the unit was being maintained so need to be changed..

- Most glass traps on systems are dirty and most are connected the wrong way around with inadequate air gaps.

- Cooling coil drip tray area not easy to clean. Cooling coil baffles cannot be easily removed due to cable and trunking installation in the AHU.

- The scale of the graduations on the magnahelic gauges is too large to give accurate readings on the filter pressure drop. In addition, they are not marked to show clean and dirty pressure limits.

- Motorised dampers take a long time to open and close which impacts on the speed of auto-changeover. In addition, they do not appear to be spring return (motorised dampers should close in the event of the power failure).

- Auto change over arrangements need to be fully tested. Some MD's do not close on plant isolation and some units will not re-start after both motors have been isolated.

- There is a noisy quadrant fan in the canopy of theatre 38 so this has limited life.

- The plant does not seem to benefit from close control. Theatre 35 air volumes are erratic and give differing readings at different times. Several theatres do not achieve the close temperature control as would be expected from modern controls (eg theatres 34 and 35 had fluctuating temperatures which were mirrored by altering RH readings suggesting that temperature control is partially being met by use of cooling rather than closure of heating valves, i.e. heating and cooling batteries compensating for each other. It is essential that the underlying reasons for these fluctuations is understood and resolved by changes to controls.

- Plant labelling incorrect and shows incorrect areas served. Some direction arrows on ductwork are incorrect and branch ducts where they leave plant areas are not fully marked up to show areas served

- Some AHU motors are running at over 95% speed so there is limited scope for systems to overcome dirty filter pressure drop and maintain system performance.

- There were communication problems between the BMS and one AHU (serving theatre 33). This has probably been corrected but we witnessed regular plant/AHU failures which could not be explained by construction or maintenance staff on site.

- We were unable to locate any duct traverse test points on the Angio and MRI AHU's so could not fully confirm air supply volumes to the area.

- It is not clear if critical plant will operate in stand-alone mode in the event of issues with the BMS or communications systems.

Appendix 3 – Theatre 32 witnessing and subsequent additional findings

Theatre 32 airflows were checked by IOM on Tuesday 1st October 2019

Room	Measured air volume (l/s) UCV	Con	Air changes	Meets requirements?
Theatre suite supply (UCV)	1584			Y
Theatre supply (conv)		1462		Y
Prep supply(SPS)	101	126	10.6/13.21	Y
Anaesthetic supply	235	260	16.5/18.6	Y
Theatre room supply UCV	1248		22.94 including scrub area	N
Theatre room supply conventional		1076	19.8 including scrub area	N
Anaesthetic extract	234	249	16.48/17.5	Y
Dirty utility extract*	512	521	49/50	Y
Theatre LL extract	421	401		No figure in SHTM
Scrub extract	118	111		failed smoke visualisation 27/09/2019
Open door protection	587– worst case (conv)		N/A	N – needs 750 l/s

Note H&V duct traverse 03/07/2019 indicated 1859 l/s which would have been satisfactory in terms of both air change rates in theatre and door protection

Due to the results of the theatre 32 having a significant difference in duct traverse readings, NHS Lothian agreed to IOM carrying out a set of duct traverse readings on 3/10/2019.

This is summarised in the following table

Theatre suite	Design from H&V documents	3/07/2019 H&V Traverse l/s	3/10/2019 IOM Traverse l/s
Theatre 30 AHU 02-09 conventional	1525	1520	1410
Theatre 31 UCV AHU 02-10	1477 total	1885 total ucv 892 TH1 626 TH2 1881 con	1729 total
Comments on T31		892+626=1518 367 l/s less than measured at main traverse	
Theatre 32 UCV AHU 02-12	1850	1859 ucv 1913 con	1584 ucv 1462 con
Theatre 33 UCV AHU 02-11	1800	1775 ucv 1806 con	1896
Theatre 34 Con AHU 14	1525	1797	1717
Theatre 35 AHU 13	1525	1767	1718
Theatre 36 Intra-operative	1800	1847 ucv 1746 con	Not measured due to Work being carried
Theatre 37 UCV AHU 02-16	1477	1827 ucv 1757 con	1548
Theatre 38 UCV ahu 02-15	1750	1863 ucv 1842 con	1948
Theatre 39 AHU 02 -17	1800	1897 ucv 1765 con	1800

This has indicated that theatres 30, 32 and 37 have airflows significantly lower than three months ago.
This impacts on the available door protection in these theatres
At this stage it is uncertain why the airflows have decreased in these theatres and it will be necessary to ensure that following AHU improvements, airflows are re measured and then monitored to ensure that the systems are delivering the correct quantity of air between each planned preventative maintenance period.

MULTIPLEX

Certificate of Sub-Contract Practical Completion

Contractor: Multiplex Construction Europe Limited (Company No 03808946) and having its Registered Office at, One Broadgate, 1st Floor, London EC2M 2QS

Sub-Contractor: Mercury Engineering (Registered in the Republic of Ireland Company No 225667) and having its Registered Office at Mercury House, Sandyford Industrial Estate, Dublin 18

Sub-Contract: Sub-Contract between Multiplex Construction Europe Limited and Mercury Engineering dated 6 and 13 February 2015, Sub-Contract Order Ref 17158/031

Sub-Contract Works: the Mechanical, Electrical and Public Health (MEP) Services comprising part of the design and construction of the re-provision of the RHSC, and DCN at Little France, Edinburgh

Under the terms of the above noted Sub-Contract we hereby certify that in our opinion the Sub-Contract Works were complete in accordance with the Completion Criteria, as set out in the Contractor's Requirements on 22nd February 2019, subject to the exceptions noted in Appendix 1 to this Certificate.

Please note that the issue of this Certificate of Sub-Contract Practical Completion shall in no way affect the obligations of the Sub-Contractor under the Sub-Contract, including in respect of any Defects.

For the avoidance of doubt, this Certificate of Practical Completion is issued on the condition that the Outstanding Works, Defects and/or Snagging Matters specified in Appendix 1 to this Certificate shall be completed/rectified no later than the time periods specified in Appendix 1 to this Certificate.

Signed ---------- **Dated----------**

Appendix 1 to the Certificate of Sub-Contract Practical Completion

Outstanding Work

- **Water Testing**

  - As per the requirements of SHTM 04-01 and L8, the Sub-Contractor shall undertake a full suite of water analysis for all relevant water systems including storage tanks, domestic water, mains water, hot and cold water, and category 5 water systems in full compliance with SHTM04-01, and using the methodology of water testing undertaken by the Sub-Contractor in January 2019, including any further points agreed with the Contractor. The foregoing tests were undertaken by the Sub-Contractor on or around 27 February 2019 ("Water Tests").

  - The indicative results of the Water Tests shall be made available to the Contractor by the Sub-Contractor on or before 5 March 2019. The complete results of the Water Tests have been made available to the Contractor.

  - If the Water Tests results identify any non-compliance with SHTM 04-01, or give reasonable cause for concern by the IT that a future non-compliance may occur, the Sub-Contractor undertakes to address said non-compliance and / or potential non-compliance as a matter of urgency in accordance with the Sub-Contractor's obligations pursuant to the Sub-Contract, taking account of any submissions from the Contractor.

- **Water management regime**

  In accordance with SHTM 04-01, the Sub-Contractor shall provide a suitable and sufficient water safety management regime, specifying the water safety management regime

  The Sub-Contractor shall include in the water safety management regime a flushing regime during the Board's commissioning period which ensures there are no Little Used Water Outlets on the system.

  The Sub-Contractor will be responsible for, and shall provide maintenance services to, the water systems, including without limitation storage tanks, domestic water, mains water, hot and cold water and category 5 water systems until all tests required within the Water Testing section above are complete, and the relevant results demonstrate a compliant water system in accordance with SHTM 04-01 and L8. Where any tests required are returned with out of specification results, the relevant part of the water system, and the maintenance thereof, will remain the responsibility of the Sub-Contractor. Such maintenance obligations shall include the cleaning, disinfection and flushing as appropriate of the part of the water system which is non-compliant. Once such maintenance obligations are complete, the Sub-Contractor shall repeat the tests required and provide the results to the Contractor.

  The process shall be repeated until the relevant results demonstrate a compliant water system in accordance with SHTM 04-01 and L8 and the water systems are handed back to the Service Provider in a compliant manner, together with all associated test results and water management records.

- **Fire detection**

  - Where voids contain either natural gas, medical gas or IPS (Isolated Power Supply) circuitry, automatic smoke detection will be added within these voids.

  - For the fire alarm manual call point, the Sub-Contractor shall provide additional manual call points developed on the basis of the Risk Assessment. The Sub-Contractor shall carry

out and complete works to the fire detection and alarm system in accordance with the Contractors Instructions..

- Completion Criteria – Sub-Contractor shall demonstrate that the following criteria has been achieved:

- The fire detector, manual call point and fire-alarm are re-tested and re-commissioned.

- Cause and effect testing of the fire detector, manual call point and fire-alarm in each zone are complete and proven.

- All mechanical and electrical plant and systems associated with the void detection shall be tested, commissioned and operate satisfactorily in accordance with the specified design criteria, any manufacturers' operating requirements and all other relevant terms of the Sub-Contract

Deadline for completion: 6 June 2019

- **Isolation room heating**

  Completion of Instructed works

  Completion Criteria - Sub-Contractor shall demonstrate that the following criteria has been achieved:

  - The radiant panels are tested, commissioned and operating satisfactorily in accordance with the specified design criteria and any manufacturers' operating requirements.

  - All mechanical and electrical plant and systems associated with the heater batteries shall be tested, commissioned and operate satisfactorily in accordance with the specified design criteria, any manufacturers' operating requirements and all other relevant terms of the Sub-Contract.

  Deadline for completion: 18 May 2019

- **Internal and external foul drainage**

  Completion of Instructed works

  Completion Criteria - Sub-Contractor shall demonstrate that the following criteria has been achieved:

  - The Building Management System is operating satisfactorily in relation to the drainage sump and pumps.

  - All mechanical and electrical plant and systems associated with the internal and external foul drainage shall be tested, commissioned and operate satisfactorily in accordance with the specified design criteria, any manufacturers' operating requirements.

  Deadline for completion: 18 April 2019

- **Other Outstanding Works**

  - Security System – rectify access control doors not operating correctly & CCTV system not showing all camera images on head end
  - Plant room Insulation – rectify insulation within plant rooms that are contributing to overheating issues
  - Outstanding Commissioning
  - NCR's – close out all open NCR's

- Energy Centre Lighting – resolve compliance issue raised by Board to the satisfaction of the Independent Tester
- Oil pipework – rectify leaks currently on system
- Bin Washer pipework – complete trace heating and insulation
- Bib tap pipework – complete trace heating and insulation
- AHU pipework – complete installation of step-overs in plantrooms
- Electrical labelling – complete all labelling to all cables at panels
- Cold Water Storage Tank – complete handrails
- Lab and filter tanks –complete glass traps & early warning pipe
- Complete all outstanding Instructed works
- HV Gas Suppression Controls Demonstration
- BMS critical alarm –
    - SMS & email alerts not proven
    - Environmental proving and trend logs
- Boiler - oil system pressure regulating valve
- Resolution of HV mimic diagram
-

Deadline for completion of above items: 10 May 2019

- Completion of O&M's & BIM Model

Deadline for completion of above items: 13 June 2019

Defects

The Sub-Contractor shall remedy or repair the Defects noted in the Defects Tracker attached at Appendix 2 to this Certificate within the time period noted within the Defects Tracker (Schedule Part 12 Section 1 Appendix C to the Building Contract refers).

Snagging Matters

The Sub-Contractor shall carry out and complete the Snagging Matters outlined in the attached document titled 'Task Management PC' (10 pages) Appendix 3 to this certificate

All Snagging Matters shall be rectified by the Sub-Contractor within eight (8) Business Days of the issue of this Certificate of Sub-Contract Practical Completion.

Appendix 2 to the Certificate of Sub-Contract Practical Completion

Appendix 3 to the Certificate of Sub-Contract Practical Completion

WORKING FOR A HEALTHIER FUTURE

Services Report – P2739 (HDU 031)
Date of Survey – 22nd June 2019

Ventilation Validation

HDU – Room (1.B1.031)

Royal Hospital for Children and Young People and Department of Clinical Neurosciences

REPORT TO CLIENT

VENTILATION VALIDATION

HDU ROOM B1.031

ON BEHALF OF

NHS LOTHIAN
ROYAL HOSPITAL FOR CHILDREN AND YOUNG PEOPLE AND DEPARTMENT OF CLINICAL NEUROSCIENCES.
LITTLE FRANCE CRESCENT
EDINBURGH
EH16 4TJ

REPORT NUMBER: P2730 (HDU 031)

REPORT ISSUED: 5TH NOVEMBER 2019

VERSION: FINAL REPORT

VERIFICATION FREQUENCY – ANNUALLY

Report prepared for: Ronnie Henderson

Validation carried out by: Paul Jameson & Peter Grasby
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Authorised by:

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……
Jeremy Slann BSc (Hons) CEng CMIOSH MIMMM FIHEEM
Director of Occupational Hygiene Services and Healthcare Ventilation
IOM Consulting Ltd.

CONTENTS

EXECUTIVE SUMMARY

SHTM 03-01 requires that critical ventilation systems are verified against design/SHTM standards and that any inability to achieve the recommended standards is classed as a failure. It is not in the remit of a validation/verification company to state whether an HDU suite is fit for use. Rather, this is a judgement for the client and/or clinical department to make, given their knowledge of the particular clinical procedures to be carried out.

This summary highlights where standards have or have not been achieved and is expanded upon in the relevant "Results" sections.

Air Change Rates

HDU Supply: ***did not meet recommendations***

Pressure Differentials

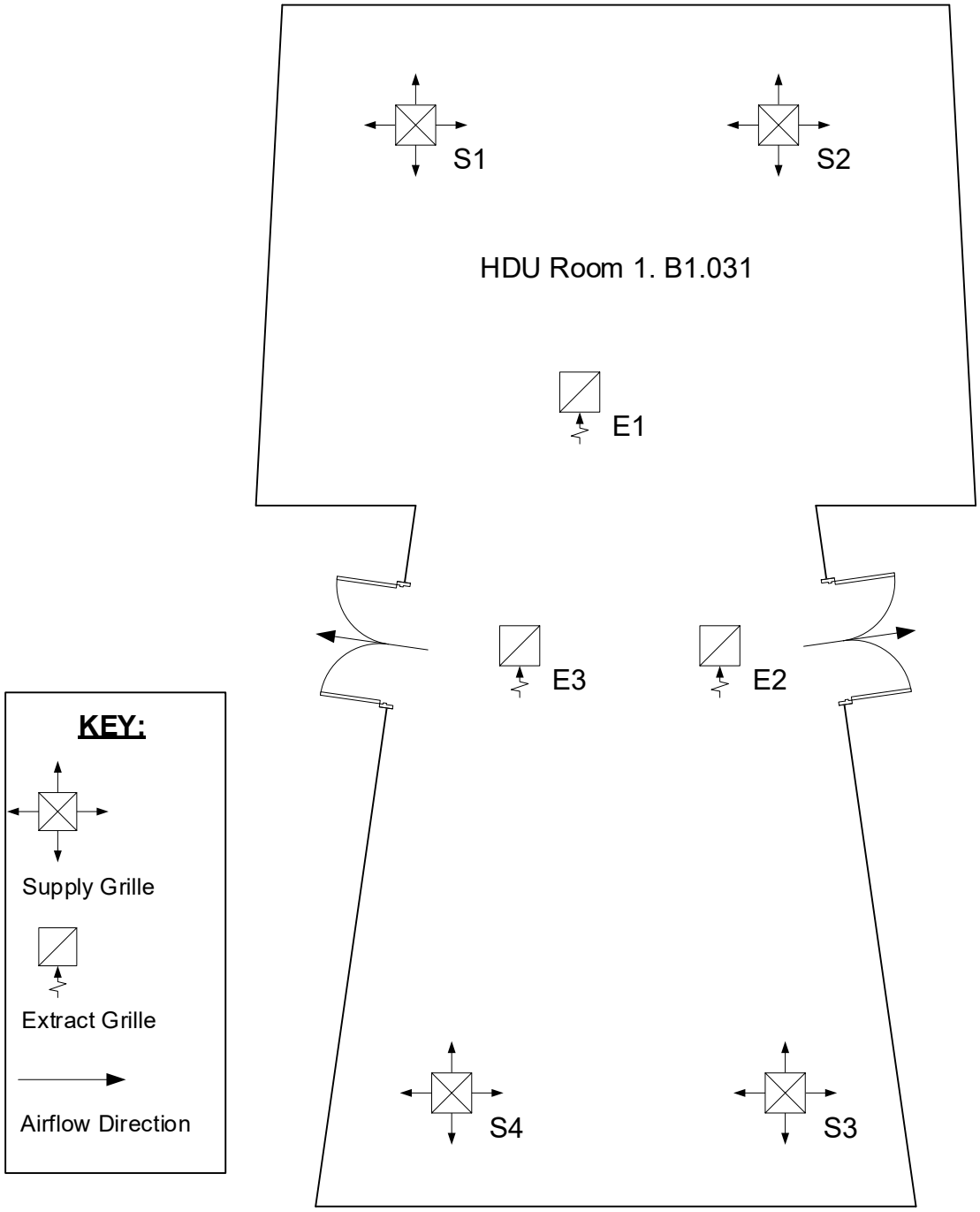
HDU: ***did not meet recommendations***

Noise Levels

HDU: **satisfactory**

SCHEMATIC DIAGRAM

(not to scale)



INTRODUCTION

IOM Consulting Ltd. was requested to undertake the validation of this HDU as required by Healthcare Facilities Scotland; Scottish Health Technical Memorandum 03-01 (SHTM 03-01) - Ventilation for Healthcare Premises.

1 PROCEDURES - Summary

This assessment has been undertaken in compliance with SHTM 03-01

The following tests were carried out;

- Airflow measurements at supply and extract grilles throughout the suite
- Pressure differential measurements throughout the suite
- Noise level measurements as appropriate

A full description of procedures can be found in Appendix 1.

Equipment used:-

Instrument	Manufacturer	Serial number
Balometer	TSI	PH 7311922002
Micromanometer	DPM	8176
Type 1 integrated noise meter	Rion NA 28	00680931
Noise calibrator (calibrated yearly)	CEL 110/2	117453

2 RESULTS

Test criteria: SHTM 03-01 gives recommended minimum quantities of fresh air to be supplied to or extracted from locations in the Critical care areas.

2.1 AIRFLOW VOLUMES

Supply Grilles

HDU

Grille Number/ Location	Measured airflow l/s
S1 / HDU	66
S2 / HDU	62
S3 / HDU	59
S4 / HDU	72
HDU Total	**259**

Extract Grilles

HDU

Grille Number/ Location	Measured airflow l/s
E1 / HDU	25
E2 / HDU	37
E3 / HDU	43
HDU Total	**105**

2.2 AIR CHANGE RATES

Test criteria: SHTM 03-01 recommends air change rates per hour (AC/hr) for the Critical Care Area and Isolation Rooms. The AC/hr is determined by dividing the supply or extract airflow rate per hour by the room volume.

Room	Room Volume m^3	Measured AC/hr	SHTM 03-01 recommended AC/hr
HDU	298.4.	3.1(S)	10

(S) = supply, (E) = extract

2.2.1 Conclusions

HDU supply air change rate **did not meet** the recommendations.

2.2.2 Recommendations

Upgrade the ventilation system to improve the air change rates to the SHTM 03-01 recommendation.

2.3 PRESSURE DIFFERENTIALS

Test criteria: For design calculations, SHTM 03-01 gives nominal room pressure values, the purpose of which is to maintain a hierarchy of cleanliness within the HDU by creating an airflow cascade from clean to less clean rooms. From these values, nominal differential pressures between the rooms can be derived.

Measurement Location	Measured Pressure Differential (Pa)	SHTM 03-01 Pressure Differential (Pa)
HDU to corridor to beds 9-15	3.2	+10
HDU to corridor to beds 16-21	0.5	+10

2.3.1 Conclusions

The pressure differentials **did not create** the correct cascade through the suites to maintain the hierarchy of cleanliness.

2.3.2 Recommendations

Airflows should be improved to provide the required cascade of air within the department.

2.4 NOISE

Location	Measured Noise Levels dB(A)	SHTM 08-01 Noise Limits dB(A)
HDU	33	35

The noise level of the HDU is within the recommended limit.

2.4.1 Recommendations

No further action. Re-verify within 12 months

APPENDIX 1 – PROCEDURES - Detailed

Grille Airflow Volume Measurements
Airflow measurements at supply and extract grilles are determined using an electronic balometer. The balometer incorporates a measuring grid connected to a micromanometer and has an air capture hood which fits over the grille. The hood captures all of the air supplied or extracted by the grille and displays the volume of air flowing. Automatic compensation is provided to allow for the balometer's resistance to airflow (back-pressure compensation).

Each grille is measured in turn and the airflow volume recorded in l/s.

Air Change Rates
The room supply/extract volumes are converted from l/s to m^3/hour and divided by the relevant room volume. This gives the number of air changes per hour (AC/hr) for each room.
HBN4, supp1 states that the air change rate within the isolation room is calculated from the sum total of the extract airflow from both isolation room and bathroom. The room volume is that of the isolation room only.

Pressure Differential Measurements
Pressure differentials in Pascals (Pa) are determined using a micromanometer. In order to measure the pressure across the doors a pitot tube is passed through the gap between or under the doors. This ensures the flexible tube is not trapped which can cause an incorrect reading.

Each pressure differential is measured in turn and the pressure recorded.

An assessment is made of the accuracy of the magnehelic gauge displaying the pressure differential between the lobby and corridor.

Noise Measurements
SHTM 03-01 requires noise levels to be tested using a Type 2 noise meter. For the avoidance of disputes, IOM uses Type 1 noise meters as they have a higher level of accuracy.

Although it is the noise level produced by the ventilation system that is being measured, equipment in the rooms or activity outside the rooms may increase sound levels thus rendering noise readings meaningless in relation to the ventilation system.

On occasion there is too much background noise from equipment within the room to accurately measure the ventilation noise level alone. This is recorded as ‘Excessive Background Noise’.

APPENDIX 2 – CALIBRATION CERTIFICATES

WORKING FOR A HEALTHIER FUTURE

Services Report – P2739 (HDU 037)
Date of Survey – 20th June 2019

Ventilation Validation

HDU –Single Bed Cubicle (1.B1.037)

Royal Hospital for Children and Young People, Edinburgh

A46676816

REPORT TO CLIENT

VENTILATION VALIDATION

HDU ROOM 1.B1.037

ON BEHALF OF

NHS LOTHIAN
ROYAL HOSPITAL FOR CHILDREN AND YOUNG PEOPLE AND
DEPARTMENT OF CLINICAL NEUROSCIENCES.
LITTLE FRANCE CRESCENT
EDINBURGH
EH16 4TJ
REPORT NUMBER: P2730 (HDU 037)

REPORT ISSUED: 5TH NOVEMBER 2019

VERSION: FINAL REPORT

VERIFICATION FREQUENCY – ANNUALLY

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……
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CONTENTS

EXECUTIVE SUMMARY

SHTM 03-01 requires that critical ventilation systems are verified against design/SHTM standards and that any inability to achieve the recommended standards is classed as a failure. It is not in the remit of a validation/verification company to state whether an HDU suite is fit for use. Rather, this is a judgement for the client and/or clinical department to make, given their knowledge of the particular clinical procedures to be carried out.

This summary highlights where standards have or have not been achieved and is expanded upon in the relevant "Results" sections.

Air Change Rates

HDU Supply: ***did not meet recommendations***

Pressure Differentials

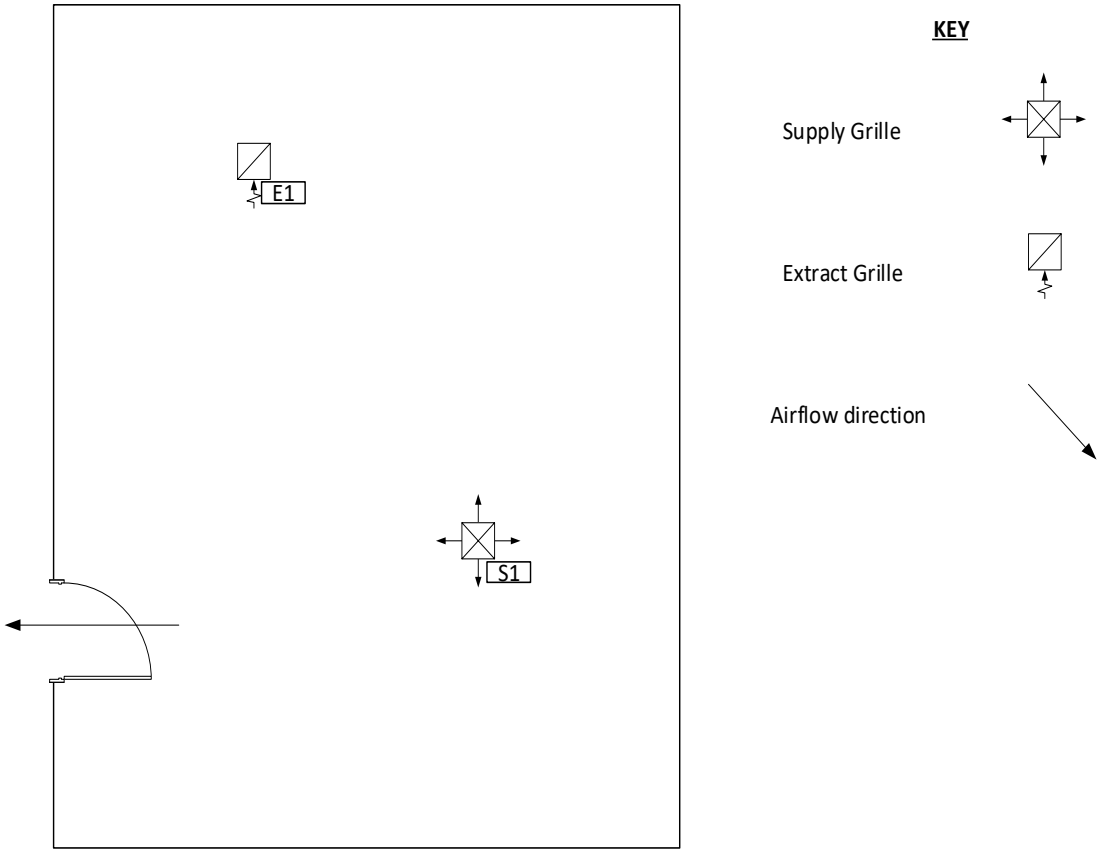
HDU: ***acceptable***

Noise Levels

HDU: **satisfactory**

SCHEMATIC DIAGRAM

(not to scale)



INTRODUCTION

IOM Consulting Ltd. was requested to undertake the validation of this HDU as required by Healthcare Facilities Scotland; Scottish Health Technical Memorandum 03-01 (SHTM 03-01) - Ventilation for Healthcare Premises.

1 PROCEDURES - Summary

This assessment has been undertaken in compliance with SHTM 03-01

The following tests were carried out;

- Airflow measurements at supply and extract grilles throughout the suite
- Pressure differential measurements throughout the suite
- Noise level measurements as appropriate

A full description of procedures can be found in Appendix 1.

Equipment used:-

Instrument	Manufacturer	Serial number
Balometer	TSI	PH 7311922002
Micromanometer	DPM	8176
Integrated noise meter	CEL	00680931
Noise Calibrator		117453

2 RESULTS

Test criteria: SHTM 03-01 gives recommended minimum quantities of fresh air to be supplied to or extracted from locations in the Critical care areas.

2.1 AIRFLOW VOLUMES

Supply Grilles

HDU

Grille Number/ Location	Measured airflow l/s
S1 / HDU	70

Extract Grilles

HDU

Grille Number/ Location	Measured airflow l/s
E1 / HDU	31

2.2 AIR CHANGE RATES

Test criteria: SHTM 03-01 recommends air change rates per hour (AC/hr) for the Critical Care Area and Isolation Rooms. The AC/hr is determined by dividing the supply or extract airflow rate per hour by the room volume.

Room	Room Volume m^3	Measured AC/hr	SHTM 03-01 recommended AC/hr
HDU	73.44	3.4 (S)	10

(S) = supply, (E) = extract

2.2.1 Conclusions

HDU supply air change rate **did not meet** the recommendations.

2.2.2 Recommendations

Upgrade the ventilation system to improve the air change rates to the SHTM 03-01 recommendation.

2.3 PRESSURE DIFFERENTIALS

Test criteria: For design calculations, SHTM 03-01 gives nominal room pressure values, the purpose of which is to maintain a hierarchy of cleanliness within the HDU by creating an airflow cascade from clean to less clean rooms. From these values, nominal differential pressures between the rooms can be derived.

Measurement Location	Measured Pressure Differential (Pa)	SHTM 03-01 Pressure Differential (Pa)
HDU to external corridor	6.3	+10

2.3.1 Conclusions

The pressure differentials **practically created** the correct cascade through the suites to maintain the hierarchy of cleanliness.

2.3.2 Recommendations

Airflows should be improved to provide the required cascade of air within the department.

2.4 NOISE

Location	Measured Noise Levels dB(A)	SHTM 03-01 Noise Limits dB(A)
HDU	33.9	35

The noise level of the HDU is within the recommended limit.

2.4.1 Recommendations

No further action. Re-verify within 12 months.

APPENDIX 1 – PROCEDURES - Detailed

Grille Airflow Volume Measurements
Airflow measurements at supply and extract grilles are determined using an electronic balometer. The balometer incorporates a measuring grid connected to a micromanometer and has an air capture hood which fits over the grille. The hood captures all of the air supplied or extracted by the grille and displays the volume of air flowing. Automatic compensation is provided to allow for the balometer's resistance to airflow (back-pressure compensation).

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SHTM 03-01 requires noise levels to be tested using a Type 2 noise meter. For the avoidance of disputes, IOM uses Type 1 noise meters as they have a higher level of accuracy.

Although it is the noise level produced by the ventilation system that is being measured, equipment in the rooms or activity outside the rooms may increase sound levels thus rendering noise readings meaningless in relation to the ventilation system.

On occasion there is too much background noise from equipment within the room to accurately measure the ventilation noise level alone. This is recorded as ‘Excessive Background Noise’.

APPENDIX 2 – CALIBRATION CERTIFICATES

RHCYP + DCN

Ventilation Action Log

Revised Date: 07/10/2019

Current Date for tracking: 09/10/2019

Issue No.	Item	Action Number	Requirements	Owner	Start Date	Target Date	Action to Close	Open /Closed	Priority to RHCYP	Priority to DCN
General										
V1	Swirl diffusers have been widely used in the development - Not normally used in critical areas like theatres as they can be difficult to measure accurately with balometers and they can impact on wound site velocity	1	These diffusers are compliant with SHTM 03-01		25/06/2019	09/08/2019	TUV Comment 26/07/19 - Air flow simulation issued The simulation demonstrates that the air flow patterns and velocities are in compliance with the requirements of SHTM 03-01 page 63, Section titled Diffuser and Grille Selection and Sizing. We would also note that they are also in accordance with CIBSE Guide B page 2-51, para 2.4.2 3 Grilles installed are as per design specification	CLOSED	YES	YES
V2	Potential discrepancies in Environmental Matrix	1	The project Environmental Matrix should be crossed referenced with what has been provided by IHSL and any discrepancies addressed. It is noted that IOM have, on behalf of NHS Lothian, carried out some validation but this work should be crossed referenced to the Environmental Matrix if not already done.	NHSL	11/09/2019	TBC	Schedule of all clinical accommodation underway listed SHTM/IHSL Design/IOM Measured on site. Matrix of air change rates showing guidance requirement, IHSL design, and IOM actual measurements to be produced with RAG rating of each location.	OPEN	YES	YES
V3	Recommissioning of ventilation system	1	Confirmation is required that all ventilation systems have been balanced and re-commissioned to meet the requirements of the environmental matrix	NHSL/IOM	11/09/2019	TBC	IOM to carry out validation checks Environ Matrix is not the correct reference point. Mandatory contract conditions are. Presumably IOM return visits will verify.	OPEN	YES	YES
V4	snagging inspection	1	Carry out a full snagging inspection of each supply and extract system including theatres, isolations rooms, general areas, catering, etc. This should be followed by “cause and effect” testing to prove all associated graphics, BMS control and graphics.	IOM	11/09/2019	TBC	IOM have already carried this out on each AHU, reports awaited	OPEN	YES	YES
V5	Fire dampers in some locations cannot be adequately tested as duct access has not been provided. Also, locations of fire dampers and fire rated ductwork has been questioned in relation to the requirements of SHTM 03-01 and confirmation of compliant provision is awaited.	1	Provide access so all fire dampers can be readily visually inspected to verify operation. Review fire damper provision and fire rated ductwork and confirm appropriate provision	MPX	11/09/2019	TBC	Access to fire dampers will be corrected as part of the work to air handling units.	OPEN	YES	YES
V6	Some areas are not completed and ready for handover. Eg ceiling tiles still missing	1	CT & Fluoroscopy only areas still affected due to Turnkey works	NHSL	25/06/2019	27/09/2019	IOM on site 25/9 for intraoperative MRI and will confirm status of all radiology areas at that time.	OPEN	YES	YES
V7	The general ward ventilation design is based on four air changes per hour mechanical ventilation plus a component of natural ventilation. With a few exceptions, the mechanical component has been validated. However, design and validation information for the natural component has not been proven.	1	Confirm that all areas served by this arrangement are suitable for categorisation as general ward areas or single rooms as listed in SHTM 03-01 Part a, Appendix 1. Undertake an IPCT risk assessment ward by ward/ speciality specific in relation to the guidance.	NHSL	11/09/2019	03/10/2019	A risk assessment undertaken by IPCT and clinical teams was approved by the OsB on 3/10/19.	CLOSED	YES	YES
V8	The pressure regimen detailed in the design, and reflecting the environmental matrix, will be affected by opening windows and the pressure between the room and the corridor, and therefore direction of air flow, cannot be relied upon when windows are open.	1	A full assessment of the services and patient population should be carried out and mechanisms for monitoring established.	NHSL	11/09/2019	03/10/2019	Ward level risk assessments will recognise the contribution of open windows to the ventilation provided mechanically. A risk assessment undertaken by IPCT and clinical teams was approved by the OsB on 3/10/19.	CLOSED	YES	YES

V9	Air intake location - Air intakes and opening windows are sited in the courtyard below the helipad and at the adjacent RIE. Information has not been provided on the impact of downdraft on air flows and pressures or entrainment of contaminants as per SHTM 03- 01.	1	Demonstrate the effect of helicopter landing on air flows in ventilation systems with intakes below through measurement when test flights take place or through modelling. This should include the air intakes of the RIE adjacent.	BYES	11/09/2019	31/10/2019	Modelling information has been shared with NSS. The effects of test flights on air flows will be measured, however, the date of the test flight is still TBC. BYES to confirm when the Monitor will be delivered.	OPEN	YES	TBC
Theatres										
V10	Preparation rooms	1	Staff should be made aware of the fact that the preparation rooms in the theatres are designated as sterile pack stores.	NHSL	11/09/2019	11/10/2019	Commissioning Managers action Evidence to be provided to HFS to show current NHSL policy is to use them in this way.	OPEN	YES	YES
V11	Some prep rooms do not meet required air supply volumes. (theatres 35, 31, 32, 33 and 38)	1	Should be 100l/s for SPS room. Resolved during validation process, verbally confirmed by Paul Jameson of IOM				SHTM 03-01 100l/s is based on a rooms size, where rooms are slightly smaller, flow rates calculated accordingly. Flow rate calculated on basis of achieving 10ac/h - THE 32 and 33 100l/s all others 90l/s. To avoid lengthy debate all Prep room design volumes increased to a minimum of 100l/s - CLOSED	CLOSED	YES	YES
V12	Very limited extract in theatre corridors. Corridors are not at 0 absolute pressure and do not meet required 7 ach/hr (SHTM03-01 part A appendix 2 Table A2). No escape for surplus air. Could impact on open door protection. Pressure in corridors is pushing fire doors open.	1	To be reviewed by IPCT, All pressure Cascades are compliant.	NHSL/MPX		30/09/2019	MPX have submitted further design information, NHSL to comment by end of 23/09/19. MPX are progressing with the work on the basis that the design meets criteria. Contractor review will take place on 25/09 and expected completion date will be advised after this.	OPEN	YES	YES
V13	Issues with doors, door actuators, closers and interlocking to DU's	1	Repairs now completed, confirmed verbally by Chris Wilson of Multiplex				Doors checked and completed - CLOSED	CLOSED	YES	YES
V14	Concerns about open door protection (eg theatre 34) - Theatre supply 1171, LLE365, scrub 73. Leaves 733 for open door vs required 750.	1	Resolved during validation process, verbally confirmed by Paul Jameson of IOM				Open door protection design was completed in conjunction with the pressure stabiliser specialist. Recorded flow rates noted (particularly theatre supply)looks lower than design and previously commissioned? All Theatres now checked and open door protection criteria achieved -CLOSED	CLOSED	YES	NO
V15	Most theatres do not properly control temperature - There are a number of faulty control valves on plant/heater batteries	1	Faulty valves and actuators replaced, confirmed by David Wilson of Multiplex				Faulty heating actuators / valves replaced. CLOSED	CLOSED	YES	YES
V16	UCV clean zone not marked in flooring - not tape but alternative coloured zone or lines in flooring.	1	Para 7.108 of SHTM 03-01 part A and Para 6.26of HBN 26 which states 'In theatres with ultra-clean ventilation the floor area enclosed by the hood should be marked with lines or contrasting coloured area of flooring'.				Floors now marked - CLOSED	CLOSED	YES	YES
V17	Some fabric issues in theatres (eg holes to fill and under benching gaps to fill)	1	Completed, confirmed by Multiplex				Area previously reviewed with NHSL - Works carried out by others- CLOSED	CLOSED	YES	YES
V18	Theatre 33 - 4 cells fail 0 2 test at 0.17m/s. Filter screen may have been adapted	1	Re-commission UCV - may need HEPA filters as pressure drop is 170pa vs typical 100/110 for clean filters.				Resolved during validation process, verbally confirmed by Paul Jameson of IOM, MAT confirm that filter change threshold is 240pa System passed as part of original commissioning - Re-checked and adjusted where required. Filter dirty condition approximately 240Pa- CLOSED	CLOSED	YES	NO
V19	It is understood that extract grilles in DU are supplied one from each theatre.	1	Systems will need to be interlocked so both theatres are running when any one is in use. Theatre Staff understand that theatres work as a pair	IOM / NHSL		27/09/2019	MPX have provided video evidence of airflow patterns, IOM reviewing information supplied and will comment. MPX/NHSL/IPCT witnessed demonstration on 20/09 and can confirm air flow was from clean to dirty on each occasion. Written confirmation awaited.	OPEN	YES	YES
V20	Dirty utility extract rates do not meet requirements in some Theatres 30, 36, 37, 33, 38. Should be 410l/s.	1	Resolved during validation process, verbally confirmed by Paul Jameson of IOM				Flow rates calculated base on achieving > 20ac/h and pressure cascade. To avoid lengthy debate all Prep room design volumes increased to a minimum of 410l/s - CLOSED	CLOSED	YES	YES
V21	issues on some theatre light stems, covers missing, not well fitted and cabling exposed	1	Ongoing AV works under control of NHSL	NHSL / MPX		27/09/2019	MPX/NHSL to visit area and establish extent of issue	OPEN	YES	YES

V22	Individual grilles in conventional theatres not balanced which can impact on air flows at patient wound site. - BSRIA Guide AG 3/89.3 Table 1 page 10 requires them to be within 10% of lowest grille reading.	1	Resolved during validation process, verbally confirmed by Paul Jameson of IOM				Reviewed and adjusted where required - CLOSED	CLOSED	YES	NO
V23	Noise slightly high in UCV theatres - measurements 3.5 dbA above requirements. We would expect new facilities to meet the SHTM standard.	1	Resolved during validation process, verbally confirmed by Paul Jameson of IOM. One location slightly high +2dba				Previously measured and within limits (UCV commissioning reports). Refer to item on THE38 re faulty fan to be replaced Comment 26/07/19 Theatre 36 & 38 affected - Theatre 36 fan replaced, Theatre 38 fan adjusted, MPX to monitor - IOM to review 09/08/19 RH discussed with IOM can now be closed	CLOSED	YES	YES
V24	UCV hepa filter pressure drops relatively high (140-170 pa) compared with expected 100/110 pa for new filters	1	Resolved during validation process, verbally confirmed by Paul Jameson of IOM, MAT confirm that filter change threshold is 240pa				No issue. Filter dirty condition approximately 240Pa - review by Bouygues regarding replacement MPX to confirm lifecycle of filters with MAT & Bouygues - Comment 26/07/19 - Clean filters 110-140Pa air floe dependant current filters range between 120-156Pa. MAT confirmed that filters were currently good and part of their 6 monthly Checks. Confirmation email sent re pressure and life cycle - CLOSED	CLOSED	YES	YES
V25	Hepa filter screens on UCV are distorted in places	1	Resolved during validation process, verbally confirmed by Paul Jameson of IOM				Any remedial works required carried out - CLOSED	CLOSED	YES	YES
V26	Excessive flexible ductwork in theatre ceilings - Flexible connections greater than 1m and not fire rated to BS8313	1		NHSL		20/09/2018	NHSL to issue close out statement 20/09 - ITEM CLOSED 20/09 this item has been addressed and future issues to be raised through the contact mechanisms	CLOSED	YES	YES
V27	Theatre 38 - Faulty UCV quadrant fan needs to be replaced	1					MAT attending on 25th July to replace the fan - THE36 to be looked at also - Comment 26/07/19 THE 36 fan replaced, THE 38 find adjusted and currently ok - CLOSED	CLOSED	YES	YES
V28	Theatre volumes incorrectly calculated - Scrub room not included in room volume	1					Now included - CLOSED	CLOSED	YES	YES
V29	Theatre Supply ductwork design - The design of ductwork to theatre is sub optimal. In some case the four ducts serving the UCV canopies are off different ducts from plant areas and the link in points for anaesthetic and prep rooms are not well located. The is likely to leave UCV to be vulnerable to the quadrants going out of balance. It is an out of balance design	1					Comments noted. Can be monitored during annual verification - HFS to review. RH to provide drawings to HFS. 06/08/19 drawings available on Aconex	CLOSED	YES	YES
V30	Anaesthetic Room grilles - The supply grilles are relatively close to the low level extract which can short circuit the clear airflow path across the patient in the room	1		IOM/NHSL		27/09/2019	MPX have provided video evidence of airflow patterns in anaesthetic rm 33, IOM reviewing information supplied and will comment. MPX/NHSL/IPCT witnessed demonstration on 20/09 in Anaesthetic rooms 30, 31, 33 & 34and can confirm air flow did not short circuit on each occasion. IOM carried out smoke visualisation test on 27/09 and report to be issued on results.	OPEN	YES	YES
V31	Anaesthetic rooms 31 and 34 do not demonstrate a clean air flow path to reduce exposure of staff to gasses as per SHTM 03-01. Move ceiling supply to opposite side of room from extract. In room 30, move supply away from door.	1	Move ceiling supply to opposite side of room from extract. In room 30, move supply away from door.		11/09/2019	TBC	Demonstration of a clean air path has been requested by 13 September 2019; otherwise the supply will be moved. IOM carried out smoke visualisation test on 27/09 and report to be issued on results.	OPEN	YES	NO
V32	Access to VCDs - There are some volume control dampers in theatres which are not accessible for adjustment (e g. THE 34 - the two grilles nearest to the anaesthetic / prep wall. Proper access needed.	1					Access to VCDs available via hatches and removable light fittings. MPX to check examples listed and confirm accessibility - w/c 29/07/19 02/08/19 MPX - Bracket moved to allow access to VCD when light fitting is removed. - CLOSED	CLOSED	YES	NO

V33	Scrub areas which are narrow and deep are unlikely to be scavenged effectively by theatre air changes and require e alternative means of achieving removal of contaminants as per SHTM 03-01. The efficacy of the high level extract to achieve sufficient dilution of contaminants or entrainment of heavier than air water droplets is not in accordance with the requirements of SHTM 03-01and has not demonstrated as equivalent.	1	The ability of the single high level extract provided in deep plan scrub areas to effectively prevent contaminants being dispersed into theatres should be demonstrated and/or additional low level ventilation provided.	NHSL	11/09/2019	TBC	Evidence to confirm the adequate dispersal of contaminants has been requested. If this not satisfactory then a Board change will be instructed to provide low level ventilation. MPX designers insist that they are compliant, NHSL/HFS to advise how they consider this to be non compliant. At the moment MPX intend to do no more unless this evidence is provided. NHSL to determine if via helpdesk/defect or Board Change. IHSL to undertake either via MPX or BYES Scrub rooms to be fitted with low level extract or IHSL to demonstrate that 25 ac/h is being achieved through scrub. IOM carried out smoke visualisation test on 27/09 and report to be issued on results. ~~IHSL to ev de ce doo p otect o at sc ub doo s co pl a t cu e t arrangement~~ ~~IHSL to nstall add t onal extract to corr dors to prov de 7 ac/h at bala ced p essu e~~	OPEN	YES	YES
V34	Theatre utility rooms Extract ventilation means theatres have to be used in pairs and taking a theatre out of service may reduce the extract in utility room below the levels as per SHTM 03-01.	1	Add supplementary extract ventilation to allow for one theatre being out of service or plan for service impact following the loss of a pair of theatres. NHS Lothian has advised that the appropriate pressure differentials are maintained when only one theatre is operation. Validation evidence is to be provided.		11/09/2019	18/10/2019	IHSL have provided evidence that this arrangement meets the standard. Final checks on this are being completed. IOM carried out smoke visualisation test on 27/09 and report to be issued on results.	OPEN	YES	YES
V35	Angio procedures room -There is no user indicator panel in the angio procedures room which allows the user to control the plant or indicates if there is a plant failure	1		NHSL	11/09/2019	27/09/2019	MPX assert that unit is compliant RH to visit with S Evans to demonstrate and confirm back if happy.	CLOSED	YES	YES
V36	Recovery Room Ventilation - Air change rates below requirement (15ac/h)	1		NHSL/IHSL		27/09/2019	IOM have rechecked, Report issued 30/09. NHSL/IHSL reviewing.	OPEN	YES	YES
Isolation Rooms										
V37	Some isolation rooms not achieving the required 10 ach/hr - Min running at 5 ach and some just under 10	1	Resolved during validation process, verbally confirmed by Paul Jameson of IOM				All rooms previously commissioned / validated and signed off (06/06/19). All rooms re-checked and compliant (note some Fans were found to be off when investigated? 4 rooms on level 1 to be re-checked. Comment 26/07/19 - MPX checked rooms and are as commissioned - to be demonstrated to IOM 29/07/19 Comment 30/07/19 - Demonstrated to IOM 29/07/19	CLOSED	YES	YES
V38	The “maintenance by-pass” associated with the AHU requires to be fully detailed and proven.	1	Details required include: - Full written details for each system Identification of systems which do not have a secondary source of ventilation. Identification of all spaces which will have no mechanical ventilation when by-pass is initiated. The minimum and maximum estimated times for a maintenance by-pass and for recovery of a major fault. The impact of these arrangements on the fire strategy. The strategy for advising clinical staff in the areas affected. Commissioning and validation certificates for the changeover system, all associated controls, revised room volumes and pressures. The clinical service plan should reflect the operational procedures in the event of failure of an air handling unit.	IHSL	11/09/2019	27/09/2019	Information awaited from IHSL: MPX will produce a matrix showing the effect on all rooms in each location when in bypass. - Satisfactory design List of systems that do have back up arrangement To be identified within satisfactory design documents Bouygues response and rectification times To be identified within satisfactory design documents Bouygues notification and escalation procedure To be provided at end of commissioning and validation process Following receipt of the above Full clinical risk assessment to be undertaken for impact in bypass mode and in total failure mode	OPEN	YES	YES

Critical Care										
V39	Critical Care ventilation not in accordance with SHTM 03-01	1	Finalise the design through the Change Process	IHSL	30/08/2019	TBC	IHSL to provide response to HVC 095. After Proposal received, NHSL to review and undertake risk assessment for effect of works on rest of facility; including HAI-SCRIBE	OPEN	YES	NO
AHUs										
V40	The AHU require to be compliant with healthcare guidance,	1	Define protocol for changing fans and components located within the AHU.	IHSL	11/09/2019	TBC	IHSL to undertake either via MPX or BYES	CLOSED	YES	YES
V41	The AHU require to be compliant with healthcare guidance,	1	Light switches to be at an accessible height.	IHSL	11/09/2019	TBC	IHSL to undertake either via MPX or BYES	OPEN	YES	YES
V42	Air tightness	1	To be rectified as part of AHU works. All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage	MPX		TBC	To be reviewed when each AHU is rectified	OPEN	YES	YES
V43	AHU access		NHSL require confirmation that all access doors to AHU's are free from opening restrictions	MPX		TBC	To be reviewed when each AHU is rectified	OPEN	YES	YES
V44	Ductwork section changes		NHSL require confirmation that ductwork section changes comply with SHTM 03-01, Part A, paras 5.35 and 5.36	MPX		TBC	To be reviewed when each AHU is rectified	OPEN	YES	YES
V45	AHU Intake Louvres		NHSL require confirmation that access to intake louvre complies with SHTM 03-01, Part B, para 3.23	MPX		TBC	To be reviewed when each AHU is rectified	OPEN	YES	YES
V46	AHU Drainage		NHSL require confirmation that the borosilicate traps have been suitable cleaned and that a maintenance regime is in place to inspect and clean	MPX		TBC	To be reviewed when each AHU is rectified	OPEN	YES	YES
V47	AHU 04-07 drainage		NHSL require confirmation that brackets and impediments to the appropriate installation of drainage pipework have been removed and that pipe runs have been installed correctly	MPX		TBC	To be reviewed when each AHU is rectified	OPEN	YES	YES
V48	Air flow test points		NHSL require confirmation that appropriate and correctly labelled airflow test points are available on major branches to main ducts	MPX		TBC	To be reviewed when each AHU is rectified	OPEN	YES	YES
V49	cabling inside AHU also cable connectors inside AHU, potential for electrical faults to cause as source of fire within the airstream. Potential for smoke/fume to enter clinical areas. Cables and connectors will be difficult to clean and soapy water used to clean AHU internals may impact on connections		Cabling in airstream - SHTM 03-01 Part A Para 4.12 - "The plant and its distribution system must not contain any material or substance that could cause or support combustion."	MPX		TBC	AHU 02-06 will be available for review 27/09 PM. Intent is to have all associated work except damper closing on power failure completed for this review. NHSL/IPCT/IOM/HFS to attend	OPEN	YES	YES

V50	Filter pleat orientation incorrect on top row of final filters - Should be vertical		SHTM 03-01 Part A Para 8.26 - The quality of filter housing and in particular, the seals is a critical factor in maintaining the efficacy of the filtration system by ensuring that air does not bypass the filter panels. Therefore, the following checks should be made: - filter seals should be fitted and in good condition; - filters should be installed correctly with respect to air flow; - bag filters should be installed so that the bags are vertical and their pockets free; - HEPA filters should be installed in a sealed housing and their seals tested to DIN 1946 if specified; - all filters should be checked to ensure they are free of visible damage; - the differential pressure indicators should be checked for accuracy and that they are marked with the initial and final filter resistance.	MPX		TBC		OPEN	YES	YES
V51	Filter gauges reading low in some cases suggesting filter bypass. Final filter clamping mechanism is ineffective in some units leading to filter bypass. Additionally air flow pushing filters onto the housing.		SHTM 03-01 Part A Para 4.117 - "Filters must be securely housed and sealed in well-fitting frames that minimise air by pass. Air by pass significantly reduces filter efficiency, the higher the filter grade the greater the effect. Mounting frames should be designed so that the air flow pushes the filter into its housing to help minimise air bypass. Mounting frames that withdraw so that the filter can be changed without having to reach into the unit are preferred."	MPX		TBC		OPEN	YES	YES
V52	Magnahelic gauges not marked for clean and dirty limits		Manometer/filter gauges - SHTM 03-01 Part A Para 4.120 - "All filters should be provided with a means of visually checking the differential pressure across them. Direct-reading dial-type gauges marked with clean and dirty sectors are preferred."				All filters monitored by BMS and will alarm when dirty. -Gauges to be labelled clean / dirty as SHTM03-01 clause 4.120. 26/07/19 - Labels ordered. 23/08/19 MPX - Gauges now marked 30-08-19 - Item can be closed.	CLOSED	YES	YES
V53	Insufficient access for cleaning (eg inlets) and access hatches are too small for cleaning/maintenance						Ducts and AHUs have been successful cleaned on two previous occasions with no access issues. Particular attention to be paid to the inlet ductwork (louvre to AHU) some units have no hatch other are very small. Comment 26/07/19 - hatches to be installed in AHU02-13, AHU04-01, AHU04-07 and AHU04-08 Comment 30/07/19 - Access hatches to be fitted 06/08/19 09/08/19 - MPX Hatches now fitted. IOM to inspect	CLOSED	YES	YES
V54	Some duct traverse test points are not plugged							CLOSED	YES	YES
V55	Surplus drip tray in AHU (?humidifier removed?). Tray drain is not blanked off						Specification call for empty space for 'future humidifier c/w drip tray' Caps ordered for drains and will be fitted. MPX to confirm when complete. Comment 02/08/19 - Caps due 09/08/19 09/08/19 MPX - Caps fitted - IOM to check 09/08/19 RH discussed with IOM can now be closed.	CLOSED	YES	YES
V56	Cooling coil drip tray area not easy to clean. Cooling coil baffles cannot be easily removed due to cable installation						Drip tray is fully removable and droplet eliminator is fully removable - CLOSED	CLOSED	YES	YES
V57	Trap arrangements incorrect. No suitable air gaps and traps dirty and incorrectly installed					TBC	Traps installed as per manufactures guidance and sized in relation to AHU pressure designs. Dirty traps to be reviewed. HFS to review on site. 06/08/19 reviewed - insufficient air gap MPX to address	OPEN	YES	YES
V58	Magnahelic gauge scale too wide - 1-500pa whereas 1-250 reflects likely filter pressure drops						Gauges give a clear indication of pressure. The BMS all gives the required information as well. CLOSED	CLOSED	YES	YES

V59	Motorised dampers take a long time to open and close which impacts on the speed of auto-changeover Some MD's do not close on plant isolation No spring return fitted so may not close in the event of power failure.		SHTM 03-01 Part A Para 4.30 - "Motorised low-leakage shut-off dampers should be located immediately behind the intake and discharge of each supply and extract system respectively. They should be of the opposed-blade type, opening through a full 90º and must close automatically in the event of power failure or plant shutdown to prevent any reversal of the system airflow."	MPX		TBC	MPX await statement of compliance from Schneider, will not be complete by 27/9 on demonstration unit but will be part of AHU works.	OPEN	YES	YES
V60	Dampers - Some of the backdraught dampers fitted had deteriorated badly and were in need of repair			MPX		TBC	AHU 02-06 will be available for review 27/09 PM. Intent is to have all associated work except damper closing on power failure completed for this review. NHSL/IPCT/IOM/HFS to attend	OPEN	YES	YES
V61	Plant labelling incorrect and shows incorrect areas served. - Temporary labelling installed. Needs to be permanent.		Identification of labelling - SHTM 03-01 Part B Para 3.60 - "All supply and extract ventilation systems should be clearly labelled. The label should identify both the AHU and the area that it serves. The lettering should be at least 50mm high and be mounted in an easily visible place near the fan of the unit. Any sub-systems and the principal branch ducts should be similarly labelled." Identification of labelling - SHTM 03-01 Part B Para 3.61 - "The direction of air-flow should be clearly marked on all main and branch ducts." Identification of labelling - SHTM 03-01 Part B Para 3.62 - "All air-flow test-points should be clearly identified and the size of the duct given."				Satisfactorily inspected by NHSL 20/09 - ITEM CLOSED	CLOSED	YES	YES
V62	Branch ducts not generally marked up to show areas served						Satisfactorily inspected by NHSL 20/09 - ITEM CLOSED	CLOSED	YES	YES
V63	Auto change over arrangements need to be fully tested. Some MD's do not close on plant isolation and some units will not re-start after both motors have been isolated. Item underlined and in red above moved to item 39 item 42 can now be closed		SHTM 03-01 Part A Para 4.63 - "It is necessary to ensure that - should the computer control system or its software develop a fault - then the fan can be switched to a direct-start, fixed-speed, manual operation. This is particularly important for critical care systems serving operating suites, high-dependency care units of any type, patient isolation facilities, laboratories and pharmaceutical production suites. Off-site software support is no substitute for the ability of on site staff to override the automatic control and keep the system operating in an emergency. Under these circumstances actions that may shorten the life of the plant are considered of secondary importance to that of preserving the health and safety of patients and staff."				Previously tested and operational - please identify relevant AHUs to allow any faults to be rectified. NHSL to confirm with IOM 09/08/19 Update - IOM's concern is that AHU's appear to be difficult to control on manual setting local to AHU. MPX to confirm restart arrangements and manual operation. Confirm restart operations after Generator Test 16/08/19 MPX - AHUs will automatically start after power failure when power is restored. Manual operation can be achieved by turning speed controls / inverters to hand (as demonstrated during FM team training). Further demo to be arranged w/c 19/08/19 16/08/19 - MPX to demonstrate hand control and restart procedure to satisfaction of BYES. 23/08/19 MPX - demonstration successfully carried out 20/08/19 at 3pm - Present - David Wilson & Tony Anderson (MPX), David Gordon, Alan Herkes and James Taylor (BYES), Ronnie Henderson (NHSL), Kenny Whyte (Schneider) 30-08-19 - Item is partially closed. Auto change over arrangement has been demonstrated but issue regarding motorised dampers do not close on plant isolation has not been resolved. 06/09 Update - Close item after moving underlined element in column 1 to item 39	CLOSED	YES	YES
V64	Some motors running at over 95% speed so there is limited scope for system to overcome dirty filter pressure drop and maintain system performance			MPX		04/10/2019	Report expected by 27/09. NHSL & IOM to review information	OPEN	YES	YES
V65	AHU Inspection Light - Theatre 32 inspection lights do not operate when the unit is isolated						To be checked by MPX. Comment 26/07/19 - For safety reasons the main isolator isolates all power to the AHU including internal inspection lights . During maintenance the AHU can be switched off and the motors isolated / locked off locally allowing the lights to stay operational - IOM to comment - CLOSED	CLOSED	YES	NO
V66	Maintenance Access to AHUS - Limited maintenance access to some part of the AHUs As they are regularly located side by side in pairs. The supply motor located adjacent to the control panel in each AHU looks extremely difficult to change in the event of a failure which could result in excessive down time.						Sufficient access is provided to maintain AHUS. All access for maintenance is from one side. Fans and motors can be removed and replaced as has been previously completed on some units. Bouygues to review and comment. Comment 26/07/19 - AHU04-07 Extract has some potential restrictions. MPX/MER to review and rectify. Comment 30/07/19 - to be complete by 02/08/19 02/08/19 - Restriction removed and maintenance access achieved - CLOSED	CLOSED	YES	YES

V67	AHU Thermal Wheels- We have concerns regarding the use of thermal wheels on theatre systems. The high rotational speeds will overcome the relatively small purge section and transfer extract air to supply air path.		The manufacturer should attend site and confirm that they are installed and operating correctly				The Thermal wheels are part of the AHU which has been installed by the manufacturer. Operation has been checked by controls specialist. Schneider to confirm that the thermal wheel have all been checked and are running at the correct speed and that there is no carry over of extract air into supply air. 26/07/19 - NHSL IOM to check once MPX confirm purge section is not compromised. Comment 30/07/19 - Thermal wheel set between 6-12rpm as manufacturers recommendations. IOM to confirm if they experienced issues at 12rpm speed 06/08/19 MPX -Schneider / Qnis to carry out a re-check and record.by 13/08/19 16/08/19 MPX - All AHU thermal wheel checks now complete with all operating at a max level of 12rpm as per manufacturers instructions. report issued	CLOSED	YES	YES
V68	Angio & MRI AHUs - Unable to located main test points						Angio AHU (AHU02-18) has a main set of test holes within plantroom. AHU serving MRI (AHU02-20) has a test point serving majority of system but due to duct configuration a main test point was unachievable. AHU volume flowrate derived from pitot traverse (serving majority of system) plus summation of grille volume flowrates not captured by traverse. - CLOSED	CLOSED	YES	YES
V69	Cooling coil drip tray area not easy to clean. Cooling coil baffles cannot be easily removed due to cable installation		Witnessed the following comment: Drip trays and glass traps dirty. Some drip trays cannot be slid out/removed for cleaning due to pipework having been installed in the way.				Drip tray is fully removable and droplet eliminator is fully removable - demonstration of baffles being removed carried out 07/08/19 .	CLOSED	YES	YES
V70	Inverters - There are some units with inverters also within the airstream		SHTM 03-01 Part A Para 4.12 - "The plant and its distribution system must not contain any material or substance that could cause or support combustion."	MPX		TBC	AHU 02-06 will be available for review 27/09 PM. Intent is to have all associated work except damper closing on power failure completed for this review. NHSL/IPCT/IOM/HFS to attend	OPEN	YES	YES
V71	Dampers - Some multi fan units had no backdraught dampers so would not operate effectively in the event of any fan failure (air would re-circulate in fan section)						All duty / standby fans have backdraft dampers fitted. AHUs (non clinical areas) that use multiple fans to achieve design volumes that are not duty / standby have no requirement for backdraft dampers	CLOSED	YES	YES
V72	Cleaning - Internals of some units not clean.		SHTM 03-01 Part A Para 8.20 - "Should any doubt exist whether the guidance has been observed, the ducts must be cleaned internally to restore them to this standard before being taken into use." SHTM 03-01 Part B Para 5.19 - "AHUs should be vacuumed-out and/or washed down internally as necessary to remove obvious dust and dirt."	BYES		TBC	IHSL to confirm with Bouygues if complete	OPEN	YES	YES
V73	Thermal Wheels - The thermal wheels are on the suction side of the AHU fan meaning any leakage will be entrained into the supply air.		Position of heat recovery device - SHTM 03-01 Part A Figure 1 (Page 21) shows it after fan. Position of heat recovery unit - SHTM 03-01 Pat A Para 4.26 - "The AHU should be arranged so that the majority of items are under positive pressure. Any item of plant requiring a drain should be on the positive pressure side of the fan. A recommended layout is given in schematic from in Figure 3." Contradicted by SHTM 03-01 Part A Para 4.36 - "The following arrangement of plant components is typical although in many instances not all elements will be required: - fresh air intake; - motorised isolation damper; - frost / fog coil; - pre-filter;				16/08/19 As per cabling in AHU issue MPX to submit proposal 23/08/19 - Refer to separate AHU report 29/08/19 - Speed of thermal wheels rectified. Report sent to IOM for comment/Approval 06/09 Update - Item to be closed out as per discussion HFS/NHSL/IOM	CLOSED	YES	YES
V74	Inlet Section - No self-drain arrangements on inlet sections to ahu's		Fresh air inlet drainage - SHTM 03-01 Part A Para 5.10 - "In inherently wet areas, such as the base of fresh air inlet ducts and some extract systems, the ductwork may require draining to prevent a build-up of standing water. The layout of the drains should be as specified in Paragraphs 4.20 - 4.25." SHTM 03-01 Part A Para 3.70 - "The duct behind louvres should be self-draining. If this is not practicable, it should be tanked and provided with a drainage system."	MPX		27/09/2019	MPX progressing	OPEN	YES	YES
Pest Control										
V75	AHUs - Cleaning - Evidence of bird droppings to one unit and one unit has a dead mouse or small bird in the inlet section		SHTM03-01 Part B Para 5.18 - "The intake section of a ventilation system should be vacuumed-out as necessary to remove visible particles."	BYES		24/09/2019	IHSL to confirm with Bouygues if complete.	OPEN	YES	YES

V76	External doors to plant rooms		Alter/replace the external plant room doors to ensure that excessive gaps are removed and appropriate anti vermin measures are applied to all the doors and screens as per SHTM 03-01 and HFS Interim Guidance - Managing the Risk of Contamination of Ventilation Systems by Fungi from Bird Droppings – February 2019.		11/09/2019	30/09/2019	This will be addressed by the end of September. All doors will then comply with the guidance.	OPEN	YES	YES
BMS and Monitoring										
V77	Communication problems between BMS and AHU (eg theatre 33)		These are observations and were passed to IHSL (for Hard FM) on receipt for action				Fault rectified - communication now available - CLOSED	CLOSED	YES	YES
V78	It is not clear if critical plant will operate in stand alone mode in the event of issues with BMS or comms						Units can be switched to hand should there be a catastrophic failure of BMS. - CLOSED	CLOSED	YES	YES
V79	AHU Pressure Controls - The use of pressure control sensors downstream of AHU but upstream of UCV canopy has been shown at other hospitals to cause fluctuating or hunting airflows within UCV canopy. The use of air flow sensors appears to have be more stable THE 35 air volumes are erratic and give differing readings at different times			NHSL/IOM		27/09/2019	IOM still reviewing and have double checked some items while on site.	OPEN	YES	YES
V80	UCV and Theatre Surgeons panel alarms - When the UCV was operational in THE 39 but the AHU was not running there was no alarm on the Surgeons panel. Similarly in THE 34 the surgeons panel indicated healthy when the AHU was not running						Connectivity to be checked between Surgeons panels and BMS. MPX to confirm and evidence operating correctly. Comment 26/07/19 - Plant alarms checked and are replicated on Surgeons panel with the exception of when the AHU is locally switched off. Fault to be rectified by 31/07/19 02/08/19 MPX - rectified and checked. to be demoed to IOM 05/08/19 16/08/19 IOM checked and confirmed OK on 15/8 item closed	CLOSED	YES	YES
V81	Plant control temperature Control - The plant dose not appear to benefit from close control. Several Theatres do not achieve close temperature control (THE 34 and 35 had heater batteries operational and cooling coils open to reduce heat?		Various AHU heater batteries have been isolated?	MPX		11/10/2019	Logs expected from Schneider by 27/09. NHSL / IOM to review information	OPEN	YES	YES

OPEN	39
CLOSED	42

High Value Change Notice - DRAFT

Project:	**RHCYP + DCN – Little France Edinburgh**

1 – Issue of Change Notice to Project Co			
Title:	**Paediatric Critical Care and Haematology / Oncology Ventilation**		
Reference No: 0107		**Date:** **TBA**	
Target Cost Capital:	**£4.6m**	**Target Cost Revenue:**	**TBA**

High Value Change Requirements (Schedule Part 16, Section 4, Clause 2.1.3)

Single bedrooms and Multi-bedrooms in Paediatric Critical Care

In accordance with Schedule Part 16 (Change Protocol), Project Co is required to design, manufacture, supply, construct, test, commission and complete, and thereafter throughout the Operational Term, provide Services to, maintain, repair, renew and replace, a ventilation system or systems which will deliver **10 air changes/hour at +10pa** as per SHTM 03-01, Appendix 1, Table A1 to the following rooms at the Facilities:

Room Number	Room Type
1-B1-065	*Neo Natal 3 cot area* including 1-B1-022 – *Corridor*, 1-B1-069 – *Staff Base*, 1-B1-066 – *Clean Utility* and 1- B1-071 – *Resus Bay* which are all open to 1-B1-065
1-B1-075	*Single cot cubicle neo natal* including *1-B1-074 en-suite*
1-B1-063	*Open plan bay 4 bed*
1-B1-037	*Single bed cubicle*
1-B1-031	*Open plan bay 4 bed*
1-B1-021	*Single bed cubicle*
1-B1-020	*Single bed cubicle*
1-B1-019	*Single bed cubicle*
1-B1-009	*Open plan bay 4 bed*

Isolation Rooms in Paediatric Critical Care

In accordance with Schedule Part 16 (Change Protocol), Project Co is required to design, manufacture, supply, construct, test, commission and complete, and thereafter throughout the Operational Term, provide Services to, maintain, repair, renew and replace, a ventilation system or systems for a positive pressure ventilated lobby PPVL Single Bedroom Isolation Suite with a lobby air supply terminal with a HEPA filter, as per SHTM 03-01, SHPN 04-01, Supplement 1: Isolation Facilities in Acute Settings (Version 1.0 September 2008) Table 1, to the following rooms at the Facilities.

Project Co may utilise the supply and extract ventilation system description in SHPN 04-01, Supplement 1, Clause 4.5 for a dedicated ventilation system per Suite or SHPN 04-01, Supplement 1, Clause 4.8 for a common ventilation system to multiple Suites as the basis of their design. If Clause 4.8 is selected as the basis of design, a duplicate supply unit is considered necessary. A combination of both methods may be used provided Project Co, as far as is reasonably practical, reuse the existing ventilation installations. Regardless of option chosen, all aspects of the design and installation must be technically compliant with all relevant guidance.

NHSL require to remove or significantly reduce the risk of losing all isolations rooms due to a single point of failure. Ideally each isolation room would benefit from its own supply and extract, however, NHSL appreciate this may not be possible or practical due to other constraints e.g. space. Therefore, Project Co are requested to provide their best practical solution to reduce the risk as low as possible but maintaining guidance criteria as per SHTM 03-01, SHPN 04-01, Supplement 1: Isolation Facilities in Acute Settings (Version 1.0 September 2008) Table 1.

Room Number	Room Type
1-B1-016	Isolation Bedroom
1-B1-017	Isolation Bedroom
1-B1-026	Isolation Bedroom

1-B1-036	Isolation Bedroom

Single bedrooms and Multi-bedrooms in Haematology and Oncology

In accordance with Schedule Part 16 (Change Protocol), Project Co is required to design, manufacture, supply, construct, test, commission and complete, and thereafter throughout the Operational Term, provide Services to, maintain, repair, renew and replace, a ventilation system or systems which will deliver **10 air changes/hour at +10pa** as per SHTM 03-01, Appendix 1, Table A1 and fit Hepa filters (H12 grade) to the air inlets to the following rooms at the Facilities:

Room Number	Room Type
3-C1.4-059	Single Bedroom
3-C1.4-057	Single Bedroom
3-C1.4-055	Single Bedroom
3-C1.4-046	Single Bedroom
3-C1.4-032	Single Bedroom
3-C1.4-018	Single Bedroom
3-C1.4-016	Single Bedroom
3-C1.4-013	Single Bedroom
3-C1.4-010	Single Bedroom
3-C1.4-074	Single Bedroom
3-C1.4-076	Single Bedroom
3-C1.4-078	Single Bedroom
3-C1.4-084	Multi-Bed (3) Day Care
3-C1.4-061	Multi-Bed (6) Day Care

Isolation Rooms in Haematology and Oncology

In accordance with Schedule Part 16 (Change Protocol), Project Co is required to design, manufacture, supply, construct, test, commission and complete, and thereafter throughout the Operational Term, provide Services to, maintain, repair, renew and replace, a ventilation system or systems for a positive pressure ventilated lobby PPVL Single Bedroom Isolation Suite with a lobby air supply terminal with a HEPA filter, as per SHTM 03-01, SHPN 04-01, Supplement 1: Isolation Facilities in Acute Settings (Version 1.0 September 2008) Table 1, to the following rooms at the Facilities.

Project Co may utilise the supply and extract ventilation system description in SHPN 04-01, Supplement 1, Clause 4.5 for a dedicated ventilation system per Suite or SHPN 04-01, Supplement 1, Clause 4.8 for a common ventilation system to multiple Suites as the basis of their design. If Clause 4.8 is selected as the basis of design, a duplicate supply unit is considered necessary. A combination of both methods may be used provided Project Co, as far as is reasonably practical, reuse the existing ventilation installations. Regardless of option chosen, all aspects of the design and installation must be technically compliant with all relevant guidance.

NHSL require to remove or significantly reduce the risk of losing all isolations rooms due to a single point of failure. Ideally each isolation room would benefit from its own supply and extract, however, NHSL appreciate this may not be possible or practical due to other constraints e.g. space. Therefore, Project Co are requested to provide their best practical solution to reduce the risk as low as possible but maintaining guidance criteria as per SHTM 03-01, SHPN 04-01, Supplement 1: Isolation Facilities in Acute Settings (Version 1.0 September 2008) Table 1.

Room Number	Room Type
3-C1.4-040	Isolation Bedroom
3-C1.4-043	Isolation Bedroom
3-C1.4-049	Isolation Bedroom

3-C1.4-052	Isolation Bedroom
3-C1.4-072	Isolation Bedroom

(the "**Ventilation Works and Services**").

All environmental requirements for all spaces in the Facilities served by or affected by the Ventilation Works and Services systems shall be met and maintained – including but not limited to, temperature and control, lighting levels, noise, and humidity. These should be consistent to the agreed parameters throughout the Facilities to meet the specific clinical and operational needs for each space in the Facilities.

The Ventilation Works and Services shall fully comply with SHTM 03-01 requirements which includes, without limitation, implementation of the Ventilation Works and Services so that the system installation, finishes and maintenance regime shall be in accordance with SHTM 03-01 requirements, together with the clinical and operational constraints identified below:

1. All Ventilation Works and Services shall be carried out and monitored after and with reference to a collaborative full Stage 3 HAI SCRIBE assessment being approved by the Board.
2. The fire strategy and systems agreed for the Facilities will be maintained throughout the Ventilation Works and Services and the Operational Term and such that the ventilation systems will integrate with the fire strategy and systems and all other building management systems comprised in the Facilities.
3. The location of the installation within the rooms, external areas, route across such spaces and the take out of any windows, etc, will enable the current operational functionality and safety policies and procedures to be maintained.
4. The design, layouts, finishes and other details etc for the Ventilation Works and Services, at all stages (including during the design development stages), will require to be agreed with the Board's Representative (and in turn the clinical service and related stakeholders and Project Co recognises that in order to achieve agreement from the Board's Representative's the Board's Representative will seek input from the Board and all appropriate stakeholders.
5. Design must provide resilience in compliance with SHTM 03-01 to ensure performance of ventilation to rooms during maintenance downtime.

The Board will, in consultation with Project Co, continue to review costs as the design develops and at other stages. In order for the Board to assess whether the High Value Change Stage 2 Submission offers it value for money the submission shall include as a minimum the following information:

- A detailed and fully quantified pricing schedule for the construction works
- A detailed breakdown of all Preliminaries and general cost items
- Construction issue drawings and specification
- Proposed, construction and commissioning/testing programme
- Construction phase method statement

Date by which parties are required to meet to review the High Value Change Notice and agree the content for the High Value Change Proposal (Schedule Part 16, Section 4, Clause 2.3.1)	**TBA**

To: **IHS Lothian**

We require the Change described above.
Please advise when Project Co will submit a High Value Change Proposal for the above.

Signed on behalf of NHS Lothian: ……..

Name of Signatory (type or print): ……Brian Currie – Board Rep – NHS Lothian……

Date: ……

WORKING FOR A HEALTHIER FUTURE

Services Report P4884-1
Date of site work January/February 2021

Ventilation Validation

Royal Hospital for Children and Young People And Department of Clinical Neurosciences

Areas

1-B1 PICU & HDU

1-H2 Clinical Research Facility

1-J1 Bereavement Suite

REPORT TO CLIENT

VALIDATION AUDIT

ON BEHALF OF

NHS LOTHIAN
ROYAL HOSPITAL FOR CHILDREN AND YOUNG PEOPLE & DEPARTMENT OF CLINICAL NEROSCIENCES
LITTLE FRANCE CRESCENT
EDINBURGH
EH16 4TJ

REPORT NUMBER: P4884-1

REPORT ISSUE DATE: 2ND MARCH 2021

VERSION: DRAFT

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Report prepared by:

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.....
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Jeremy Slann BSc(Hons) CEng CMIOSH MIMMM FIHEEM
IOM Consulting Ltd.

CONTENTS

1 INTRODUCTION

IOM were appointed by NHS Lothian Health Board to validate the critical ventilation systems at the Royal Hospital for children and young people.

The validation process involved undertaking a number of measurements and checks with the overall purpose of ensuring that the whole system operates correctly and meets the requirements of SHTM 03-01 or standard agreed as part of the design process.

2 DESIGN ASSURANCE STATEMENT

John M Rayner, Authorising Engineer of Turner Professional Engineering Services (TPES) issued a design assurance statement on the 4th February 2021 following site visit on 19th to 21st January 2021; see Appendix A and B respectively for full statements. Turner confirmed the standard of installation and the commissioning activities of the new Air Handling Units meet the full requirements of SHTM 03-01. Turner further considered that the units are fit for their projected purpose if these installations are adequately maintained.

3 AHU FACTORY VISIT

Paul Jameson, Authorising Engineer (Ventilation) of the institute of Occupational Medicine undertook a factory visit on 20th July 2020; see Appendix C for Full Statement. Paul Jameson confirmed the Daikin Air Handling Units were superior to the original Sandometal Unit. Overall, Paul Jameson was satisfied the units were, in his opinion, satisfactory.

4 HEPA FILTER INTEGRITY TEST

Filter Integrity test were carried out to the Isolation Rooms in the PICU and HDU (1-B1) by H&V Commissioning Services Ltd on the 12 February 2021: See Appendix D. This was performed to confirm that installed filter systems are properly installed by verifying the absence of bypass leakage in the installation, and that the filters are free of defects in accordance to ISO 14664-3:2009.

All HEPA filters tested passed the integrity test of <0.01% particle penetration.

Room Number	Isolation Room	Particle Penetration Reading (%)
B1-033	Isolation Room 16	<0.01
B1-015	Isolation Room 05	<0.01
B1-018	Isolation Room 06	<0.01
B1-025	Isolation Room 10	<0.01

5 IOM CONFIRMATORY READINGS

IOM carried out confirmatory readings and compared data with H&V commissioning services of all the grilles in 1-B1, 1H1-1 and 1-J1 based on the Hoare Lea design data through January and February 2021. During this time all three parties along with the NHS Lothian made changes as required in line with SHTM 03-01. Section 6 is the final reading carried out by IOM. In line with the rest of the work carried out at RHCYP a k factor of 1.2 was applied throughout with the exception of

the Isolation rooms in which k factor of k 1.11 was applied based on reading supplied by H&V Commissioning Service Ltd.

6 AREAS VENTILATION DETAILS

Notes
1.Open plan to larger area. Overall supply volume in larger area satisfies compliance.
2. Rooms with no supply air identified achieve fresh air make-up via corridor (excess supply air from other spaces).
3. Isolation bedroom receives supply air from lobby through pressure stabiliser and extract via ensuite. This room achieves SHTM 03-01 compliance of 10AC/H.

1-B1 PICU & HDU

Room Number	Room Name	Grille Number	Volume	Supply Design Airflow Rate (l/s)	Supply Actual Airflow Rate (l/s)	Supply Design (ac/hr)	Corrected (ac/hr)	Extract Design Airflow Rate (l/s)	Extract Actual Airflow Rate (l/s)	Extract Design (ac/hr)	Corrected (ac/hr)	Pressure	Filter
1-B1-002	Retrieval Equipment Store	EG14	33.36					23	21	2.5	3	Negative	None
1-B1-003	Staff Room	SG57	85.05	143	140	**6**	7					Negative	F9
1-B1-003	Staff Room	EG51	85.05					190	162	8	8		
1-B1-004	Senior Charge Nurse Office	SG39	28.89	32	33	**4**	5					Positive	F9
1-B1-004	Senior Charge Nurse Office	EG32	28.89					24	20	3	3		
1-B1-005	WC - Staff	DEG21	6.96					12	11	6	7	Negative	None
1-B1-006	WC - Staff	DEG22	8.4					14	14	6	7	Negative	None
1-B1-007	Equipment Service Room	EG47	65.34					111	94	6	6	Negative	F9
1-B1-007	Equipment Service Room	SG63	65.34	74	70	**4**	5						
1-B1-009	Bay 1	EG42A, EG42B, EG42C	311.85					550	504	6	7.0	Positive (11Pa)	F9
1-B1-009	Bay 1	SG52, SG53, SG54, SG55	311.85	856	810	**10**	11						
1-B1-010	Gas Cylinder Store	EG37	5.04					10	26	7	22	Negative	None
1-B1-011	Multidisciplinary Work Area PICU	EG40	44.01					49	42	4	4	Negative	F9
1-B1-019	Single Room 8	EG38	70.2					78	73	4	4.5	Positive (10Pa)	F9
1-B1-019	Single Room 8	SG46	70.2	195	185	**10**	11						
1-B1-020	Single Room 7	EG29	70.2					45	45	2.3	2.8	Positive (11Pa)	F9
1-B1-020	Single Room 7	SG44	70.2	195	227	**10**	14						
1-B1-021	Single Room 9	EG28	70.47					59	60	3	3.7	Positive (11Pa)	F9
1-B1-021	Single Room 9	SG43	70.47	192	195	**10**	12						
1-B1-027	Clean Utility	SG45	49.68	85	85	**6**	7					Positive (11Pa)	F9

Room Number	Room Name	Grille Number	Volume	Supply Design Airflow Rate (l/s)	Supply Actual Airflow Rate (l/s)	Supply Design (ac/hr)	Corrected (ac/hr)	Extract Design Airflow Rate (l/s)	Extract Actual Airflow Rate (l/s)	Extract Design (ac/hr)	Corrected (ac/hr)	Pressure	Filter
1-B1-028	Bed/Patient Chair / Buggy Storage	EG25	17.04					14	18	3	5	Negative	None
1-B1-029	Dirty Utility	DEG18	50.03					85	110	6	9	Negative	None
1-B1-031	Bay 2	EG26A, EG26B, EG26C	298.35					374	291	4	4	Positive (11Pa)	F9
1-B1-031	Bay 2	SG33, SG34, SG35, SG36	298.35	832	784	10	11						
1-B1-032	Patients' Assisted Bathroom	DEG16	21.33					59	51	10	10	Negative	None
1-B1-037	Single Room 17	EG19	72.36					82	68	4	4	Positive (12Pa)	F9
1-B1-037	Single Room 17	SG30	72.36	82	224	10	13						
1-B1-041	Clean Utility	SG32	21.33	37	35	6	7					Positive	F9
1-B1-042	Multidisciplinary Work Area HDU	EG21	41.31					46	39	4	4	Negative	F9
1-B1-043	Laboratory	EG41	25.92					45	40	6	7	Positive	F9
1-B1-043	Laboratory	SG51	25.92	45	45	6	8						
1-B1-045	Quiet / Interview Room	EG13	21.5					40	30	6	6.0	Negative	F9
1-B1-046	Store - Equipment	EG18	128.385					71	148	2	5	Negative	None
1-B1-047	Family Interview Room	EG35	33.48					47	41	5	5	Positive	F9
1-B1-047	Family Interview Room	SG41	33.48	50	53	6	7						
1-B1-048	On call consultant	SG40	28.62	48	47	6	7					Positive	F9
1-B1-048	On call consultant	EG34	28.62					20	32	2.5	5		
1-B1-049	Retrieval Team	EG16	29.04					32	27	4	4.0	Negative	F7
1-B1-051	Data Manager & Secretarial Office (3 person)	EG33	58.86					49	47	3	3	Positive	F9
1-B1-051	Data Manager & Secretarial Office (3 person)	SG38	58.86	97	92	6	7						
1-B1-055	Waiting Area (Visitors)	EG31	44.88					50	44	4	4	Positive	F9
1-B1-055	Waiting Area (Visitors)	SG37	44.88	90	85	5	8						
1-B1-056	WC - Wheelchair accessible	DEG19	10.6					30	25	10	10	Negative	None
1-B1-057	X-Ray Processing	EG44	21.6					48	42	8	8	Positive	F9
1-B1-057	X-Ray Processing	SG60	21.6	48	46	8	9						
1-B1-058	Mobile X-Ray / Ultrasound Bay	SG56	8	20	18	8	10					Positive	F9
1-B1-058	Mobile X-Ray / Ultrasound Bay												
1-B1-059	Cardiac Echo/ECG Bay	EG43	9.6					20	17	7	8	Negative	None
1-B1-060	Seminar Room	EG49	91.26					190	151	7	7	Positive	F9
1-B1-060	Seminar Room	SG58, SG59	91.26	190	191	7	9						
1-B1-061	Disposal Hold	DEG23	26.73					45	38	6	6	Negative	None

Room Number	Room Name	Grille Number	Volume	Supply Design Airflow Rate (l/s)	Supply Actual Airflow Rate (l/s)	Supply Design (ac/hr)	Corrected (ac/hr)	Extract Design Airflow Rate (l/s)	Extract Actual Airflow Rate (l/s)	Extract Design (ac/hr)	Corrected (ac/hr)	Pressure	Filter
1-B1-062	WC - Staff	DEG17	8.4					14	13	6	7	Negative	None
1-B1-063	Bay 3	EG15A, EG15B, EG15C	277.29					347	295	4.5	5	Positive (13Pa)	F9
1-B1-063	Bay 3	SG24, SG25, SG27, SG27	277.29	772	776	**10**	12						
1-B1-064	Dirty Utility	DEG15	38.07					57	51	6	6	Negative	None
1-B1-065	Neonatal Bay 4	EG10B, EG10C	126.36					122	113	3.5	4	Positive (11Pa)	F9
1-B1-065	Neonatal Bay 4	SG16, SG17, SG18	126.36	545	510	**10**	17						
1-B1-066	Clean Utility (Neo-Natal) Part of Room B1-065	SG20	22.41	107	108	10	21					Positive (11Pa)	F9
1-B1-067	Medical Gas Store	EG23	5.76					10	12	6	9	Negative	None
1-B1-068	Baby Infant / Feeding Room	DEG13	12.52					36	33	10	11	Negative	None
1-B1-069	Staff Base 4 Part of Room B1-065	EG10A	13.8					26	22	4	7	Negative	F9
1-B1-072	Play Specialist Base & Store	EG12	19.09					21	17	4	4	Negative	F9
1-B1-073	Pantry / Milk Store	EG11	24.12					54	40	7	7	Negative	None
1-B1-074	Neonatal Cot 22 - Ensuite	DEG14	11.2					38	29	10	11	Negative	None
1-B1-075	Neonatal Cot 22	SG19	40.77	113	110	**10**	12				Extract via Ensuite		F9
1-B1-077	DSR	DEG11	18.72					32	31	6	7	Negative	None
1-B1-078	Relative Overnight Stay Room 1	SG14	24	24	23	**4**	4					Positive	F9
1-B1-079	Relative Overnight Room 1 Ensuite	DEG09	14.88					25	22	6	6	Negative	None
1-B1-080	WC - Relatives	DEG10	7					12	10	6	6	Negative	None
1-B1-082	Relative Overnight Stay Room 2	SG13	24.72	24	26	**4**	5					Positive	F9
1-B1-083	Relative Overnight Room 2 - Ensuite	DEG12	10.8					18	16	6	6	Negative	None
1-B1-084	Relatives' Sitting Room	SG15	50.22	48	46	**3**	4.0					Positive	F9
1-B1-090	Equipment Cleaning	EG22	21.06					36	34	6	7.0	Negative	None

1-H2 Clinical Research Facility

Room Number	Room Name	Grille Number	Volume	Supply Design Airflow Rate (l/s)	Supply Actual Airflow Rate (l/s)	Supply Design (ac/hr)	Corrected (ac/hr)	Extract Design Airflow Rate (l/s)	Extract Actual Airflow Rate (l/s)	Extract Design (ac/hr)	Corrected (ac/hr)	Pressure	Filter
1-H2-001	Disposal Hold	DEG08	27.54					46	44	6	6	Negative	None
1-H2-002	Waiting Play Area	SG11	33.48	50	46	**5**	5					Balanced	F9
1-H2-002	Waiting Play Area	EG08	33.48					50	41	5	5		
1-H2-004	Reception	SG12	10.26	10	15	**3**	6.3					Positive	F9
1-H2-005	WC Accessible Patients	DEG07	12.42					31	30	10	10	Negative	None
1-H2-006	DSR	DEG06	19.1					32	32	6	6	Negative	None
1-H2-007	Office - 4 person	SG10	54	60	55	**4**	4.4					Positive	F9
1-H2-007	Office - 4 person	EG07	54					38	34	2.5	3		
1-H2-009	Consulting Room 2	SG09	32.94	27	27	**3**	3.5					Positive	F9
1-H2-009	Consulting Room 2	EG06	32.94					23	22	2.5	2.9		
1-H2-010	Consulting Room 1	SG08	42.66	35	34	**3**	3.4					Positive	F9
1-H2-010	Consulting Room 1	EG05	42.66					92	30	3	3.0		
1-H2-011	WC Staff	DEG03	6.83					12	13	6	7	Negative	None
1-H2-012	Pantry	EG02	17.5					31	28	7	7	Positive	F9
1-H2-012	Pantry	SG03	17.712	26	29	**6**	7.1						
1-H2-013	Store - Equipment	EG09	57.24					40	38	2.5	3	Negative	None
1-H2-014	Bay 1	SG05	176.58	148	148	**3**	3.6					Positive	F9
1-H2-014	Bay 1	EG03	176.58					148	123	3	3.0		
1-H2-015	Bay 1 - Ensuite	DEG05	16.2					41	40	10	11	Negative	None
1-H2-016	Sample Processing	SG07	41.04	92	103	**8**	11					Positive	F9
1-H2-016	Sample Processing	EG04	41.04					68	73	6	8		
1-H2-017	Dirty Utility	DEG04	18.9					33	31	6	7	Negative	None
1-H2-020	Clean Utility	SG04	21.33	36	45	**6**	9					Positive	F9
1-H2-022	Room 5 - Ensuite	DEG01	10.2					29	24	10	10	Negative	None
1-H2-024	Single Room 5	SG01	42.39	47	55	**4**	5.6				Negative via Ensuite		
1-H2-027	Room 5 - Ensuite		4.32						16	3	13	Negative	None

1-J1 Bereavement Suite

Room Number	Room Name	Grille Number	Volume	Supply Design Airflow Rate (l/s)	Supply Actual Airflow Rate (l/s)	Supply Design (ac/hr)	Corrected (ac/hr)	Extract Design Airflow Rate (l/s)	Extract Actual Airflow Rate (l/s)	Extract Design (ac/hr)	Corrected (ac/hr)	Pressure	Filter
1-J1-002	WC - Wheelchair accessible	DEG20	10.6					31	25	10	10.2	Negative	None
1-J1-003	Viewing Room	SG61	46	60	52	**4**	4.8					Negative	F7
1-J1-003	Viewing Room	EG46	46					70	76	6	7.1		
1-J1-004	Sitting Room with Beverage Bay	SG62	54	60	56	**4**	4.5					Negative	F7
1-J1-004	Sitting Room with Beverage Bay	EG45	54					67	76	5	6.1		

Isolation Rooms

Room Number	Room Name	Grille Number	Volume	Design Airflow Rate (l/s)	Actual Airflow Rate (l/s)	Corrected Actual (Ac/Hr)	Lobby Pressure WRT Corridor*	Filter
1-B1-015	Lobby 5	SG50	16.2	225	208	50	11	H14
1-B1-016	Single Room 5 Isolation	DEG31	70.2	197	186	11		
1-B1-017	Single Room 6 Isolation	DEG30	70.2	199	198	11	11	H14
1-B1-018	Lobby 6	SG49	15.93	248	253	63		
1-B1-025	Lobby 10	SG42	17.01	248	264	62	13.1	H14
1-B1-026	Single Room 10 - Isolation	DEG29	89.1	257	274	12		
1-B1-033	Lobby 16	SG31	17.76	248	327	74		
1-B1-036	Single Room 16 Isolation (Negative Isolation Room)	DEG28	72.9	426	449	25	-10	H14
1-H2-018	Single Room 4 Isolation	DEG02	11.61	192	138	49		
1-H2-021	Single Room 4 (Isolation)	via lobby	40.5			10		
1-H2-021	Single Room 4 (Isolation)	via ensuite	40.5			10		
1-H2-023	Single Room Lobby 4	SG02	16.2	140	150	37	11	H14

7 CONCLUSIONS

Based on the information provided by NHS Lothian;

- Design Assurance Statement by Turner PES
- Site Visit by Turner PES
- AHU Factory Visit by IOM
- HEPA Filter Integrity Tests by H&V Commissioning Ltd
- IOM On-Site Grille Readings
- Hoare Lea RHYCP + DCN (HVC107) ACH Verification Document

The system is acceptable at the time of validation. It is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life.

APPENDIX A - TPES DESIGN STATEMENT

Turner Property Services Limited
t/a Turner Professional Engineering Services (TPES)
65 Craigton Road, Glasgow, G51 3EQ, United Kingdom
Tel: +44 (0)141 309 5530 | *Email:* info@turnerpes.co.uk

NHS Lothian Health Board
Waverley Gate
2-4 Waterloo Place
Edinburgh
EH1 3EG

4 February 2021

Dear Sirs,

Supplemental Agreement No.2 ("SA2"): Ventilation Works

Design Assurance Statement

References:

A. Hoare Lea – MEP Engineering, Stage 4 Report: Rev 7, dated 2 Feb 21.
B. Air Handling Unit Technical Specifications.
C. Air Handling Unit Manufacturer's Drawings
D. Requests for Information (RFIs) 01 – 063.
E. AE Trip Report 20210129 -RHCYP&DCN.

I confirm in my capacity as Lothian Health Board's Authorising Engineer (Ventilation) that I have completed a review of IHS Lothian Limited's design response to HVC 107 as detailed in the following documentation as it exists on 4 February 2021 (together Part B of the Scope) and confirm to the NHS Lothian Health Board my opinion that the contents and design proposals therein should allow Project Co to meet the requirements of Part A of the Scope.

I have monitored the design development and I consider that it should be possible for the design included in Part B of the Scope to meet the requirements of Part A of the Scope. This is not an acceptance on my part of any design liability.

I have witnessed the standard of installation and the commissioning activities of the new Air Handling Units and consider that they meet the full requirements of SHTM 03-01. I further consider that these units are fit for their projected purpose if these installations are adequately maintained.

Yours Faithfully [redacted]

Eur Ing John M Rayner, BSc (Eng), CEng, FIHEEM, FCMI, MIMechE, MIET, MSVHSoc, TechIOSH

APPENDIX B - TPES SITE VISIT

Trip Report - Ventilation
NHS Lothian Board – RHCYP & DCN
19 – 21 January 2021

Background

1. I was asked to visit the worksites and assess the quality and standards of remedial project work in early December. A lot of the work was incomplete at the time, and a subsequent visit was requested. Due to flight restrictions I arranged to travel to Edinburgh on Sun 17 Jan and then to carry out additional work for NHS Lothian on Mon 18 Jan. I visited the RCHYP & DCN working areas during the next few days. I also attended the in-house routine meetings on Tue 19 Jan in person rather than by MS "Teams".

2. I visited one large and all of the smaller AHUs to assess the standards of design and installation work. I was escorted by Dean Riddell (NHSL Project team) and Darren Forbes (Imtech Senior Projects Manager) throughout this visit.

AHU 04-07

3. This large equipment is located in the Level 4 plant room. The air intake is from the nearby roof area. The anti-vermin seals on this roof access double doorway were still incomplete as I had noted in Dec 20. Darren Forbes agreed to sort out this non-operational problem.

4. The intake louvres did not appear to have a separate anti-vermin screen but were constructed in an effective labyrinth pattern section. These louvres should be easy to maintain by pressure washers from the outside. The lower surface of the ductwork inside the building sloped down to the lower intake louvre level and there were no intake drainage issues.

5. The temperature sensors and anti-frost coil were well constructed. The primary filter housing frame was also well constructed, and the filters were soundly held on the upstream side. The heat recovery coils were in good condition and no problems with their operation were reported. The chiller and heater battery supply pipes were well insulated and included isolation valves. The chiller drainage tray was well constructed with good interior slopes. The borosilicate trap was not fitted as there was an interference fit with the other external water pipes in that area. Darren Forbes reported that this problem was currently being addressed.

6. The final filter frame was well constructed, and filters were held on the upstream side of the frame - the bag pleats were all vertical. The duct test points were in the nearby ductwork towards the end of a straight section. The test points were all plugged but were not labelled as the insulation had been removed in this area for IOM testing work.

7. In summary, the installation has been well designed, constructed and installed. The door to the roof still needs remedial anti-vermin sealing. The AHU drainage systems still need their final assembly and fitting.

Level 2 Roof AHUs

8. AHU Cabins. The two new AHU cabins that contain four and one AHU have now been almost fully fitted out. Their interior designs are sound and provide good access to the five AHUs for routine inspection and maintenance.

9. The AHU intakes are located on the side away from the building in separate louvred intakes. The exterior parts of these intakes have large louvred cowls to prevent rainwater, etc. ingress. These units include anti-vermin screens.

10. The intake sections were well designed. No problems were reported with the operation of the motorised dampers and the frost coils had conventional detector units. All of the hot water pipe systems were well insulated and additionally were fitted with trace element heating. The intake filter mounts were soundly constructed and the filter units securely mounted. I noted that while the lower bank of (large) filter cartridges had their pleats vertical the upper level bank of (small) filter units had their pleats vertical. All of these filter

pleats should be vertical. Darren Forbes noted that the manufacturer did not provide the small units with the filter pleats in the other orientation. I did not consider this to be a significant problem for these types of non-bag filter unit.

11. The two fans were mounted vertically in the airstream with VSD controls. No problems were reported with their operational characteristics. The energy recovery system uses a run around coil system with well insulated supply systems. These included isolation valves.

12. The chiller batteries were supplied with 30% glycol mix. The pipes were well insulated and had isolation valves fitted. The condensate trays were well designed with good drainage gradients. The borosilicate traps were not fitted at the time of my visit. The post trap drainage systems were amalgamated under the cabin floors and routed into the neighbouring plant room where the air gap was located. These systems were reportedly fitted with trace element heating systems and had the required drainage slopes.

13. The chiller drainage systems (borosilicate trap, air gap & tundish) were not in place at the time of my visit. See my later comments.

14. External roof areas. The main raised access walkways were in place. The inspection hatch for unit 4 crosses the walkway at a relatively low elevation and in addition there is an inspection hatch mounted on the lower surface, further reducing headroom. I strongly recommend that this is provided with adequate padding and warning notices.

15. In addition, the 4-AHU cabin escape route is alongside the parapet wall, squeezing between the 1-AHU cabin and the wall. This area has been used to route the LV power cables for both AHU cabins on a “big foot” support racking system. This has been damaged in this area and needs repair. It also needs to have the vertical support pillars reduced in height and a walkway installed at the lowest possible elevation so that the parapet wall is not at an unsafe relative height.

Level 1 Grassy Knoll AHUs

16. AHU Cabin. I visited this installation while Imtech were starting to assemble the AHU drainage system for these four smaller AHUs. They observed that the lower level AHU drainage system (borosilicate trap and tundish) would have to be located under the working floor level. I noted that this would be acceptable as the floor is a non-slip grid structure supported at a reasonable height above the local ground level. I considered that visual checks of this trap and maintenance access would be relatively easy to make by the operations & maintenance staff.

17. I recommended that one tundish should be positioned for each side of the cabin so that each vertical pair of units could use this as a common drainage route. The two drains could then be joined under the floor level for eventual transmission to the main hospital drainage system. Imtech agreed to this concept and noted that they may have to use a sump pump arrangement in this location because of the relative drainage elevations. I agreed that I would consider this to be an acceptable arrangement if it was located after the tundish assembly.

18. The AHUs in this cabin appeared to be identical in construction to the ones outside the Level 2 plantroom and the above drainage comments should also be applied to those cabins.

19. I was unable to closely inspect the AHUs in this area due to the drainage works described above. The detailed equipment comments made for the Level 2 cabins should be applied to this installation.

20. External areas. The emergency escape route from the cabin led to an area bounded by the AHU output ducts on both sides. There is then about a 3m clear space from the cabin to the area wall. If this is considered to be an insufficiently sized safe area it would be quite easy to climb over a lower level duct to further evacuate to the nearby escape door in the wall. I recommend that this latter route should be clearly marked on the insulated cover of the duct. I did not feel that any support structure was required.

Summary of outstanding problems

21. The Level 4 plant roof access door requires vermin proofing.

22. The AHU drainage system for AHU 04-07 should be completed in a satisfactory manner before handover.

23. The work in the three AHU cabins to install the chiller drainage systems was being undertaken at the time of my visit. This should be completed before handover.

24. Some practical problems concerning the access and emergency exit routes to the three AHU cabins at both areas need to be addressed.

Conclusion

25. I consider that these works meet the requirements of SHTM 03-01 if the problems summarised above are completed in a satisfactory manner.

[redacted]

J M Rayner
Authorising Engineer (Ventilation)

APPENDIX C – IOM AHU FACTORY VISIT

David Holmes

From: Paul Jameson [redacted]
Sent: 21 July 2020 13:51
To: Henderson, Ronnie
Cc: Darren.Forbes[redacted]
Subject: AHU factory visit

Hi Ronnie

It was nice to catch up yesterday and look at the proposed new air handling units for the changes to the critical care areas at the site.

I as discussed on the day the physical inspections we made indicate that the Dakin units look superior to the previous Sandometal units installed on site.

We used the 26 point checklist of issues developed by you from the previous units and no significant issues were identified.
seems to have been complied with on these units.

I would confirm that the filter housings were far superior to the previous air handling units and the airflow pushes both primary and final filters into the housings and onto sealing strips.

The drip trays were easily accessible for cleaning and we witnessed that water introduced to them flowed out smoothly and there was no ponding noted.

There were minor improvement opportunities noted on site with respect to magnahelic gauge scales and location of high level isolators and it was agreed that changes would be made prior to delivery to siste.

It was noted that the grid flooring may need an access panel to get to the glss traps when installed and that trps exposed to the elements would benefit from trace heating so they do not freeze and break in cold weather. It was agreed that these adjustments could be accommodated in the site installation work.

The large units will need access arrangements for maintenance and we witnessed the removal of one of the high level access doors which would be needed on site for maintenance.

We jointly witnessed the air handling unit volume supply test one large and one small unit. The small unit this demonstrated over 20% spare capacity and 40% on the largr unit.

The leakage test on both units also met requirements.

We had a discussion about the additional fine insect mesh on the louvers. The fine insect mesh is over and above the expectation of the HTM and could over time become blocked over time. However, if this was a request of Bouygues, as they are the maintainer, they will need to ensure they stay clean.

The units will be supplied without controls and Darren seems to be acutely aware of the need to avoid internal cabling and components.

The units come with lighting pre-installed and this was in steel conduit with robust electrical connectors which can be kept clean.

There was an outstanding question about the clearance for the spring return actuator on the motorized dampers particularly in the units contained in cabins. It is understood that Darren will be confirming that there is sufficient space for the actuators.

Overall, the units are in my opinion satisfactory and I stated earlier far superior to the previous units used on the site.

If you require any further input on this issue, please let me know.

Paul

Paul Jameson
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Authorising Engineer (Ventilation)
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APPENDIX D – HEPA FILTER INTEGRITY TEST

LEVEL 1 ISOLATION ROOMS

HEPA FILTER INTEGRITY TEST

RHCYP & DCN - EDINBURGH

Client:	Imtech	**Client Contact:**	Darren Forbes
Hospital:	RHCYP & DCN - Edinburgh	**Site Address:**	Little France Crescent, Edinburgh
Area:	Isolation Rooms 1st floor	**Report No:**	AG01250221
Date of Test:	12th February 2021	**Date of Last Test:**	n/a
Report Preparation:	Alan Gourdie	**Signature:**	[redacted]
H&V Approval:	John Reilly	**Signature:**	[redacted]
Client Reviewed by:		**Signature:**	

RHCYP & DCN - EDINBURGH

Table of Contents

RHCYP & DCN - EDINBURGH

Section 1 – Scope of Works

To carry out HEPA Filter Integrity testing on the supply HEPA filters fitted in the Lobby of each of the 4 Isolation Rooms with the 1st floor of RHfC & YP, Edinburgh.

It is assumed that all rooms are commissioned to SHTM03-01 guidelines.

To pass, the HEPA filters will be tested to achieve a leakage rate of ≤0.01%.

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Section 2 - Executive Summary/Observations:

All filters and seals tested and passed.

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Section 3 - HEPA Filter Integrity

OBJECTIVE

Test performed to confirm that installed filter systems are properly installed by verifying the absence of bypass leakage in the installation, and that the filters are free of defects (small holes and other damage in the filter medium, frame, seal and leaks in the filter bank framework).

PRE-REQUISITES

- Supply airflow rates have been measured and within specification.
- **Smoke generator** – ISO14644-3:2019, 3.6.1 *aerosol generator*
- **Photometer** – ISO14644-3:2019, 3.6.2 *aerosol photometer*
- **Calibration certificates** – required for the above and appended to the test report.

METHODOLOGY

The test will be performed by introducing an aerosol challenge upstream of each HEPA filter and scanning immediately downstream of the filters and support frame, in accordance with ISO14644-3:2019, B.7.2 *Procedure for installed filter system leakage scan test with an aerosol photometer.*
A test report will be prepared which will include confirmation of the methodology used, results of testing for each filter, whether each test is a **pass** or **fail**, the location of any detected leaks and indication of the position and extent of any repairs and calibration certificates for all test equipment used.

ACCEPTANCE CRITERIA

- Aerosol concentration readings must be $\leq$ 0.01 % of the upstream concentration within Grade A (ISO 5) and Grade B (ISO 5) of the upstream concentration within Grade C (ISO 7) and Grade D (ISO 8) rooms.
- A test report is prepared which includes confirmation of the methodology used, results of testing for each filter, whether each test is a **pass** or **fail.** If a fail is recorded replace the filter and retest.
- Attach copy of calibration certificates for all test equipment.

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Section 4 – Level 1 - Isolation Room 1-B1-033

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Isolation Room 1-B1-033	Lobby supply Grille	18	<0.01	Pass
Comments: Filter and seal passed; test carried out by Michael Cameron 12-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n 1025732	2nd December 2021

Section 5 – Level 1 - Isolation Room 1-B1-015

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Isolation Room 1-B1-015	Lobby supply Grille	12	<0.01	Pass
Comments: Filter and seal passed; test carried out by Michael Cameron 12-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n 1025732	2nd December 2021

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Section 6 – Level 1 - Isolation Room 1-B1-018

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Isolation Room 1-B1-018	Lobby supply Grille	11	<0.01	Pass
Comments: Filter and seal passed; test carried out by Michael Cameron 12-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n 1025732	2nd December 2021

Section 7 – Level 1 - Isolation Room 1-B1-025

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Isolation Room 1-B1-025	Lobby supply Grille	12	<0.01	Pass
Comments: Filter and seal passed; test carried out by Michael Cameron 12-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n 1025732	2nd December 2021

Section 8 - Calibration Certificates

TRACEABLE CERTIFICATION & CALIBRATION REPORT

Digital Aerosol Photometer

Customer : H & V Commissioning Services Ltd

Envirtonmental Conditions		
Temperature	21.5	°C
Ambient Pressure	101.1	kPa

Model	ATI 2i
Serial No.	34011
WIP	7675
SR	SR24369

Air Techniques International
4 Campus 5
Letchworth Business Park
Letchworth Garden City
Hertfordshire
SG6 2JF
United Kingdom

Telephone
+44 (0)1462 676446
Facsimile
+44 (0)1462 486078

Email
salesuk@atitest.com

Website
http://www.atitest.com

Registered in England
No. GB 3889548

VAT Number
GB 770862705000

Calibration Equipment

	Multimeter	Electronic Balance	Flowmeter
Model	RS-14 Digital Multimeter	HP220DC	Mass Flowmeter
Serial Number	180516553	D455800028	F165086/01
Cal Due Date	Nov-21	Jun-21	Oct-22

Calibration Data

Volumetric Flow: L/min ± 5% of reading

Test Point	Measurement	2i Output	ABS ERROR	Allowed ERROR	Cal status
As Found	28.50	28.40	0.10	1.4	Pass
As Left	28.30	28.50	-0.20	1.4	Pass

Stray Light: Volts

	As Found	As Left
Stray Light	0.000248	0.000326

ONDINA Concentration: 100 µg/L ± 10% of Reading*

Test Point	Generator	2i Output	ABS ERROR	ALLOWED ERROR	CAL Status
As Found	100.00	106.00	-6.00	10	Pass
As Left	100.00	100.60	-0.60	10	Pass

PAO Concentration: 100 µg/L ± 10% of Reading*

Test Point	Generator	2i Output	ABS ERROR	ALLOWED ERROR	CAL Status
As Found	100.00	93.50	6.50	10	Pass
As Left	100.00	97.00	3.00	10	Pass

DOP Concentration: 100 µg/L ± 10% of Reading*

Test Point	Generator	2i Output	ABS ERROR	ALLOWED ERROR	CAL Status
As Found	100.00	88.90	11.10	10	Fail
As Left	100.00	96.20	3.80	10	Pass

HIGH Concentration: 100 µg/L ± 30µg/L

Test Point	Generator	2i Output	ABS ERROR	ALLOWED ERROR	CAL Status
As Found	100.00	85.00	15.00	30	Pass
As Left	100.00	97.00	3.00	30	Pass

TUR 1:1

Condition of Unit

AS FOUND				AS LEFT			
☐	In tolerance	☐	Inoperable	☑	Calibrated as left	☐	New instrument
☑	Out of tolerance			☐	No calibration performed		

Maintenance Performed

☑	Rework scattering chamber	☑	Test scanning probe	☑	Leak Check	
☑	Clean Sampling System	☐	Test Absolute Filter	☐	Printer	
☐	Replace Cell Lamp	☐	Replace Gaskets	☐	Voltage Checks	
☐	Align Optics	☑	Tighten Loose Hardware	☑	Final Test	

Calibration Statement

The instrument listed on this certificate has been calibrated against standards traceable to NIST or other recognized national metrology institutes, derived from ratio type measurements, or compared to nationally recognized consensus standards. The uncertainty of the above concentration measurements are ±10%. All results contained within this certificate relate only to the item(s) calibrated. Any number of factors may cause the calibrated item to drift out of calibration before the instruments calibration interval has expired. This certificate shall not be reproduced except in full and with written consent of ATI. This unit has been calibrated to the most recent revisi[redacted]

Calibrated by	A.Carter	Signed	
Cal Date	13 January 2021	Cal Due	13 January 2022

S & M Electronics Ltd.
105, Eastcote Road, Pinner,
Middlesex HA5 1ET U.K.
Tel : (020) 8429 1222
Fax : (020) 8248 4313
info@sandmelectronics.com

The Authority in HEPA support

AEROSOL GENERATOR CERTIFICATE OF C0MPLIANCE

Certificate No:	17345	Test Date:	2nd December 2020.
Manufacturer:	CONCEPT	Model:	1300/135/1.1
Serial No :	1025732	Test Due :	2nd December 2021.
Customer :	H & V Commissioning Services Limited Kilknowe Office, 16 Barrmill Road, Galston, Ayrshire KA4 8HH.	Contact :	Ms. Karen Gavin.

Upon receipt by S & M Electronics Limited, on first inspection & testing, the Generator Heater Block Temperature was 334°C (Tolerance +/- 10 °C) & the instrument was found to be in good working order.

This instrument has been serviced by S & M Electronics Limited in accordance with the Manufacturer's requirements, having been fully tested and found to be in good order.

This equipment has been calibrated using instruments traceable to National Standard. The measurements were correct at the time of calibration.

The calibration was performed in the service area at room temperature of 21 °C +/- 5 °C.
Environmental considerations are not relevant to the performance of the instrument.

Results :

Heater Block Temperature : 335 °C +/- 10 °C. Regulator : 0 - 100 PSI
Heater Assembly: 240V 1.1 K Watts. Output: Variable 0 – 120 psi Particle Size: 0.2-0.3 micron(mmd)
Oil/Gas ratio: Smear free at 20 P.S.I. Smoke Output: 0-150m³min @ 1.5 visibility.
Only **Shell Ondina X420 Oil** is recommended for this equipment.

Calibration Completed by :.....[redacted]..... Mr. A. Patel (Engineer).

Certified Test Equipment : Model TLK - 38 S/N: S&M CAL-4 UKAS Cert. No: C32868.

S & M ELECTRONICS TESTED & CALIBRATED LIMITED

Website: www.sandmelectronics.com

Register Office: 74 Dickenson Road, Manchester M14 5HF Registered in England No: 2580956

S & M Electronics Ltd.
105, Eastcote Road, Pinner,
Middlesex HA5 1ET U.K.
Tel : (020) 8429 1222
Fax : (020) 8248 4313
info@sandmelectronics.com

The Authority in HEPA support

CERTIFICATE OF ELECTRICAL SAFETY TEST.

Certificate No:	17345-1	Test Date:	2nd December 2020.
Manufacturer:	CONCEPT	Model:	1300/135/1.1
Serial No :	1025732	Test Due :	2nd December 2021.
Customer :	H & V Commissioning Services Limited Kilknowe Office, 16 Barrmill Road, Galston, Ayrshire KA4 8HH.	Contact :	Ms. Karen Gavin.

This instrument has been tested against our portable appliance tester Seaward Europa Plus S/N: 27B-0771

The results are as follows :

Test Number	:	*17345*
Date	:	2nd December 2020.
Test Mode	:	Automatic.
Visual Check	:	Pass.
Earth Test	:	*0.04* Ohm. Pass.
Insulation Test	:	*>99.9* Meg. Ohm. Pass.
Load Test	:	*0.67* K.V.A. Pass.
Leakage Test	:	*<0.10* ma. Pass.

Test Completed by : ..... [redacted] ..... Mr. A. Patel (Engineer).

Certified Test Equipment: Seaward Europa Plus S/N: 27B-0771

S & M ELECTRONICS TESTED & CALIBRATED LIMITED

Website: www.sandmelectronics.com

A46676816

APPENDIX E – HOARE LEA HVC 107 VERIFICATION DOCUMENT

IOM are not responsible for the accuracy of the information contained within the Hoare Lea document attached below. However it is included here for information and completeness.

Address
Hoare Lea
58 Waterloo Street
Glasgow
G2 7DA

RHCYP+DCN (HVC107)

VENTILATION

AIR CHANGE VERIFICATION DOCUMENT

Rev	Description	Prepared by	Checked by	Authorised by	Date
A	First Issue	Andrew Nisbet	Stratis Vatis	Paul Winning	11/02/2021
B	Second Issue	Andrew Nisbet	Stratis Vatis	Paul Winning	12/02/2021
C	Updated inline with NHS, IOM and Infection Control meeting (22/02/2021)	Andrew Nisbet	Stratis Vatis	Paul Winning	22/02/2021
D	Updated inline with Arcadis	Andrew Nisbet	Stratis Vatis	Paul Winning	25/02/2021

Existing Design Data

Proposed Design Data

* All Open to 1-B1-065

** Windows will be locked shut

Rooms associated with Single bedrooms and Multi-bedrooms in Paediatric Critical Care & Single bedrooms and Multi-bedrooms in Haematology and Oncology

Rooms associated with Isolation Rooms in Paediatric Critical Care & Isolation Rooms in Haematology and Oncology

Negative/Negative Isolation Room

Achieves Compliance

Notes

1.Open plan to larger area. Overall supply volume in larger area satisfies compliance.
2. Rooms with no supply air identified achieve fresh air make-up via corridor (excess supply air from other spaces).
3. Isolation bedroom recieves supply air from lobby through pressure stabiliser and extract via ensuite. This room achieves SHTM 03-01 compliance of 10AC/H.
4. Combined extract from bay 1 (3-C1.3-011) plus adjoining toilet (3-C1.3-010) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.
5. Combined extract from bay 2 (3-C1.3-013) plus adjoining toilet (3-C1.3-014) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.

HOARE LEA

Imtech

Room No.	Department		Room Name	Qty	Room Function	SHTM03-01 Appendix A Table 1 Classification	Ventilation														
							EXISTING	PROPOSED	EXISTING		PROPOSED		AS INSTALLED (IOM)					Relative pressure	Proposed	Measured Pressure (H&V)	Min filtration	
							(type)	(type)	Supply (ac/hr)	Extract (ac/hr)	Supply (ac/hr)	Extract (ac/hr)	Room Volume (m3)	Supply (L/s)	Extract (L/s)	Supply (ac/hr)	Extract (ac/hr)				EXISTING	PROPOSED
1-B1-002	B1	PICU and HDU's - 24 Beds	Retrieval Equipment Store	1	Storage Area Equipment		Central General Extract		0	3	0	2	33.36	0	25.2	0	3	Negative	Negative		None	
1-B1-003			Staff Room	1	Common room/staff room/lounge		Central Supply and Extract		6	8	6	8	85.05	168	194.4	7	8	Negative	Negative		F7	F9 ePM1 90%
1-B1-004			Senior Charge Nurse Office	1	Cellular / Ward Offices		Central Supply and Extract		4	3	4	3	28.89	39.6	24	5	3	Positive	Positive		F7	F9 ePM1 90%
1-B1-005			WC - Staff	1	Toilet		Central Dirty Extract		0	10	0	6	6.96	0	13.2	0	7	Negative	Negative		None	
1-B1-006			WC - Staff	1	Toilet		Central Dirty Extract		0	10	0	6	8.4	0	16.8	0	7	Negative	Negative		None	
1-B1-007			Equipment Service Room	1	Small Workshop		Central Supply and Extract		4	6	4	6	65.34	84	112.8	5	6	Negative	Negative		F7	F9 ePM1 90%
1-B1-008			IPS Room	1	IPS Room		Central General Extract		0	3	0	4	6.48	0	10	0	6	Negative	Negative		None	
1-B1-009			Bay 1	1	Multi-bed Wards	Critical Care Area	Natural and Central Supply Air	Central Supply Air **	4	1.7	10	6	311.85	972	604.8	11	7	+10Pa	+10Pa	+11Pa	F7	F9 ePM1 90%
1-B1-010			Gas Cylinder Store	1	Storage Area Med Gas		Central General Extract		0	7	0	7	5.04	0	31.2	0	22	Negative	Negative		None	
1-B1-011			Multidisciplinary Work Area PICU	1	Multi Disciplinary Work Areas		Central Supply and Extract		6	4	0	4	44.01	0	50.4	0	4	Positive	Negative		F7	F9 ePM1 90%
1-B1-012			Staff Base 1	1	Cellular / Ward Offices		Central Supply and Extract	Central Extract	0	3	0	Part of Corridor	36.34	Part of 1-B1-040			NOTE 1	Negative	Negative		F7	F9 ePM1 90%
1-B1-014			Resuscitation Trolley Bay	1	Circulation Equipment Storage Bays		Central General Extract		0	3	0	Part of Corridor	3.12	0			NOTE 1	Negative	Negative		None	
1-B1-015			Lobby 5	1	Isolation Lobby	Infectious disease Iso Room Lobby	Central Supply	Isolation Room Supply System	55	0	50	0	16.2	250	0	56	0	+10Pa to corridor	+10Pa to corridor	+11Pa to corridor	H14	H14
1-B1-016			Single Room 5 Isolation	1	Isolation Bedroom	Infectious disease Iso Room	Supply via lobby	Supply via lobby + Dirty Extract	10	10	10	10	70.2	199	199	10	10	Balanced	Balanced	-	H14	H14
1-B1-017			Single Room 6 Isolation	1	Isolation Bedroom	Infectious disease Iso Room	Supply via lobby	Supply via lobby + Dirty Extract	10	10	10	10	70.2	197	197	10.0	10	Balanced	Balanced	-	H14	H14
1-B1-018			Lobby 6	1	Isolation Lobby	Infectious disease Iso Room Lobby	Central Supply	Isolation Room Supply System	55	0	55	0	15.93	358	0	81	0	+10Pa to corridor	+10Pa to corridor	+11Pa to corridor	H14	H14
1-B1-019			Single Room 8	1	Bedroom	Critical Care Area	Central Supply & Extract	Central Supply & Extract **	4	4	10	4	70.2	222	87.6	11	4.5	+10Pa	+10Pa	+10Pa	F7	F9 ePM1 90%
1-B1-020			Single Room 7	1	Bedroom	Critical Care Area	Central Supply & Extract	Central Supply & Extract **	4	4	10	2.3	70.2	272.4	54	14	2.8	+10Pa	+10Pa	+11Pa	F7	F9 ePM1 90%
1-B1-021			Single Room 9	1	Bedroom	Critical Care Area	Central Supply & Extract	Central Supply & Extract **	4	4	10	3	70.47	234	72	12	3.7	+10Pa	+10Pa	+11Pa	F7	F9 ePM1 90%
1-B1-023			Staff Base 2	1	Cellular / Ward Offices		Central Supply and Extract		4	3	0	Part of Corridor	9.89	0	200	0	NOTE 1	Positive	Negative		F7	F9 ePM1 90%
1-B1-024			Resuscitation Trolley Bay	1	Circulation Equipment Storage Bays		None		0	0	0	Part of Corridor	2.4	0	0	0	NOTE 1	n/a	Negative		None	
1-B1-025			Lobby 10	1	Isolation Lobby	Infectious disease Iso Room Lobby	Central Supply	Isolation Room Supply System	62	0	62	0	17.01	358	0	76	0	+10Pa to corridor	+10Pa to corridor	+10Pa to corridor	H14	H14
1-B1-026			Single Room 10 - Isolation	1	Isolation Bedroom	Infectious disease Iso Room	Supply via lobby	Supply via lobby + Dirty Extract	10	10	10	10	89.1	257	257	10	10	Balanced	Balance	-	H14	H14
1-B1-027			Clean Utility	1	Clean Utility		Central Supply Air		6	0	6	0	49.68	102	0	7	0	Positive	Positive		F7	F9 ePM1 90%
1-B1-028			Bed/Patient Chair / Buggy Storage	1	Storage Area Equipment		Central General Extract		0	3	0	3	17.04	0	21.6	0	5	Negative	Negative		None	
1-B1-029			Dirty Utility	1	Dirty utility		Central Dirty Extract		0	6	0	6	51.03	0	132	0	9	Negative	Negative		None	
1-B1-030			Linen Bay (1 Trolley)	1	Linen Bay		None		0	0	0	0	3.36					n/a	n/a		None	
1-B1-031			Bay 2	1	Multi-bed Wards	Critical Care Area	Central Supply & Extract	Central Supply & Extract **	4	1.8	10	4	298.35	940.8	349.2	11	4	+10Pa	+10Pa	+11Pa	F7	F9 ePM1 90%
1-B1-032			Patients' Assisted Bathroom	1	Bathroom		Central Dirty Extract		0	10	0	10	21.33	0	61.2	0	10	Negative	Negative		None	

Existing Design Data

Proposed Design Data

* All Open to 1-B1-065

** Windows will be locked shut

Rooms associated with Single bedrooms and Multi-bedrooms in Paediatric Critical Care & Single bedrooms and Multi-bedrooms in Haematology and Oncology

Rooms associated with Isolation Rooms in Paediatric Critical Care & Isolation Rooms in Haematology and Oncology

Negative/Negative Isolation Room

Achieves Compliance

Notes

1.Open plan to larger area. Overall supply volume in larger area satisfies compliance.
2. Rooms with no supply air identified achieve fresh air make-up via corridor (excess supply air from other spaces).
3. Isolation bedroom recieves supply air from lobby through pressure stabiliser and extract via ensuite. This room achieves SHTM 03-01 compliance of 10AC/H.
4. Combined extract from bay 1 (3-C1.3-011) plus adjoining toilet (3-C1.3-010) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.
5. Combined extract from bay 2 (3-C1.3-013) plus adjoining toilet (3-C1.3-014) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.

HOARE LEA

Imtech

Room No.	Department	Room Name	Qty	Room Function	SHTM03-01 Appendix A Table 1 Classification	Ventilation											Relative pressure	Proposed	Measured Pressure (H&V)	Min filtration	
						EXISTING	PROPOSED	EXISTING		PROPOSED		AS INSTALLED (IOM)								EXISTING	PROPOSED
						(type)	(type)	Supply (ac/hr)	Extract (ac/hr)	Supply (ac/hr)	Extract (ac/hr)	Room Volume (m3)	Supply (L/s)	Extract (L/s)	Supply (ac/hr)	Extract (ac/hr)					
1-B1-033		Lobby 16	1	Isolation Lobby	Infectious disease Iso Room Lobby	Central Supply	Isolation Room Supply System	45	0	45	0	17.76	358	426	73	86	-5Pa to corridor	-5Pa to corridor	-5Pa to corridor	H14	H14
1-B1-034		Linen Bay (1 Trolley)	1	Linen Bay		None		0	0		Part of Corridor	3.68				NOTE 1	n/a	Negative		None	
1-B1-035		Hoist Bay	1	Circulation Equipment Storage Bays		Central General Extract		0	3		Part of Corridor	7.2				NOTE 1	Negative	Negative		None	
1-B1-036		Single Room 16 Isolation	1	Isolation Bedroom	Infectious disease Iso Room	Supply via lobby	Supply via lobby + Dirty Extract	10	10	10	15	72.9	0	426	0	21	-10Pa to Lobby	-10Pa to Lobby	-12Pa	H14	H14
1-B1-037		Single Room 17	1	Bedroom	Critical Care Area	Central Supply & Extract	Central Supply & Extract **	4	4	10	4	72.36	268.8	81.6	13	4	+10Pa	+10Pa	+12Pa	F7	F9 ePM1 90%
1-B1-038		Staff Base 3	1	Staff Base		Central Supply and Extract		4	3		Part of Corridor	9.43			0	0	Positive	n/a		F7	F9 ePM1 90%
1-B1-039		Resuscitation Trolley Bay	1	Circulation Equipment Storage Bays		Central General Extract		0	3		Part of Corridor	9.43					Negative	n/a		None	
1-B1-041		Clean Utility	1	Clean Utility		Central Supply Air		6	0	6	0	21.33	42	0	7	0	Positive	Positive		F7	F9 ePM1 90%
1-B1-042		Multidisciplinary Work Area HDU	1	Multi Disciplinary Work Areas		Central Supply and Extract		6	4	0	4	41.31	0	46.8	0	4	Positive	Negative		F7	F9 ePM1 90%
1-B1-043		Laboratory	1	Laboratory		Central Supply and Extract		6	6	6	6	25.92	54	48	8	7	Balanced	Positive		F7	F9 ePM1 90%
1-B1-044		IPS Room	1	IPS Room		Central General Extract		0	3	0	3	5.4	0	10	0	7	Negative	Negative		None	
1-B1-045		Quiet / Interview Room	1	Meeting Room		Central Supply and Extract		4 people at 10 l/s per person (7ach)	4 people at 10 l/s per person (7ach)	0	6	21.5	0	36	0	6	Balanced	Negative		F7	F9 ePM1 90%
1-B1-046		Store - Equipment	1	Storage Area Equipment		Central General Extract		0	3	0	2	128.385	0	177.6	0	5	Negative	Negative		None	
1-B1-047		Family Interview Room	1	Meeting Room		Central Supply and Extract		5 people at 10 l/s per person (5ach)	5 people at 10 l/s per person (5ach)	6	5	33.48	63.6	49.2	7	5	Balanced	Positive		F7	F9 ePM1 90%
1-B1-048		On call consultant	1	Cellular / Ward Offices		Central Supply and Extract		6	4	6	2.5	28.62	56.4	38.4	7	5	Positive	Positive		F7	F9 ePM1 90%
1-B1-049		Retrieval Team	1	Cellular / Ward Offices		Central Supply and Extract		6	4	0	4	29.04	0	32.4	0	4	Positive	Negative		F7	F9 ePM1 90%
~~1-B1-050~~		~~Bulk Supplies Store~~	~~1~~	~~Storage Area Equipment~~		~~Central General Extract~~		~~0~~	~~3~~			~~128.385~~					~~Negative~~	n/a		~~None~~	
1-B1-051		Data Manager & Secretarial Office (3 person)	1	Cellular / Ward Offices		Central Supply and Extract		6	4	6	3	58.86	110.4	56.4	7	3	Positive	Positive		F7	F9 ePM1 90%
1-B1-055		Waiting Area (Visitors)	1	Waiting Room		Central Supply and Extract		5	5	5	4	44.88	102	52.8	8	4	Balanced	Positive		F7	F9 ePM1 90%
1-B1-056		WC - Wheelchair accessible	1	Toilet		Central Dirty Extract		0	10	0	10	10.6	0	30	0	10	Negative	Negative		None	
1-B1-057		X-Ray Processing	1	Diagnostic room		Central Supply and Extract		8	8	8	8	21.6	55.2	50.4	9	8	Balanced	Positive		F7	F9 ePM1 90%
1-B1-058		Mobile X-Ray / Ultrasound Bay	1	Circulation Equipment Storage Bays		Central Supply & Extract		8	8	8	8	8	21.6	20	10	9	Balanced	Positive		F7	F9 ePM1 90%
1-B1-059		Cardiac Echo/ECG Bay	1	Circulation Equipment Storage Bays		Central General Extract		0	8	0	7	9.6	0	20.4	0	8	Negative	Negative		None	
1-B1-060		Seminar Room	1	Meeting Room		Central Supply and Extract		19 people at 10 l/s per person (7ach)	19 people at 10 l/s per person (7ach)	7	7	91.26	229.2	181.2	9	7	Balanced	Positive		F7	F9 ePM1 90%
1-B1-061		Disposal Hold	1	Disposal Hold		Central Dirty Extract		0	6	0	6	26.73	0	45.6	0	6	Negative	Negative		None	
1-B1-062		WC - Staff	1	Toilet		Central Dirty Extract		0	10	0	6	8.4	0	15.6	0	7	Negative	Negative		None	
1-B1-063		Bay 3	1	Multi-bed Wards	Critical Care Area	Central Supply & Extract	Central Supply & Extract **	4	3	10	4.5	277.29	931	354	12	5	+10Pa	+10Pa	+13Pa	F7	F9 ePM1 90%
1-B1-064		Dirty Utility	1	Dirty utility		Central Dirty Extract		0	6	0	6	38.07	0	61.2	0	6	Negative	Negative		None	
1-B1-065		Neonatal Bay 4 *	1	Multi-bed Wards	Critical Care Area	Central Supply and Extract	Central Supply and Extract**	4	4	10	5	126.36	612	135.6	17	NOTE 1	+10Pa	+10Pa	+11Pa	F7	F9 ePM1 90%
1-B1-066		Clean Utility (Neo-Natal)	1	Clean Utility	Critical Care Area	Central Supply Air	Central Supply and Extract**	6	0	10	5	22.41	129.6	0	21	NOTE 1	+10Pa	+10Pa	Part of Room 1-B1-063	F7	F9 ePM1 90%

Existing Design Data

Proposed Design Data

* All Open to 1-B1-065

** Windows will be locked shut

Rooms associated with Single bedrooms and Multi-bedrooms in Paediatric Critical Care & Single bedrooms and Multi-bedrooms in Haematology and Oncology

Rooms associated with Isolation Rooms in Paediatric Critical Care & Isolation Rooms in Haematology and Oncology

Negative/Negative Isolation Room

Achieves Compliance

Notes

1.Open plan to larger area. Overall supply volume in larger area satisfies compliance.
2. Rooms with no supply air identified achieve fresh air make-up via corridor (excess supply air from other spaces).
3. Isolation bedroom recieves supply air from lobby through pressure stabiliser and extract via ensuite. This room achieves SHTM 03-01 compliance of 10AC/H.
4. Combined extract from bay 1 (3-C1.3-011) plus adjoining toilet (3-C1.3-010) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.
5. Combined extract from bay 2 (3-C1.3-013) plus adjoining toilet (3-C1.3-014) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.

HOARE LEA

Imtech

Room No.	Department	Room Name	Qty	Room Function	SHTM03-01 Appendix A Table 1 Classification	Ventilation														
						EXISTING	PROPOSED	EXISTING		PROPOSED		AS INSTALLED (IOM)					Relative pressure	Proposed	Measured Pressure (H&V)	Min filtration	
						(type)	(type)	Supply (ac/hr)	Extract (ac/hr)	Supply (ac/hr)	Extract (ac/hr)	Room Volume (m3)	Supply (L/s)	Extract (L/s)	Supply (ac/hr)	Extract (ac/hr)				EXISTING	PROPOSED
1-B1-067	B1	Medical Gas Store	1	Storage Area Med Gas		General Central Extract		0	6	0	6	5.76	0	14.4	0	9	Negative	Negative		None	
1-B1-068		Baby Infant / Feeding Room	1	Baby Feeding		Central Dirty Extract		0	10	0	10	12.52	0	39.6	0	11	Negative	Negative		None	
1-B1-069		Staff Base 4 *	1	Cellular / Ward Offices	Critical Care Area	Central Supply and Extract	Central Supply and Extract**	6	4	10	5	13.8		26.4	NOTE 1	7	+10Pa	+10Pa	Part of Room 1-B1-065	F7	F9 ePM1 90%
1-B1-071		Resuscitation Trolley Bay *	1	Circulation Equipment Storage Bays	Critical Care Area	None	Central Supply and Extract**	0	0	10	5	2.4			NOTE 1	NOTE 1	+10Pa	+10Pa	Part of Room 1-B1-065	None	F9 ePM1 90%
1-B1-072		Play Specialist Base & Store	1	Storage Area Equipment		Central Supply and Extract		6	4	0	4	18.09	0	20.4	0	4	Positive	Negative		F7	F9 ePM1 90%
1-B1-073		Pantry / Milk Store	1	Pantry		Central Supply and Extract		6	8	0	7	24.12	0	48	0	7	Negative	Negative		F7	F9 ePM1 90%
1-B1-074		Neonatal Cot 22 - Ensuite	1	Bathroom	Critical Care Area	Central Dirty Extract	Central Dirty Extract	0	minimum 10	0	10	11.2	0	34.8	0	11	Negative	Negative	Part of Room 1-B1-065	None	None
1-B1-075		Neonatal Cot 22	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4	via ensuite	10	via ensuite	40.77	132	0	12	Via ensuite	+10Pa	+10Pa	Part of Room 1-B1-065	F7	F9 ePM1 90%
1-B1-077		DSR	1	DSR		Central Dirty Extract		0	6	0	6	18.72	0	37.2	0	7	Negative	Negative		None	
1-B1-078		Relative Overnight Stay Room 1	1	Relatives Overnight Stay		Central Supply Air		4	0	4	0	24	27.6	0	4	0	Positive	Positive		F7	F9 ePM1 90%
1-B1-079		Relative Overnight Room 1 Ensuite	1	Bathroom		Central Dirty Extract		0	10	0	6	14.88	0	26.4	0	6	Negative	Negative		None	
1-B1-080		WC - Relatives	1	Toilet		Central Dirty Extract		0	10	0	6	7	0	12	0	6	Negative	Negative		None	
1-B1-082		Relative Overnight Stay Room 2	1	Relatives Overnight Stay		Central Supply Air		4	0	4	0	24.72	31.2	0	5	0	Positive	Positive		F7	F9 ePM1 90%
1-B1-083		Relative Overnight Room 2 - Ensuite	1	Bathroom		Central Dirty Extract		0	10	0	6	10.8	0	19.2	0	6	Negative	Negative		None	
1-B1-084		Relatives' Sitting Room	1	Common room/staff room/lounge		Central Supply and Extract		6	0	3	0	50.22	55.2	0	4	0	Positive	Positive		F7	F9 ePM1 90%
1-B1-090		Equipment Cleaning	1	DSR		Central Dirty Extract		0	6	0	6	21.06	0	40.8	0	7	Negative	Negative		None	
1-B1-001		Corridor	1	Corridor		None		0	0	0	0	39.6	0	0	0	0	n/a	n/a		None	
1-B1-013		Corridor	1	Corridor		None		0	0	0	0	36.34	0	0	0	0	n/a	n/a		None	
1-B1-013A		Corridor	1	Corridor		None		0	0	0	0	36.34	0	0	0	0	n/a	n/a		None	
1-B1-013B		Corridor	1	Corridor		None		0	0	0	0	36.34	0	0	0	0	n/a	n/a		None	
1-B1-013C		Corridor	1	Corridor		None		0	0	0	0	36.34	0	0	0	0	n/a	n/a		None	
1-B1-022		Corridor *	1	Corridor	Critical Care Area	None	Central Supply and Extract**	0	0	10	5	62.16	200	100	12	6	+10Pa	+10Pa	Part of Room 1-B1-065	None	F9 ePM1 90%
1-B1-040		Corridor	1	Corridor		None	Extract	0	0	0	7	151.92	0	350	0	8	Negative	Negative		None	
1-B1-052		Corridor	1	Corridor		None	Extract	0	0	0	6	114.48	0	216	0	7	Negative	Negative		None	
1-B1-070		Corridor	1	Corridor		None	Extract	0	0	0	31	13.8	0	138	0	36	Negative	Negative		None	
1-B1-076		Corridor	1	Corridor		None		0	0	0	0	40.77	0	0	0	0	n/a	n/a		None	
1-B1-086		Corridor	1	Corridor		None		0	0	0	0	50.22	0	0	0	0	n/a	n/a		None	
1-B1-087		Corridor	1	Corridor		None		0	0	0	0	50.22	0	0	0	0	n/a	n/a		None	
1-B1-088		Corridor	1	Corridor		None		0	0	0	0	50.22	0	0	0	0	n/a	n/a		None	
1-B1-089		Switch Cupboard	1	Switch Cupboard		None		0	0	0	0	50.22	0	0	0	0	n/a	n/a		None	

APPENDIX F – IOM BALOMETER CALIBRATION CERTIFICATE

Associated Instruments Repairs
Unit 11 Top Angel Buckingham Industrial Park
Buckingham MK18 1TH England
Tel / Fax +44 (0) 1280 823823
e-mail: air@ttseries.com www.a-i-r.co.uk

CALIBRATION CERTIFICATE

CUSTOMER DETAILS I O M Consulting Ltd

CALIBRATION DETAILS		**INSTRUMENT DETAILS**	
Date Of Calibration:	13/08/2020	**Manufacturer**	TSI Airflow
Next Calibration:	13/08/2021	**Type:**	Balometer
Certificate Number:	47791	**Model:**	PH731
Result	Pass	**Serial Number:**	PH7311922002
Repair required:	No	**Customer S/N:**	N/A
Adjustment required:	Yes	**Manufacturer's Spec:**	±3% of Reading ± 3.3 l/s
TEST ROOM CONDITIONS		**Range:**	30-555 l/sec
Temperature:	26°C±2°C		
Relative Humidity:	55% ± 10% RH		
Barometric Pressure (mbar)	1008 mbar		

Calibration Points: l/sec	30	60	90	150	200	300	400	555
Indicated Readings: Supply	28	56	85	145	195	290	386	536
Indicated Readings: Exhaust	27	56	84	143	191	290	385	541

Notes: Results obtained with a 4 way diffuser.
The above results are obtained on the date of calibration, with no account being taken of the instruments ability to maintain its calibration.

Equipment: Balometer Test Rig: Tested according to BSEN ISO 9001:2000. Orifice plates & volume flow measuring section manufactured in accordance with that specified in ISO 5801:1997

Instrument: Micromanometer: TT 570SV SN 5661, calibrated against Instrument SN T00189 (UKAS Calibration Laboratory No 0157), plus Instrument SN UK19504 (UKAS Calibration Laboratory No 0807) which are both traceable to National Standards.

[redacted]

Calibrated By Hussein Khimji:

WORKING FOR A HEALTHIER FUTURE

Services Report P4884-2
Date of site work January/February 2021

Ventilation Validation

Royal Hospital for Children and Young People & Department of Clinical Neurosciences

Areas

3-C1.3 Neuroscience

3-C1.4 Haematology/Oncology Inpatients

3-C1.5 Shared Support

REPORT TO CLIENT

VALIDATION AUDIT

ON BEHALF OF

NHS LOTHIAN
ROYAL HOSPITAL FOR CHILDREN AND YOUNG PEOPLE & DEPARTMENT OF CLINICAL NEUROSCIENCES
LITTLE FRANCE CRESCENT
EDINBURGH
EH16 4TJ

REPORT NUMBER: P4884-2

REPORT ISSUE DATE: 2ND MARCH 2021

VERSION: 01

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IOM Consulting Ltd.

CONTENTS

1 INTRODUCTION

IOM were appointed by NHS Lothian Health Board to validate the critical ventilation systems at the Royal Hospital for children and young people.

The validation process involves undertaking a number of measurements and checks with the overall purpose of ensuring that the whole system operates correctly and meets the requirements of SHTM 03-01 or standard agreed as part of the design process.

2 DESIGN ASSURANCE STATEMENT

John M Rayner, Authorising Engineer of Turner Professional Engineering Services (TPES) issued a design assurance statement on the 4th February 2021 following site visit on 19th to 21st January 2021; see Appendix A and B respectively for full statements. Turner confirmed the standard of installation and the commissioning activities of the new Air Handling Units meet the full requirements of SHTM 03-01. Turner further considered that the units are fit for their projected purpose if these installations are adequately maintained.

3 AHU FACTORY VISIT

Paul Jameson, Authorising Engineer (Ventilation) of the institute of Occupational Medicine undertook a factory visit on 20th July 2020; see Appendix C for Full Statement. Paul Jameson confirmed the Daikin Air Handling Units were superior to the original Sandometal Unit. Overall, Paul Jameson was satisfied the units were, in his opinion, satisfactory.

4 HEPA FILTER INTEGRITY TEST

Filter Integrity test were carried out to the Isolation/Critical Care Rooms by H&V Commissioning Service Ltd between the 12th and 23rd February 2021: See Appendix D, The was performed to confirm that installed filter systems are properly installed by verifying the absence of bypass leakage in the installation, and that the filters are free of defects in accordance to ISO 14664-3:2009.

All HEPA filters tested passed the integrity test of <0.01% particle penetration.

Room Number	Isolation Room	Particle Penetration Reading (%)
3-C1.4-078	Single Room 1	0.0015
3-C1.4-076	Single Room 2	0.0003
3-C1.4-033	Single Room 3	0.0061
3-C1.4-071	Room 4 – Lobby Isolation Room	<0.01
3-C1.4-053	Room 5 – Lobby Isolation Room	0.0005
3-C1.4-048	Room 6 – Lobby Isolation Room	0.0061
3-C1.4-044	Room 7 – Lobby Isolation Room	<0.01
3-C1.4-039	Room 6 – Lobby Isolation Room	<0.01
3-C1.4-032	Single Room 9	0.0029
3-C1.4-018	Single Room 10	0.0006
3-C1.4-010	Single Room 11	0.0018
3-C1.4-013	Single Room 12	0.002
3-C1.4-016	Single Room 14	0.005

Room Number	Isolation Room	Particle Penetration Reading (%)
3-C1.4-046	Single Room 15	0.007
3-C1.4-055	Single Room 16	0.0001
3-C1.4-057	Single Room 17	<0.01
3-C1.4-059	Single Room 18	0.0023
3-C1.4-061 SG038	Bay 1 (Beds 1-6) (Treatment Room)	0.0009
3-C1.4-061 SG039	Bay 1 (Beds 1-6) (Treatment Room)	0.0008
3-C1.4-061 SG040	Bay 1 (Beds 1-6) (Treatment Room)	0.0001
3-C1.4-084 SG036	Bay 2 (Beds 7-9)	0.0017
3-C1.4-084 SG037	Bay 2 (Beds 7-9)	0.0007

5 IOM CONFIRMATORY READINGS

IOM carried out confirmatory readings and compared data with H&V commissioning services of all the grilles in 3-C1.3, 3-C1.4 and 3-C1.5 based on the Hoare Lea design data through January and February 2021. During this time all three parties along with NHS Lothian made changes as required in line with SHTM 03-01. Section 6 is the final reading carried out by IOM. In line with the rest of the work carried out at RHCYP a k factor of 1.2 was applied throughout with the exception of the Isolation rooms in which a k factor of k 1.11 was applied based on reading supplied by H&V Commissioning Service Ltd

6 AREAS VENTILATION DETAILS

Notes
1.Open plan to larger area. Overall supply volume in larger area satisfies compliance.
2. Rooms with no supply air identified achieve fresh air make-up via corridor (excess supply air from other spaces).
3. Isolation bedroom receives supply air from lobby through pressure stabiliser and extract via ensuite. This room achieves SHTM 03-01 compliance of 10AC/H.
4. Combined extract from bay 1 (3-C1.3-011) plus adjoining toilet (3-C1.3-010) and half of the extract air Haematology and Oncology from wet room (3-C1.3-012) complies with the design ventilation air change rate.
5. Combined extract from bay 2 (3-C1.3-013) plus adjoining toilet (3-C1.3-014) and half of the extract air from wet room (3-C1.3-012) complies with the design ventilation air change rate.

3-C1.3 Neuroscience

Room Number	Room Name	Grille Number	Volume	Supply Design Airflow Rate (l/s)	Supply Actual Airflow Rate (l/s)	Supply Design (ac/hr)	Corrected (ac/hr)	Extract Design Airflow Rate (l/s)	Extract Actual Airflow Rate (l/s)	Extract Design (ac/hr)	Corrected (ac/hr)	Pressure	Filter
3-C1.3-002	Waiting Area	EG03	27					60	54	5	9	Negative	F9
3-C1.3-002	Waiting Area		27		50	60	8						
3-C1.3-003	Staff Base		7.2		8.3	5	5					Positive	F9
3-C1.3-004	WC Accessible	DEG03	9.6					30	27	10	12	Negative	None
3-C1.3-005	Store - Equipment	EG08	21.6					18	17	3	3	Negative	None
3-C1.3-010	Bay 1 - Toilet	DEG10	9.6					30	30	10	14	Negative	None
3-C1.3-011	Bay 1 (Bed 2-5)	SG23, SG24	159.3	176	167	4	5					Positive	F9
3-C1.3-011	Bay 1 (Bed 2-5)	EG23	159.3					80	75	1.8	2		
3-C1.3-012	Bay 1 - Ensuite	DEG09	33.6					93	90	10	12	Negative	None
3-C1.3-013	Bay 2 (beds 6-9)	SG25, SG26	156.6	174	193	4	5					Positive	F9
3-C1.3-013	Bay 2 (beds 6-9)	EG24	156.6					80	74	1.8	2		
3-C1.3-014	Bay 2 - Toilet	DEG11	11.4					32	27	10	10	Negative	None
3-C1.3-017	Store - General	EG82	43.2					32	35	3	4	Negative	None
3-C1.3-018	Multi-Disciplinary Office	SG27	48.6	54	67	4	6.0					Positive	F9
3-C1.3-018	Multi-Disciplinary Office	EG84	48.6					41	37	3	3		
3-C1.3-019	Patient Interview Room	SG28	24.3	40	49	6	9					Positive	F9
3-C1.3-019	Patient Interview Room	EG13	24.3					40	38	6	7		
3-C1.3-020	Senior Charge Nurse Office	SG29	27	29	34	4	5					Positive	F9
3-C1.3-020	Senior Charge Nurse Office	EG14	27					22	22	3	4		
3-C1.3-021	WC - Staff	DEG21	8.1					20	26	10	14	Negative	None
3-C1.3-022	WC - Staff	DEG20	8.1					20	24	10	13	Negative	None

Room Number	Room Name	Grille Number	Volume	Supply Design Airflow Rate (l/s)	Supply Actual Airflow Rate (l/s)	Supply Design (ac/hr)	Corrected (ac/hr)	Extract Design Airflow Rate (l/s)	Extract Actual Airflow Rate (l/s)	Extract Design (ac/hr)	Corrected (ac/hr)	Pressure	Filter
3-C1.3-023	WC - Visitors	DEG19	8.1					20	24	10	13	Negative	None
3-C1.3-024	Snoezelen Room	SG10	32.4	40	38	3	5					Balanced	F9
3-C1.3-024	Snoezelen Room	EG16	32.4					40	37	3	5		
3-C1.3-025	Rehabilitation Room	SG09	78.3	80	99	3	5					Positive	F9
3-C1.3-025	Rehabilitation Room	EG10	78.3					80	74	3	4		
3-C1.3-027	Touchdown Base	SG08	5.4	10	17	7	14					Positive	F9
3-C1.3-028	Single Room 10 (VT)	SG07	45.9	51	61	4	6				Negative Via Ensuite		F9
3-C1.3-029	Room 10 - Ensuite	DEG12	10.8					51	43	10	17	Negative	None
3-C1.3-030	Single Room 11 (VT)	SG06	45.9	51	67	4	6				Negative Via Ensuite		F9
3-C1.3-031	Room 11 - Ensuite	DEG07	13.5					51	47	10	15	Negative	None
3-C1.3-032	Single Room 12	SG05	45.9	51	68	4	6				Negative Via Ensuite		F9
3-C1.3-033	Room 12 - Ensuite	DEG08	10.8					51	46	10	18	Negative	None
3-C1.3-034	Ward Kitchen	EG09	32.4					48	47	6	7	Negative	None
3-C1.3-035	Patients' Assisted Bathroom	DEG05	37.8					94	89	10	10	Negative	None
3-C1.3-036	Dirty Utility	DEG04	32.4					58	57	6	7	Negative	None
3-C1.3-037	Treatment Room	SG04	43.2	119	147	10	15					Positive	F9
3-C1.3-038	Clean Utility	SG03	32.4	48	71	6	9					Positive	F9
3-C1.3-039	Dining / Play Room	SG02	42.2	50	79	4.2	8					Positive	F9
3-C1.3-039	Dining / Play Room	EG02	42.2					60	55	5	6		
3-C1.3-040	DSR	DEG02	27					40	36	6	6	Negative	None
3-C1.3-041	Disposal Hold	DEG01	23.9					40	34	6	6	Negative	None

3-C1.4 Haematology/Oncology Inpatients

Room Number	Room Name	Grille Number	Volume	Supply Design Airflow Rate (l/s)	Supply Actual Airflow Rate (l/s)	Supply Design (ac/hr)	Corrected (ac/hr)	Extract Design Airflow Rate (l/s)	Extract Actual Airflow Rate (l/s)	Extract Design (ac/hr)	Corrected (ac/hr)	Pressure	Filter
3-C1.4-002	Quiet Study Room	EG18	27					22	21	3	3	Negative	F9
3-C1.4-004	Disposal Hold	DEG19	23.5					39	33	6	6	Negative	None
3-C1.4-005	DSR	DEG20	16.7					28	24	6	6	Negative	None
3-C1.4-006	Store - General	EG15	27					18	17	3	3	Negative	None
3-C1.4-007	Patient Interview Room	EG17	24.3					40	42	6	7	Negative	F9
3-C1.4-008	Complementary Therapy Room	EG16	32.4					23	24	3	3	Negative	F9
3-C1.4-009	Room 11- Ensuite	DEG18	13.5					40	33	10	11	Negative	F9
3-C1.4-010	Single Room 11	SG29	45.9	53	127	10	12				Positive (10pa)		H14
3-C1.4-011	Assisted Bathroom	DEG17	43.2					108	111	10	11	Negative	None
3-C1.4-013	Single Room 12	SG28	38.6	55	127	10	11				Positive (12pa)		H14
3-C1.4-014	Room 12 - Ensuite	DEG15	13.5					40	31	10	10	Negative	None
3-C1.4-015	Social Space	EG11	64.8					141	150	8	10	Negative	F9
3-C1.4-016	Single Room 14	SG26	44.9	52	117	10	11				Positive (10pa)		H14
3-C1.4-017	Room 14 - Ensuite	DEG16	13.5					40	35	10	11	Negative	None
3-C1.4-018	Single Room 10	SG25	54	150	158	4	13				Positive (10pa)		H14
3-C1.4-019	Room 10 - Ensuite	DEG14	13.5					50	41	10	13	Negative	None
3-C1.4-022	Dirty Utility	DEG13	37.8					63	52	6	6	Negative	None
3-C1.4-023	Nursing Staff Office	SG21	24.3	20	24	3	4.0					Balanced	F9
3-C1.4-023	Nursing Staff Office	EG07	24.3					20	23	3	4		
3-C1.4-024	Multi-Disciplinary Office	SG23	48.6	54	94	4	8					Positive	F9
3-C1.4-024	Multi-Disciplinary Office	EG05	48.6					41	36	3	3		
3-C1.4-025	Medical Staff Office	SG24	54	60	111	4	9					Positive	F9
3-C1.4-025	Medical Staff Office	EG06	54					45	42	3	3		
3-C1.4-026	Consultant Office (5 person)	SG22	70.2	79	81	4	5					Positive	F9
3-C1.4-026	Consultant Office (5 person)	EG04	70.2					60	60	3	4		
3-C1.4-027	Store - Equipment	EG08	24					20	17	3	3	Negative	None
3-C1.4-028	Research Staff Office	SG19	51.3	57	81	4	7					Negative	None
3-C1.4-028	Research Staff Office	EG03	51.3					43	42	3	4		

Room Number	Room Name	Grille Number	Volume	Supply Design Airflow Rate (l/s)	Supply Actual Airflow Rate (l/s)	Supply Design (ac/hr)	Corrected (ac/hr)	Extract Design Airflow Rate (l/s)	Extract Actual Airflow Rate (l/s)	Extract Design (ac/hr)	Corrected (ac/hr)	Pressure	Filter
3-C1.4-029	Nursing Staff Office	SG18	40.5	44	64	4	7.0					Positive	F9
3-C1.4-029	Nursing Staff Office	EG02	40.5					33	47	3	5		
3-C1.4-030	Senior Charge Nurse Office	SG20	21.6	25	27	4	5					Positive	F9
3-C1.4-030	Senior Charge Nurse Office	EG09	21.6					20	22	3	4		
3-C1.4-032	Single Room 9	SG17	48.6	53	131	10	12				Positive (10pa)		H14
3-C1.4-033	Room 9 - Ensuite	DEG12	9.6					40	33	10	15	Negative	None
3-C1.4-036	WC - Staff	DEG06	7.2					23	20	10	12	Negative	None
3-C1.4-037	WC - Staff	DEG07	9.5					27	23	10	10	Negative	None
3-C1.4-038	Clean Utility	SG15	48.6	137	148	10	13.2					Positive	F9
3-C1.4-046	Single Room 15	SG12	45.9	51	114	10	10.7				Positive (10pa)		H14
3-C1.4-047	Room 15 - Ensuite	DEG32	12					40	35	10	13	Negative	None
3-C1.4-055	Single Room 16	SG08	45.9	52	121	10	11.4				Positive (11pa)		H14
3-C1.4-056	Room 16 - Ensuite	DEG31	12					40	38	10	15.0	Negative	None
3-C1.4-057	Single Room 17	SG05	45.9	52	110	10	10.4				Positive (11pa)		H14
3-C1.4-058	Room 17 - Ensuite	DEG30	12					40	35	10	13.9	Negative	None
3-C1.4-059	Single Room 18	SG04	45.9	51	116	10	11.0				Positive (10pa)		H14
3-C1.4-060	Room 18 - Ensuite	DEG29	96					36	32	10	13.0	Negative	None
3-C1.4-061	Bay 1 (Beds 1-6) (Treatment Room)	SG38, SG39, SG40	237.6	660	634	10	11.5				Positive (11pa)		H14
3-C1.4-061	Bay 1 (Beds 1-6) (Treatment Room)	EG25, EG26	237.6					300	331	5	6.0	Negative	None
3-C1.4-062	Bay 1 - Ensuite	DEG22	12					34	29	10	10	Negative	None
3-C1.4-063	Play Room	EG01	59.4					133	198	8	14	Negative	F9
3-C1.4-064	Ward Kitchen	EG22	33.6					55	50	6	6	Negative	None
3-C1.4-065	Treatment Room	SG42	48.6	138	167	10	14.8					Positive	F9
3-C1.4-066	Clean Utility	SG41	32.4	48	58	6	7.2					Positive	F9
3-C1.4-067	WC - Visitors	DEG25	9.096					20	28	10	13	Negative	None
3-C1.4-068	Waiting Area	EG13	43.2					70	71	5	7	Negative	F9
3-C1.4-069	Reception / Staff Base	EG12	11.76					100	102	3	37	Negative	F9
3-C1.4-074	Single Room 3	SG06	48.6	52	126	10	11.2				Positive (11pa)		H14
3-C1.4-075	Room 3 - Ensuite	DEG01	12					40	39	10	14	Negative	None
3-C1.4-076	Single Room 2	SG03	45.9	51	111	10	10.4				Positive (11pa)		H14
3-C1.4-077	Room 2 - Ensuite	DEG27	12					40	35	10	13	Negative	None
3-C1.4-078	Single Room 1	SG02	54	52	177	10	14.2				Positive (11pa)		H14
3-C1.4-079	Room 1 - Ensuite	DEG26	12					52	47	10	17	Negative	None

Room Number	Room Name	Grille Number	Volume	Supply Design Airflow Rate (l/s)	Supply Actual Airflow Rate (l/s)	Supply Design (ac/hr)	Corrected (ac/hr)	Extract Design Airflow Rate (l/s)	Extract Actual Airflow Rate (l/s)	Extract Design (ac/hr)	Corrected (ac/hr)	Pressure	Filter
3-C1.4-083	Dirty Utility	DEG23	29.7					74	63	6	9	Negative	None
3-C1.4-084	Bay 2 (Beds 7-9)	SG36, SG37	132.3	148	365	**4**	12.0				Positive (10pa)		H14
3-C1.4-085	Bay 2 - Ensuite	DEG21	12					30	29	10	10	Negative	None
3-C1.4-087	Treatment Room	SG74	43.2	120	140	**3**	14					Positive	F9
3-C1.4-087	Treatment Room	EG14	43.2					108	31	3	3.1		

3-C1.5 Shared Support

Room Number	Room Name	Grille Number	Volume	Supply Design Airflow Rate (l/s)	Supply Actual Airflow Rate (l/s)	Supply Design (ac/hr)	Corrected (ac/hr)	Extract Design Airflow Rate (l/s)	Extract Actual Airflow Rate (l/s)	Extract Design (ac/hr)	Corrected (ac/hr)	Pressure	Filter
3-C1.5-002	Store - back up clothing	EG21	9.6					8	11	**3**	5.2	Negative	None
3-C1.5-003	Family Sitting Room	SG13	70.2	119	144	**6**	8.7					Balanced	F9
3-C1.5-003	Family Sitting Room	EG20	70.2					150	142	8	8.6		
3-C1.5-004	Baby Infant / Feeding Room	DEG15	9.6					27	24	10	10.8	Negative	None
3-C1.5-005	Nappy Change	DEG14	9.6					27	24	10	11.0	Negative	None
3-C1.5-006	Breast Pump Room	DEG16	9.6					27	24	10	11.0	Negative	None
3-C1.5-007	WC-Wheelchair Accessible	DEG18	10.9					30	26	10	10.3	Negative	None
3-C1.5-008	WC-Wheelchair Accessible	DEG17	12.7					20	25	3	8.5	Negative	None

Isolation Rooms

Room Number	Room Name	Grille Number	Floor Area	Room Height	Volume	Design Airflow Rate (l/s)	Actual Airflow Rate (l/s)	Design (ac/hr)	Corrected (ac/hr)	Comments	Pressure WRT Corridor	Filter
3-C1.4-039	Room 8 Lobby	SG16	4.6	2.7	13.5	196	238	50	70		+10pa	H14
3-C1.4-040	Single Room 8 (Isolation)	via lobby	17.3	2.7	45.9			10	16	supply is from 039		
3-C1.4-040	Single Room 8 (Isolation)	via ensuite	17.3	2.7	45.9			10	14	041 is ensuite		
3-C1.4-041	Room 8 - Ensuite	DEG11	4.5	2.4	12.42	131	201	55	65			None
3-C1.4-042	Room 7 - Ensuite	DEG10	4.5	2.4	12	128	168	62	56			None
3-C1.4-043	Single Room 7 (Isolation)	via lobby	16.9	2.7	45.9			10	17	supply is from 044		
3-C1.4-043	Single Room 7 (Isolation)	via ensuite	16.9	2.7	45.9			45	12	042 is ensuite		
3-C1.4-044	Room 7 Lobby	SG13	4.1	2.7	10.8	193	238	10	88		+10pa	H14
3-C1.4-048	Room 6 - Lobby	SG11	4.6	2.7	13.5	198	237	16	70		+10pa	H14
3-C1.4-049	Single Room 6 (Isolation)	via lobby	17.0	2.7	45.9				16	supply is from 048		
3-C1.4-049	Single Room 6 (Isolation)	via ensuite	17.0	2.7	45.9				12	050 is ensuite		
3-C1.4-050	Room 6 - Ensuite	DEG09	4.6	2.4	12.15	128	173	31	57			None
3-C1.4-051	Room 5 - Ensuite	DEG08	4.6	2.4	12	127	167	50	60			None
3-C1.4-052	Single Room 5 (Isolation)	via lobby	16.9	2.7	45.9			10	16	supply is from 053		
3-C1.4-052	Single Room 5 (Isolation)	via ensuite	16.9	2.7	45.9			10	12	051 is ensuite		
3-C1.4-053	Room 5 - Lobby	SG09	4.6	2.7	13.5	192	238	55	70		+10pa	H14
3-C1.4-071	Room 4 - Lobby	SG07	4.6	2.7	13.5	193	240	62	71		+10pa	H14
3-C1.4-072	Single Room 4 (Isolation)	via lobby	17.2	2.7	48.6			10	15	supply from 071		
3-C1.4-072	Single Room 4 (Isolation)	via ensuite	17.2	2.7	48.6			45	10	073 is ensuite		
3-C1.4-073	Room 4 - Ensuite	DEG24	4.7	2.4	12	117	144	10	55			None
3-C1.3-008	Room 4 - Lobby	SG65	3.9	2.7	10.8	193	209	16	79		+10pa	H14
3-C1.3-007	Single Room 4 (Isolation)	via lobby	16.9	2.7	45.9				15	supply from 008		
3-C1.3-007	Single Room 4 (Isolation)	via ensuite	16.9	2.7	45.9				10	009 is ensuite		
3-C1.3-009	Room 4 - Ensuite	DEG109	4.5	2.4	9.6	133	142	31	59			None

7 CONCLUSIONS

Based on the information provided by NHS Lothian;

- Design Assurance Statement by Turner PES
- Site Visit by Turner TES
- AHU Factory Visit by IOM
- HEPA Filter Integrity Tests by H&V Commissioning Ltd
- IOM On-Site Grille Readings
- Hoare Lea RHYCP + DCN (HVC107) ACH Verification Document

The system is acceptable at the time of validation. It is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life.

APPENDIX A - TPES DESIGN STATEMENT

Turner Property Services Limited
t/a Turner Professional Engineering Services (TPES)
65 Craigton Road, Glasgow, G51 3EQ, United Kingdom
Tel: +44 (0)141 309 5530 | *Email:* info@turnerpes.co.uk

NHS Lothian Health Board
Waverley Gate
2-4 Waterloo Place
Edinburgh
EH1 3EG

4 February 2021

Dear Sirs,

Supplemental Agreement No.2 ("SA2"): Ventilation Works

Design Assurance Statement

References:

A. Hoare Lea – MEP Engineering, Stage 4 Report: Rev 7, dated 2 Feb 21.
B. Air Handling Unit Technical Specifications.
C. Air Handling Unit Manufacturer's Drawings
D. Requests for Information (RFIs) 01 – 063.
E. AE Trip Report 20210129 -RHCYP&DCN.

I confirm in my capacity as Lothian Health Board's Authorising Engineer (Ventilation) that I have completed a review of IHS Lothian Limited's design response to HVC 107 as detailed in the following documentation as it exists on 4 February 2021 (together Part B of the Scope) and confirm to the NHS Lothian Health Board my opinion that the contents and design proposals therein should allow Project Co to meet the requirements of Part A of the Scope.

I have monitored the design development and I consider that it should be possible for the design included in Part B of the Scope to meet the requirements of Part A of the Scope. This is not an acceptance on my part of any design liability.

I have witnessed the standard of installation and the commissioning activities of the new Air Handling Units and consider that they meet the full requirements of SHTM 03-01. I further consider that these units are fit for their projected purpose if these installations are adequately maintained.

Yours Faithfully [redacted]

Eur Ing John M Rayner, BSc (Eng), CEng, FIHEEM, FCMI, MIMechE, MIET, MSVHSoc, TechIOSH

APPENDIX B - TPES SITE VISIT

Trip Report - Ventilation
NHS Lothian Board – RHCYP & DCN
19 – 21 January 2021

Background

1. I was asked to visit the worksites and assess the quality and standards of remedial project work in early December. A lot of the work was incomplete at the time, and a subsequent visit was requested. Due to flight restrictions I arranged to travel to Edinburgh on Sun 17 Jan and then to carry out additional work for NHS Lothian on Mon 18 Jan. I visited the RCHYP & DCN working areas during the next few days. I also attended the in-house routine meetings on Tue 19 Jan in person rather than by MS "Teams".

2. I visited one large and all of the smaller AHUs to assess the standards of design and installation work. I was escorted by Dean Riddell (NHSL Project team) and Darren Forbes (Imtech Senior Projects Manager) throughout this visit.

AHU 04-07

3. This large equipment is located in the Level 4 plant room. The air intake is from the nearby roof area. The anti-vermin seals on this roof access double doorway were still incomplete as I had noted in Dec 20. Darren Forbes agreed to sort out this non-operational problem.

4. The intake louvres did not appear to have a separate anti-vermin screen but were constructed in an effective labyrinth pattern section. These louvres should be easy to maintain by pressure washers from the outside. The lower surface of the ductwork inside the building sloped down to the lower intake louvre level and there were no intake drainage issues.

5. The temperature sensors and anti-frost coil were well constructed. The primary filter housing frame was also well constructed, and the filters were soundly held on the upstream side. The heat recovery coils were in good condition and no problems with their operation were reported. The chiller and heater battery supply pipes were well insulated and included isolation valves. The chiller drainage tray was well constructed with good interior slopes. The borosilicate trap was not fitted as there was an interference fit with the other external water pipes in that area. Darren Forbes reported that this problem was currently being addressed.

6. The final filter frame was well constructed, and filters were held on the upstream side of the frame - the bag pleats were all vertical. The duct test points were in the nearby ductwork towards the end of a straight section. The test points were all plugged but were not labelled as the insulation had been removed in this area for IOM testing work.

7. In summary, the installation has been well designed, constructed and installed. The door to the roof still needs remedial anti-vermin sealing. The AHU drainage systems still need their final assembly and fitting.

Level 2 Roof AHUs

8. AHU Cabins. The two new AHU cabins that contain four and one AHU have now been almost fully fitted out. Their interior designs are sound and provide good access to the five AHUs for routine inspection and maintenance.

9. The AHU intakes are located on the side away from the building in separate louvred intakes. The exterior parts of these intakes have large louvred cowls to prevent rainwater, etc. ingress. These units include anti-vermin screens.

10. The intake sections were well designed. No problems were reported with the operation of the motorised dampers and the frost coils had conventional detector units. All of the hot water pipe systems were well insulated and additionally were fitted with trace element heating. The intake filter mounts were soundly constructed and the filter units securely mounted. I noted that while the lower bank of (large) filter cartridges had their pleats vertical the upper level bank of (small) filter units had their pleats vertical. All of these filter

pleats should be vertical. Darren Forbes noted that the manufacturer did not provide the small units with the filter pleats in the other orientation. I did not consider this to be a significant problem for these types of non-bag filter unit.

11. The two fans were mounted vertically in the airstream with VSD controls. No problems were reported with their operational characteristics. The energy recovery system uses a run around coil system with well insulated supply systems. These included isolation valves.

12. The chiller batteries were supplied with 30% glycol mix. The pipes were well insulated and had isolation valves fitted. The condensate trays were well designed with good drainage gradients. The borosilicate traps were not fitted at the time of my visit. The post trap drainage systems were amalgamated under the cabin floors and routed into the neighbouring plant room where the air gap was located. These systems were reportedly fitted with trace element heating systems and had the required drainage slopes.

13. The chiller drainage systems (borosilicate trap, air gap & tundish) were not in place at the time of my visit. See my later comments.

14. External roof areas. The main raised access walkways were in place. The inspection hatch for unit 4 crosses the walkway at a relatively low elevation and in addition there is an inspection hatch mounted on the lower surface, further reducing headroom. I strongly recommend that this is provided with adequate padding and warning notices.

15. In addition, the 4-AHU cabin escape route is alongside the parapet wall, squeezing between the 1-AHU cabin and the wall. This area has been used to route the LV power cables for both AHU cabins on a “big foot” support racking system. This has been damaged in this area and needs repair. It also needs to have the vertical support pillars reduced in height and a walkway installed at the lowest possible elevation so that the parapet wall is not at an unsafe relative height.

Level 1 Grassy Knoll AHUs

16. AHU Cabin. I visited this installation while Imtech were starting to assemble the AHU drainage system for these four smaller AHUs. They observed that the lower level AHU drainage system (borosilicate trap and tundish) would have to be located under the working floor level. I noted that this would be acceptable as the floor is a non-slip grid structure supported at a reasonable height above the local ground level. I considered that visual checks of this trap and maintenance access would be relatively easy to make by the operations & maintenance staff.

17. I recommended that one tundish should be positioned for each side of the cabin so that each vertical pair of units could use this as a common drainage route. The two drains could then be joined under the floor level for eventual transmission to the main hospital drainage system. Imtech agreed to this concept and noted that they may have to use a sump pump arrangement in this location because of the relative drainage elevations. I agreed that I would consider this to be an acceptable arrangement if it was located after the tundish assembly.

18. The AHUs in this cabin appeared to be identical in construction to the ones outside the Level 2 plantroom and the above drainage comments should also be applied to those cabins.

19. I was unable to closely inspect the AHUs in this area due to the drainage works described above. The detailed equipment comments made for the Level 2 cabins should be applied to this installation.

20. External areas. The emergency escape route from the cabin led to an area bounded by the AHU output ducts on both sides. There is then about a 3m clear space from the cabin to the area wall. If this is considered to be an insufficiently sized safe area it would be quite easy to climb over a lower level duct to further evacuate to the nearby escape door in the wall. I recommend that this latter route should be clearly marked on the insulated cover of the duct. I did not feel that any support structure was required.

Summary of outstanding problems

21. The Level 4 plant roof access door requires vermin proofing.

22. The AHU drainage system for AHU 04-07 should be completed in a satisfactory manner before handover.

23. The work in the three AHU cabins to install the chiller drainage systems was being undertaken at the time of my visit. This should be completed before handover.

24. Some practical problems concerning the access and emergency exit routes to the three AHU cabins at both areas need to be addressed.

Conclusion

25. I consider that these works meet the requirements of SHTM 03-01 if the problems summarised above are completed in a satisfactory manner.

[redacted]

J M Rayner
Authorising Engineer (Ventilation)

APPENDIX C – IOM AHU FACTORY VISIT

David Holmes

From: Paul Jameson [redacted]
Sent: 21 July 2020 13:51
To: Henderson, Ronnie
Cc: Darren.Forbes[redacted]
Subject: AHU factory visit

Hi Ronnie

It was nice to catch up yesterday and look at the proposed new air handling units for the changes to the critical care areas at the site.

I as discussed on the day the physical inspections we made indicate that the Dakin units look superior to the previous Sandometal units installed on site.

We used the 26 point checklist of issues developed by you from the previous units and no significant issues were identified.
seems to have been complied with on these units.

I would confirm that the filter housings were far superior to the previous air handling units and the airflow pushes both primary and final filters into the housings and onto sealing strips.

The drip trays were easily accessible for cleaning and we witnessed that water introduced to them flowed out smoothly and there was no ponding noted.

There were minor improvement opportunities noted on site with respect to magnahelic gauge scales and location of high level isolators and it was agreed that changes would be made prior to delivery to siste.

It was noted that the grid flooring may need an access panel to get to the glss traps when installed and that trps exposed to the elements would benefit from trace heating so they do not freeze and break in cold weather. It was agreed that these adjustments could be accommodated in the site installation work.

The large units will need access arrangements for maintenance and we witnessed the removal of one of the high level access doors which would be needed on site for maintenance.

We jointly witnessed the air handling unit volume supply test one large and one small unit. The small unit this demonstrated over 20% spare capacity and 40% on the largr unit.

The leakage test on both units also met requirements.

We had a discussion about the additional fine insect mesh on the louvers. The fine insect mesh is over and above the expectation of the HTM and could over time become blocked over time. However, if this was a request of Bouygues, as they are the maintainer, they will need to ensure they stay clean.

The units will be supplied without controls and Darren seems to be acutely aware of the need to avoid internal cabling and components.

The units come with lighting pre-installed and this was in steel conduit with robust electrical connectors which can be kept clean.

There was an outstanding question about the clearance for the spring return actuator on the motorized dampers particularly in the units contained in cabins. It is understood that Darren will be confirming that there is sufficient space for the actuators.

Overall, the units are in my opinion satisfactory and I stated earlier far superior to the previous units used on the site.

If you require any further input on this issue, please let me know.

Paul

Paul Jameson
M.Sc, B.Sc (Hons), C.Eng, M.I.Mech.E, C.I.B.S.E.
Authorising Engineer (Ventilation)
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APPENDIX D – HEPA FILTER INTEGRITY TEST

LEVEL 3 ALL ROOMS

HEPA FILTER INTEGRITY TEST

RHCYP & DCN - EDINBURGH

Client:	Imtech	**Client Contact:**	Darren Forbes
Hospital:	Royal Hospital for Children & Young People	**Site Address:**	Little France Crescent, Edinburgh
Area:	3rd Floor Lochranza Ward	**Report No:**	AG01010321
Date of Test:	Various	**Date of Last Test:**	n/a
Report Preparation:	Alan Gourdie	**Signature:**	[redacted]
H&V Approval:	John Reilly	**Signature:**	[redacted]
Client Reviewed by:		**Signature:**	

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Section 1 – Scope of Works

To carry out HEPA Filter Integrity testing on the supply HEPA filters fitted in the Lobby of each of the 4 Isolation Rooms with the 1st floor of RHCYP & DCN, Edinburgh.

It is assumed that all rooms are commissioned to SHTM03-01 guidelines.

To pass, the HEPA filters will be tested to achieve a leakage rate of ≤0.01%.

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Section 2 - Executive Summary/Observations:

All filters and seals tested and passed.

Equipment Used		
Equipment Type	Serial Number	Calibration Due Date
Smoke Generator	1025732	2nd December 2021
Smoke Generator	CAG14133	27th August 2021
Smoke Generator	CAG14138	17th August 2021
Photometer	34011	13th January 2022
Photometer	4287913	9th September 2021
Photometer	14086	28th July 2021

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Section 3 - HEPA Filter Integrity

OBJECTIVE

Test performed to confirm that installed filter systems are properly installed by verifying the absence of bypass leakage in the installation, and that the filters are free of defects (small holes and other damage in the filter medium, frame, seal and leaks in the filter bank framework).

PRE-REQUISITES

- Supply airflow rates have been measured and within specification.
- **Smoke generator** – ISO14644-3:2019, 3.6.1 *aerosol generator*
- **Photometer** – ISO14644-3:2019, 3.6.2 *aerosol photometer*
- **Calibration certificates** – required for the above and appended to the test report.

METHODOLOGY

The test will be performed by introducing an aerosol challenge upstream of each HEPA filter and scanning immediately downstream of the filters and support frame, in accordance with ISO14644-3:2019, B.7.2 *Procedure for installed filter system leakage scan test with an aerosol photometer.*
A test report will be prepared which will include confirmation of the methodology used, results of testing for each filter, whether each test is a **pass** or **fail**, the location of any detected leaks and indication of the position and extent of any repairs and calibration certificates for all test equipment used.

ACCEPTANCE CRITERIA

- Aerosol concentration readings must be $\leq$ 0.01 % of the upstream concentration within Grade A (ISO 5) and Grade B (ISO 5) of the upstream concentration within Grade C (ISO 7) and Grade D (ISO 8) rooms.
- A test report is prepared which includes confirmation of the methodology used, results of testing for each filter, whether each test is a **pass** or **fail.** If a fail is recorded replace the filter and retest.
- Attach copy of calibration certificates for all test equipment.

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Section 4 – Level 3 – Single Room 001 3-C1.4-078

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-078	SG002	84	0.0015	Pass
Comments: Filter and seal passed; test carried out by Ian Stewart 23-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 4287913	9th September 2021
Smoke Generator s/n CAG14133	27th August 2021

Section 5 – Level 3 – Single Room 002 3-C1.4-076

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-076	SG003	51	0.0003	Pass
Comments: Filter and seal passed; test carried out by Darren Kerr 18-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n CAG14138	17th August 2021

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Section 6 – Level 3 – Single Room 003 3-C1.4-033

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-033	SG006	13	0.0061	Pass
Comments: Filter and seal passed; test carried out by Michael Cameron 12-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n 1025732	2nd December 2021

Section 7 – Level 3 – Single Room 004 3-C1.4-071

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-071	SG007	33	<0.01	Pass
Comments: Filter and seal passed; test carried out by Michael Cameron 12-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n 1025732	2nd December 2021

RHCYP & DCN – EDINBURGH

Section 8 – Level 3 – Isolation Room 005 3-C1.4-053

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-053	SG009	72	0.0005	Pass
Comments: Filter and seal passed; test carried out by Ian Stewart 23-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 4287913	9th September 2021
Smoke Generator s/n CAG14133	27th August 2021

Section 9 – Level 3 – Isolation Room 006 3-C1.4-048

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-048	SG011	56	<0.01	Pass
Comments: Filter and seal passed; test carried out by Michael Cameron 12-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n 1025732	2nd December 2021

RHCYP & DCN – EDINBURGH

Section 10 – Level 3 – Isolation Room 007 3-C1.4-044

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-044	SG013	13	0.0061	Pass
Comments: Filter and seal passed; test carried out by Michael Cameron 29-Jan-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n 1025732	2nd December 2021

Section 11 – Level 3 – Isolation Room 008 3-C1.4-039

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-039	SG016	18	<0.01	Pass
Comments: Filter and seal passed; test carried out by Darren Kerr 18-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n CAG14133	27th August 2021

RHCYP & DCN – EDINBURGH

Section 12 – Level 3 – Isolation Room 009 3-C1.4-032

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-032	SG017	23	0.0029	Pass
Comments: Filter and seal passed; test carried out by Darren Kerr 27-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n CAG14138	17th August 2021

Section 13 – Level 3 – Single Room 010 3-C1.4-018

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-018	SG025	85	0.0006	Pass
Comments: Filter and seal passed; test carried out by Ian Stewart 23-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 4287913	9th September 2022
Smoke Generator s/n CAG14133	27th August 2021

RHCYP & DCN – EDINBURGH

Section 14 – Level 3 – Single Room 011 3-C1.4-010

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-010	SG029	26	0.0018	Pass
Comments: Filter and seal passed; test carried out by Darren Kerr 27-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n CAG14138	17th August 2021

Section 15 – Level 3 – Single Room 012 3-C1.4-013

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-013	SG028	70	0.002	Pass
Comments: Filter and seal passed; test carried out by Ian Stewart 23-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 4287913	9th September 2022
Smoke Generator s/n CAG14133	27th August 2021

RHCYP & DCN – EDINBURGH

Section 16 – Level 3 – Single Room 014 3-C1.4-016

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-016	SG026	53	0.005	Pass
Comments: Filter and seal passed; test carried out by Grant Foster 19-Jan-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 14086	28th July 2021
Smoke Generator s/n 1025732	2nd December 2021

Section 17 – Level 3 – Single Room 015 3-C1.4-046

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-046	SG012	83	0.007	Pass
Comments: Filter and seal passed; test carried out by Grant Foster 19-Jan-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 14086	28th July 2021
Smoke Generator s/n 1025732	2nd December 2021

RHCYP & DCN – EDINBURGH

Section 18 – Level 3 – Single Room 016 3-C1.4-055

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-055	SG008	69	0.0001	Pass
Comments: Filter and seal passed; test carried out by Darren Kerr 18-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n CAG14138	17th August 2021

Section 19 – Level 3 – Single Room 017 3-C1.4-057

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-057	SG005	35	<0.01	Pass
Comments: Filter and seal passed; test carried out by Michael Cameron 29-Jan-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n 1025732	2nd December 2021

RHCYP & DCN – EDINBURGH

Section 20 – Level 3 – Single Room 018 3-C1.4-059

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-059	SG004	87	0.0023	Pass
Comments: Filter and seal passed; test carried out by Darren Kerr 27-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n CAG14138	17th August 2021

Section 21 – Level 3 – Multi Occupancy Room 001-006 3-C1.4-061

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-061	SG038	62	0.0009	Pass
	SG039	72	0.0008	Pass
	SG040	12	0.0001	Pass
Comments: Filter and seal passed; test carried out by Darren Kerr 27-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n CAG14138	17th August 2021

RHCYP & DCN – EDINBURGH

Section 22 – Level 3 – Day Care Room 007-009 3-C1.4-084

HEPA Filter Integrity Test Result

Location	HEPA Filter Ref.	Upstream Challenge (10-100mg/m^3)	Penetration Reading (%)	Results (Pass/Fail)
Room 3-C1.4-084	SG036	46	0.0017	Pass
	SG037	72	0.0007	Pass
Comments: Filter and seal passed; test carried out by Darren Kerr 27-Feb-2021.				
Acceptance Criteria: Test Method: BS EN ISO 14644-3:2019 **(Maximum Allowable Penetration = <0.01%)**				

Equipment Used	Calibration Due
Photometer s/n 34011	13th January 2022
Smoke Generator s/n CAG14138	17th August 2021

Section 23 - Calibration Certificates

S & M Electronics Ltd.
105, Eastcote Road, Pinner,
Middlesex HA5 1ET U.K.
Tel : (020) 8429 1222
Fax : (020) 8248 4313
info@sandmelectronics.com

The Authority in HEPA support

AEROSOL GENERATOR CERTIFICATE OF C0MPLIANCE

Certificate No:	17345	Test Date:	2nd December 2020.
Manufacturer:	CONCEPT	Model:	1300/135/1.1
Serial No :	1025732	Test Due :	2nd December 2021.
Customer :	H & V Commissioning Services Limited Kilknowe Office, 16 Barrmill Road, Galston, Ayrshire KA4 8HH.	Contact :	Ms. Karen Gavin.

Upon receipt by S & M Electronics Limited, on first inspection & testing, the Generator Heater Block Temperature was 334°C (Tolerance +/- 10 °C) & the instrument was found to be in good working order.

This instrument has been serviced by S & M Electronics Limited in accordance with the Manufacturer's requirements, having been fully tested and found to be in good order.

This equipment has been calibrated using instruments traceable to National Standard. The measurements were correct at the time of calibration.

The calibration was performed in the service area at room temperature of 21 °C +/- 5 °C.
Environmental considerations are not relevant to the performance of the instrument.

Results :

Heater Block Temperature : 335 °C +/- 10 °C. Regulator : 0 - 100 PSI
Heater Assembly: 240V 1.1 K Watts. Output: Variable 0 – 120 psi Particle Size: 0.2-0.3 micron(mmd)
Oil/Gas ratio: Smear free at 20 P.S.I. Smoke Output: 0-150m³min @ 1.5 visibility.
Only **Shell Ondina X420 Oil** is recommended for this equipment.

Calibration Completed by :.....[redacted]..... Mr. A. Patel (Engineer).

Certified Test Equipment : Model TLK - 38 S/N: S&M CAL-4 UKAS Cert. No: C32868.

S & M ELECTRONICS TESTED & CALIBRATED LIMITED

Website: www.sandmelectronics.com

Register Office: 74 Dickenson Road, Manchester M14 5HF Registered in England No: 2580956

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info@sandmelectronics.com

The Authority in HEPA support

CERTIFICATE OF ELECTRICAL SAFETY TEST.

Certificate No:	17345-1	Test Date:	2nd December 2020.
Manufacturer:	CONCEPT	Model:	1300/135/1.1
Serial No :	1025732	Test Due :	2nd December 2021.
Customer :	H & V Commissioning Services Limited Kilknowe Office, 16 Barrmill Road, Galston, Ayrshire KA4 8HH.	Contact :	Ms. Karen Gavin.

This instrument has been tested against our portable appliance tester Seaward Europa Plus S/N: 27B-0771

The results are as follows :

Test Number	:	*17345*
Date	:	2nd December 2020.
Test Mode	:	Automatic.
Visual Check	:	Pass.
Earth Test	:	*0.04* Ohm. Pass.
Insulation Test	:	*>99.9* Meg. Ohm. Pass.
Load Test	:	*0.67* K.V.A. Pass.
Leakage Test	:	*<0.10* ma. Pass.

Test Completed by : ..... [redacted] ..... Mr. A. Patel (Engineer).

Certified Test Equipment: Seaward Europa Plus S/N: 27B-0771

S & M ELECTRONICS TESTED & CALIBRATED LIMITED

Website: www.sandmelectronics.com

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The Authority in HEPA support

AEROSOL GENERATOR CERTIFICATE OF COMPLIANCE

Certificate No:	17098	Test Date:	27th August 2020.
Manufacturer:	S&M Electronics Limited	Model:	SCIENTIFIC
Serial No :	CAG 14133	Test Due :	27th August 2021.
Customer :	H & V Commissioning Services. Kilknowe Office, 16 Barrmill Road, Galston, Ayrshire KA4 8HH.	Contact :	Ms. Angela Daly

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This instrument has been serviced by S & M Electronics Limited in accordance with the Manufacturer's requirements, having been fully tested and found to be in good order.

This equipment has been calibrated using instruments traceable to National Standard. The measurements were correct at the time of calibration.

The calibration was performed in the service area at room temperature of 21 °C +/- 5 °C.
Environmental considerations are not relevant to the performance of the instrument.

Results :

Heater Block Temperature : 343 °C +/- 10 °C.
Regulator : 0 - 60 PSI
Heater Assembly: 230V 1.00K Watts.
Output: Infinity Variable 1.0 – 60 PSI.
Smoke Output: 0- 200 m³min @ 1.5 visibility.
Particle Size: 0.2-0.4 micron(mmd)
Oil/Gas ratio: Smear free at 20 P.S.I
Oil Metering Orifice: 0.0145"
Only **Shell Ondina Oil** is recommended for this equipment.

Calibration Completed by :..... [redacted] ..... Mr. A. Patel (Engineer).

Certified Test Equipment : Model TLK - 38 S/N: S&M CAL-4 UKAS Cert. No: C32868.

S & M ELECTRONICS TESTED & CALIBRATED LIMITED

Website: www.sandmelectronics.com

S&M ELECTRONICS
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CERTIFICATE OF ELECTRICAL SAFETY TEST.

Certificate No:	17098-1	Test Date:	27th August 2020.
Manufacturer:	S&M Electronics Limited	Model:	SCIENTIFIC
Serial No :	CAG 14133	Test Due :	27th August 2021.
Customer :	H & V Commissioning Services. Kilknowe Office, 16 Barrmill Road, Galston, Ayrshire KA4 8HH.	Contact :	Ms. Angela Daly

---

This instrument has been tested against our portable appliance tester Seaward Europa Plus S/N: 27B-0771

The results are as follows :

Test Number	:	*17098*
Date	:	27th August 2020.
Test Mode	:	Automatic.
Visual Check	:	Pass.
Earth Test	:	*0.14* Ohm. Pass.
Insulation Test	:	*>99.9* Meg. Ohm. Pass.
Load Test	:	*0.84* K.V.A. Pass.
Leakage Test	:	*<0.10* ma. Pass.

Test Completed by : ..... [redacted] ..... Mr. A. Patel (Engineer).

Certified Test Equipment: Seaward Europa Plus S/N: 27B-0771

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The Authority in HEPA support

AEROSOL GENERATOR CERTIFICATE OF COMPLIANCE

Certificate No:	17069	Test Date:	17th August 2020.
Manufacturer:	S&M Electronics Limited	Model:	SCIENTIFIC
Serial No :	CAG 14138	Test Due :	17th August 2021.
Customer :	H & V Commissioning Services. Kilknowe Office, 16 Barrmill Road, Galston, Ayrshire KA4 8HH.	Contact :	Ms. Angela Daly

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This instrument has been serviced by S & M Electronics Limited in accordance with the Manufacturer's requirements, having been fully tested and found to be in good order.

This equipment has been calibrated using instruments traceable to National Standard. The measurements were correct at the time of calibration.

The calibration was performed in the service area at room temperature of 21 °C +/- 5 °C.
Environmental considerations are not relevant to the performance of the instrument.

Results :

Heater Block Temperature : 343 °C +/- 10 °C.
Heater Assembly: 230V 1.00K Watts.
Smoke Output: 0- 200 m³min @ 1.5 visibility.
Oil/Gas ratio: Smear free at 20 P.S.I
Only **Shell Ondina Oil** is recommended for this equipment.

Regulator : 0 - 60 PSI
Output: Infinity Variable 1.0 – 60 PSI.
Particle Size: 0.2-0.4 micron(mmd)
Oil Metering Orifice: 0.0145"

Calibration Completed by :..... [redacted] ..... Mr. A. Patel (Engineer).

Certified Test Equipment : Model TLK - 38 S/N: S&M CAL-4 UKAS Cert. No: C32868.

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The Authority in HEPA support

CERTIFICATE OF ELECTRICAL SAFETY TEST.

Certificate No:	17069-1	Test Date:	17th August 2020.
Manufacturer:	S&M Electronics Limited	Model:	SCIENTIFIC
Serial No :	CAG 14138	Test Due :	17th August 2021.
Customer :	H & V Commissioning Services. Kilknowe Office, 16 Barrmill Road, Galston, Ayrshire KA4 8HH.	Contact :	Ms. Angela Daly

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This instrument has been tested against our portable appliance tester Seaward Europa Plus S/N: 27B-0771

The results are as follows :

Test Number	:	*17069*
Date	:	17th August 2020.
Test Mode	:	Automatic.
Visual Check	:	Pass.
Earth Test	:	*0.12* Ohm. Pass.
Insulation Test	:	*>99.9* Meg. Ohm. Pass.
Load Test	:	*0.90* K.V.A. Pass.
Leakage Test	:	*<0.10* ma. Pass.

Test Completed by : ..... [redacted] ..... Mr. A. Patel (Engineer).

Certified Test Equipment: Seaward Europa Plus S/N: 27B-0771

S & M ELECTRONICS TESTED & CALIBRATED LIMITED

TRACEABLE CERTIFICATION & CALIBRATION REPORT

Digital Aerosol Photometer

Customer : H & V Commissioning Services Ltd

Envirtonmental Conditions		
Temperature	21.5	°C
Ambient Pressure	101.1	kPa

Model	ATI 2i
Serial No.	34011
WIP	7675
SR	SR24369

Air Techniques International
4 Campus 5
Letchworth Business Park
Letchworth Garden City
Hertfordshire
SG6 2JF
United Kingdom

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Facsimile
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Email
salesuk@atitest.com

Website
http://www.atitest.com

Registered in England
No. GB 3889548

VAT Number
GB 770862705000

Calibration Equipment

	Multimeter	Electronic Balance	Flowmeter
Model	RS-14 Digital Multimeter	HP220DC	Mass Flowmeter
Serial Number	180516553	D455800028	F165086/01
Cal Due Date	Nov-21	Jun-21	Oct-22

Calibration Data

Volumetric Flow: L/min ± 5% of reading

Test Point	Measurement	2i Output	ABS ERROR	Allowed ERROR	Cal status
As Found	28.50	28.40	0.10	1.4	Pass
As Left	28.30	28.50	-0.20	1.4	Pass

Stray Light: Volts

	As Found	As Left
Stray Light	0.000248	0.000326

ONDINA Concentration: 100 µg/L ± 10% of Reading*

Test Point	Generator	2i Output	ABS ERROR	ALLOWED ERROR	CAL Status
As Found	100.00	106.00	-6.00	10	Pass
As Left	100.00	100.60	-0.60	10	Pass

PAO Concentration: 100 µg/L ± 10% of Reading*

Test Point	Generator	2i Output	ABS ERROR	ALLOWED ERROR	CAL Status
As Found	100.00	93.50	6.50	10	Pass
As Left	100.00	97.00	3.00	10	Pass

DOP Concentration: 100 µg/L ± 10% of Reading*

Test Point	Generator	2i Output	ABS ERROR	ALLOWED ERROR	CAL Status
As Found	100.00	88.90	11.10	10	Fail
As Left	100.00	96.20	3.80	10	Pass

HIGH Concentration: 100 µg/L ± 30µg/L

Test Point	Generator	2i Output	ABS ERROR	ALLOWED ERROR	CAL Status
As Found	100.00	85.00	15.00	30	Pass
As Left	100.00	97.00	3.00	30	Pass

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Condition of Unit

AS FOUND				AS LEFT			
☐	In tolerance	☐	Inoperable	☑	Calibrated as left	☐	New instrument
☑	Out of tolerance			☐	No calibration performed		

Maintenance Performed

☑	Rework scattering chamber	☑	Test scanning probe	☑	Leak Check	
☑	Clean Sampling System	☐	Test Absolute Filter	☐	Printer	
☐	Replace Cell Lamp	☐	Replace Gaskets	☐	Voltage Checks	
☐	Align Optics	☑	Tighten Loose Hardware	☑	Final Test	

Calibration Statement

The instrument listed on this certificate has been calibrated against standards traceable to NIST or other recognized national metrology institutes, derived from ratio type measurements, or compared to nationally recognized consensus standards. The uncertainty of the above concentration measurements are ±10%. All results contained within this certificate relate only to the item(s) calibrated. Any number of factors may cause the calibrated item to drift out of calibration before the instruments calibration interval has expired. This certificate shall not be reproduced except in full and with written consent of ATI. This unit has been calibrated to the most recent revis[redacted]

Calibrated by	A.Carter	Signed	[redacted]
Cal Date	13 January 2021	Cal Due	13 January 2022

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The Authority in HEPA support

AEROSOL PHOTOMETER CERTIFICATE OF CALIBRATION

Certificate No:	17130	Test Date:	9th September 2020.
Manufacturer:	DOP Solutions	Model:	SP200DNS-B
Serial No :	4287913	Test Due :	9th September 2021
Customer :	H & V Commissioning Services Ltd Kilknowe Office, 16 Barrmill Road, Galston, KA4 8HH.	Contact :	Ms. Angela Daly.

This instrument has been tested & Calibrated in accordance with the manufacturer's specification against our Aerosol Test Rig & Certified to meet all current U.S.A. & U.K. requirements for filter testing. This includes the following: CS-1T,2T,6T; ANSI 101 & 150; NSF 49,ASTM D-1899; IEST-RP-CC-013-86-T, IEST-RP-CC-002.2, IEST-RP-CC-034.1,EN 12469:2000, ISO 14644-3 and British Standard BS5295 and BS EN 1822.

The Aerosol Test Rig is calibrated annually when the actual mass concentration is measured by collecting and weighing the particulate, using Sartorius Scale Model 1712 s/n 3308 087 which has been certified by Sartorius Limited, UKAS Certificate No: JH1990 to meet British Standard using weights traceable to NPL standard. **Shell Ondina Oil** is used for calibration of Aerosol Photometer.

Expanded Uncertainty of Measurement: ± 6.6%

Stated uncertainty based on a temperature, humidity and pressure within 18-25 ^{o} C, 35 to 70% RH and 960 to 1045 mbar.

Reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Calibration Completed by ..... [redacted] ..... Mr.A.Patel (Engineer).

S & M ELECTRONICS TESTED & CALIBRATED LIMITED

Website:www.sandmelectronics.com

Register Office: 74 Dickenson Road, Manchester M14 5HF Registered in England No: 2580956

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The Authority in HEPA support

CERTIFICATE OF ELECTRICAL SAFETY TEST.

Certificate No:	17130-1	Test Date:	9th September 2020
Manufacturer:	DOP Solutions	Model:	SP200DNS-B
Serial No :	4287913	Test Due :	9th September 2021.
Customer :	H & V Commissioning Services. Kilknowe Office, 16 Barrmill Road, Galston, Ayrshire KA4 8HH.	Contact :	Ms. Angela Daly

---

This instrument has been tested against our portable appliance tester Seaward Europa Plus S/N: 27B-0771

The results are as follows :

Test Number	:	*17130*
Date	:	9th September 2020.
Test Mode	:	Automatic.
Visual Check	:	Pass.
Earth Test	:	*0.11* Ohm. Pass.
Insulation Test	:	*>99.9* Meg. Ohm. Pass.
Load Test	:	*0.05* K.V.A. Pass.
Leakage Test	:	*<0.35* ma. Pass.

Test Completed by : ..... [redacted] ..... Mr. A. Patel (Engineer).

Certified Test Equipment: Seaward Europa Plus S/N: 27B-0771

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The Authority in HEPA support

AEROSOL PHOTOMETER CALIBRATION REPORT

Customer Name: H & V Commissioning Services. Date: 9-Sep-2020

Model No : SP 200 DNS-B MK III Serial No : 4287913 Our Ref: 17130

Internal Reference set point Check.	Set Memory	Tolerance
Previous Service:	10.00	Ug/Litre.
Before Calibration:	10.00	10.00% +/-

D.C. Power supplies Volts :	15.00 Volt +	15.00 Volt -	Lamp. +	Pump. +
	12.09	12.05	4.96	24.06

Test:		Linear Reading:
1	22	100.0000%
2	21	88.0700%
3	20	37.2600%
4	19	46.4400%
5	18	0.1931%
6	15	0.1162%
7	10	0.0331%
8	8	0.0193%
9	5	0.0072%
10	2	0.0009%
11	1	0.0001%

Linear Mode Operation:

		H.V :
Span Dial:	5.51	342.00
Zero Dial :	9.63	
Memory Dial:	NIL	
Memory Value:	10.00	ug/Litre.
Air Flow :	30.00	Litre /Min.

Tolerance:µg/l ± 12 %

Expanded Uncertainty of Measurement 6.6%

Reported expanded uncertainty is based on standard uncertainty multiplied by coverage factor of k=2,
Providing a level of confidence of approximately 95%.

This Photometer is Calibrated by: [redacted] Date: 9-Sep-2020

THIS DOCUMENT IS VALID FOR 12 MONTHS FROM DATE OF CALIBRATION.

S & M Electronics Ltd.
105 Eastcote Road, Pinner,
Middlesex HA5 1ET, UK.
Tel : (020) 8429 1222
Fax: (020) 8248 4313
info@sandmelectronics.com

The Authority in HEPA support

AEROSOL PHOTOMETER CERTIFICATE OF CALIBRATION

Certificate No:	17001	Test Date:	28th July 2020.
Manufacturer:	A.T.I.	Model:	TDA 2G
Serial No :	14086	Test Due :	28th July 2021.
Customer :	H & V Commissioning Services. Kilknowe Office, 16 Barrmill Road, Galston, Ayrshire KA4 8HH.	Contact :	Ms. Angela Daly.

This instrument has been tested & Calibrated in accordance with the manufacturer's specification against our Aerosol Test Rig & Certified to meet all current U.S.A. & U.K. requirements for filter testing. This includes the following: CS-1T,2T,6T; ANSI 101 & 150; NSF 49,ASTM D-1899; IEST-RP-CC-013-86-T, IEST-RP-CC-002.2, IEST-RP-CC-034.1,EN 12469:2000, ISO 14644-3 and British Standard BS5295 and BS EN 1822.

The Aerosol Test Rig is calibrated annually when the actual mass concentration is measured by collecting and weighing the particulate, using Sartorius Scale Model 1712 s/n 3308 087 which has been certified by Sartorius Limited, UKAS Certificate No: JH1990 to meet British Standard using weights traceable to NPL standard. **Shell Ondina X420 Oil (P1)** is used for calibration of Aerosol Photometer.

Expanded Uncertainty of Measurement: ± 3.3%

Stated uncertainty based on a temperature, humidity and pressure within 18-25 ^{O} C, 35 to 70% RH and 960 to 1045 mbar.

Reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor of k=2, providing a level of confidence of approximately 95%.

Calibration Completed by ..... [redacted] ..... Mr.A.Patel (Engineer).

S & M ELECTRONICS
TESTED & CALIBRATED
LIMITED

Website: www.sandmelectronics.com

Register Office: 74 Dickenson Road, Manchester M14 5HF Registered in England No: 2580956

S & M Electronics Ltd.
105 Eastcote Road, Pinner,
Middlesex HA5 1ET, UK.
Tel : (020) 8429 1222
Fax: (020) 8248 4313
info@sandmelectronics.com

The Authority in HEPA support

CERTIFICATE OF ELECTRICAL SAFETY TEST.

Certificate No:	17001	Test Date:	28th July 2020.
Manufacturer:	A.T.I.	Model:	TDA 2G
Serial No :	14086	Test Due :	28th July 2021.
Customer :	H & V Commissioning Services. Kilknowe Office, 16 Barrmill Road, Galston, Ayrshire KA4 8HH.	Contact :	Ms. Angela Daly.

This instrument has been tested against our portable appliance tester Seaward Europa Plus S/N: 27B-0771

The results are as follows :

Test Number	:	*17001*
Date	:	28th July 2020.
Test Mode	:	Automatic.
Visual Check	:	Pass.
Earth Test	:	*0.09* Ohm. Pass.
Insulation Test	:	*>99.9* Meg. Ohm. Pass.
Load Test	:	*<0.05* K.V.A. Pass.
Leakage Test	:	*0.16* ma. Pass.

Test Completed by : ..... [redacted] ..... Mr. A. Patel (Engineer).

Certified Test Equipment: Seaward Europa Plus S/N: 27B-0771

S & M ELECTRONICS TESTED & CALIBRATED LIMITED

APPENDIX E – HOARE LEA HVC 107 VERIFICATION DOCUMENT

IOM are not responsible for the accuracy of the information contained within the Hoare Lea document attached below. However it is included here for information and completeness.

Address
Hoare Lea
58 Waterloo Street
Glasgow
G2 7DA

RHCYP+DCN (HVC107)

VENTILATION

AIR CHANGE VERIFICATION DOCUMENT

Rev	Description	Prepared by	Checked by	Authorised by	Date
A	First Issue	Andrew Nisbet	Stratis Vatis	Paul Winning	11/02/2021
B	Second Issue	Andrew Nisbet	Stratis Vatis	Paul Winning	12/02/2021
C	Updated inline with NHS, IOM and Infection Control meeting (22/02/2021)	Andrew Nisbet	Stratis Vatis	Paul Winning	22/02/2021
D	Updated inline with Arcadis	Andrew Nisbet	Stratis Vatis	Paul Winning	25/02/2021

Existing Design Data

Proposed Design Data

* All Open to 1-B1-065

** Windows will be locked shut

Rooms associated with Single bedrooms and Multi-bedrooms in Paediatric Critical Care & Single bedrooms and Multi-bedrooms in Haematology and Oncology

Rooms associated with Isolation Rooms in Paediatric Critical Care & Isolation Rooms in Haematology and Oncology

Negative/Negative Isolation Room

Achieves Compliance

Notes

1.Open plan to larger area. Overall supply volume in larger area satisfies compliance.
2. Rooms with no supply air identified achieve fresh air make-up via corridor (excess supply air from other spaces).
3. Isolation bedroom recieves supply air from lobby through pressure stabiliser and extract via ensuite. This room achieves SHTM 03-01 compliance of 10AC/H.
4. Combined extract from bay 1 (3-C1.3-011) plus adjoining toilet (3-C1.3-010) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.
5. Combined extract from bay 2 (3-C1.3-013) plus adjoining toilet (3-C1.3-014) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.

HOARE LEA

Imtech

Room No.	Department		Room Name	Qty	Room Function	SHTM03-01 Appendix A Table 1 Classification	Ventilation														
							EXISTING	PROPOSED	EXISTING		PROPOSED		AS INSTALLED (IOM)					Relative pressure	Proposed	Measured Pressure (H&V)	Min filtration	
							(type)	(type)	Supply (ac/hr)	Extract (ac/hr)	Supply (ac/hr)	Extract (ac/hr)	Room Volume (m3)	Supply (L/s)	Extract (L/s)	Supply (ac/hr)	Extract (ac/hr)				EXISTING	PROPOSED
3-C1.3-002	C1.3	Neuroscience Inpatients - 12 Beds	Waiting Area	1	Waiting Room		Central Supply and Extract		5	5	5	5	27	60	64.8	8	9	Balanced	Negative		F7	F9 ePM1 90%
3-C1.3-003			Reception / Staff Base	1	Reception		Central Supply Air		3	0	3	0	7.2	10	0	5	0	Positive	Positive		F7	F9 ePM1 90%
3-C1.3-004			WC Accessible	1	Toilet		Central Dirty Extract		0	10	0	10	9.6	0	32.4	0	12	Negative	Negative		None	
3-C1.3-005			Store - Equipment	1	Storage Area Equipment		Central General Extract		0	3	0	3	21.6	0	20.4	0	3	Negative	Negative		None	
3-C1.3-006			Touchdown Base	1	Staff base		Central Supply Air		7	0	7	0	5.4	10	0	7	0	Positive	Positive		F7	F9 ePM1 90%
3-C1.3-007			Room 1 - Lobby	1	Isolation Lobby		Central Supply		64	0	64	0	10.8	232	0	77	0	+10Pa to corridor	+10Pa to corridor	+10Pa	H14	
3-C1.3-008			Single Room 1***	1	Isolation Bedroom		Supply via lobby		10	10 via the ensuite	10	10 via the ensuite	45.9	0	0	REFER TO NOTE 3	REFER TO NOTE 3	Balanced	Balanced	-	H14	
3-C1.3-009			Room 1- Ensuite	1	Bathroom		Central Dirty Extract		0	43	0	43	9.6	0	158	0	59	Negative	Negative	-	None	
3-C1.3-010			Bay 1 - Toilet	1	Bathroom		Central Dirty Extract		0	10	0	10	9.6	0	36	0	14	Negative	Negative		None	
3-C1.3-011			Bay 1 (Bed 2-5) **(NOTE 4)**	1	Multi-bed Wards		Natural and Central Supply Air		4	via ensuite	4	via ensuite	159.3	200.4	90	5	2	positive to ensuite	Positive		F7	F9 ePM1 90%
3-C1.3-012			Bay 1 - Ensuite (Wetroom)	1	Bathroom		Central Dirty Extract		0	10	0	10	33.6	0	108	0	12	Negative	Negative		None	
3-C1.3-013			Bay 2 (beds 6-9) **(NOTE 5)**	1	Multi-bed Wards		Natural and Central Supply Air		4	via ensuite	4	via ensuite	156.6	231.6	88.8	5	2	positive to ensuite	Positive		F7	F9 ePM1 90%
3-C1.3-014			Bay 2 - Toilet	1	Bathroom		Central Dirty Extract		0	10	0	10	11.4		32.4		10	Negative	Negative		None	
3-C1.3-015			Resuscitation Trolley Bay	1	Resus Trolley bay		Central General Extract		0	3		Part of Corridor	2.7					negative	n/a		None	
3-C1.3-016			Linen Bay	1	Linen Bay		None		0	0		Part of Corridor	5.4					n/a	n/a		None	
3-C1.3-017			Store - General	1	Storage Area Equipment		Central General Extract		0	3	0	3	43.2	0	42	0	4	Negative	Negative		None	
3-C1.3-018			Multi-Disciplinary Office	1	Multi Disciplinary Work Areas		Central Supply and Extract		4	3	4	3	48.6	80.4	44.4	6	3	Positive	Positive		F7	F9 ePM1 90%
3-C1.3-019			Patient Interview Room	1	Meeting Room		Central Supply and Extract		4 people at 10 l/s per person (6ach)	4 people at 10 l/s per person (6ach)	6	6	24.3	58.8	45.6	9	7	Balanced	Positive		F7	F9 ePM1 90%
3-C1.3-020			Senior Charge Nurse Office	1	Cellular / Ward Offices		Central Supply and Extract		4	3	4	3	27	40.8	26.4	5	4	Positive	Positive		F7	F9 ePM1 90%
3-C1.3-021			WC - Staff	1	Toilet		Central Dirty Extract		0	10	0	10	8.1		31	0	14	Negative	Negative		None	
3-C1.3-022			WC - Staff	1	Toilet		Central Dirty Extract		0	10	0	10	8.1		28.8	0	13	Negative	Negative		None	
3-C1.3-023			WC - Visitors	1	Toilet		Central Dirty Extract		0	10	0	10	8.1		28.8	0	13	Negative	Negative		None	
3-C1.3-024			Snoezelen Room	1	Consulting Room		Central Supply and Extract		3	3	3	3	32.4	45.6	44.4	5	5	Balanced	Balanced		F7	F9 ePM1 90%
3-C1.3-025			Rehabilitation Room	1	Consulting Room		Central Supply and Extract		3	3	3	3	78.3	118.8	88.8	5	4	Balanced	Positive		F7	F9 ePM1 90%
3-C1.3-026			Hoist Bay	1	Circulation Equipment Storage Bays		Central General Extract		0	3	0	3	8.1		10	0	4	Negative	Negative		None	
3-C1.3-027			Touchdown Base	1	Staff base		Central Supply Air		1 person at 10l/s per person (7ach)	0	7	0	5.4	20.4	0	14	0	Positive	Positive		F7	F9 ePM1 90%
3-C1.3-028			Single Room 10 (VT)	1	Bedroom		Natural & Central Supply Air		4	via ensuite	4	via ensuite	45.9	73.2		6	Via ensuite	Balanced	Negative		F7	F9 ePM1 90%
3-C1.3-029			Room 10 - Ensuite	1	Bathroom		Central Dirty Extract		0	10	0	10	10.8		51.6	0	17	Negative	Negative		None	
3-C1.3-030			Single Room 11 (VT)	1	Bedroom		Natural & Central Supply Air		4	via ensuite	4	via ensuite	45.9	80.4		6	Via ensuite	Balanced	Negative		F7	F9 ePM1 90%
3-C1.3-031			Room 11 - Ensuite	1	Bathroom		Central Dirty Extract		0	10	0	10	13.5	0	56.4	0	15	Negative	Negative		None	
3-C1.3-032			Single Room 12	1	Bedroom		Natural & Central Supply Air		4	via ensuite	4	via ensuite	45.9	81.6		6	Via ensuite	Balanced	Negative		F7	F9 ePM1 90%
3-C1.3-033			Room 12 - Ensuite	1	Bathroom		Central Dirty Extract		0	minimum 10	0	10	10.8	0	55.2	0	18	Negative	Negative		None	
3-C1.3-034			Ward Kitchen	1	Ward Kitchen		Central General Extract		0	6	0	6	32.4	0	56.4	0	6	Negative	Negative		None	

Existing Design Data

Proposed Design Data

* All Open to 1-B1-065

** Windows will be locked shut

Rooms associated with Single bedrooms and Multi-bedrooms in Paediatric Critical Care & Single bedrooms and Multi-bedrooms in Haematology and Oncology

Rooms associated with Isolation Rooms in Paediatric Critical Care & Isolation Rooms in Haematology and Oncology

Negative/Negative Isolation Room

Achieves Compliance

Notes

1.Open plan to larger area. Overall supply volume in larger area satisfies compliance.
2. Rooms with no supply air identified achieve fresh air make-up via corridor (excess supply air from other spaces).
3. Isolation bedroom recieves supply air from lobby through pressure stabiliser and extract via ensuite. This room achieves SHTM 03-01 compliance of 10AC/H.
4. Combined extract from bay 1 (3-C1.3-011) plus adjoining toilet (3-C1.3-010) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.
5. Combined extract from bay 2 (3-C1.3-013) plus adjoining toilet (3-C1.3-014) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.

HOARE LEA

Imtech

Room No.	Department		Room Name	Qty	Room Function	SHTM03-01 Appendix A Table 1 Classification	Ventilation													
							EXISTING	PROPOSED	EXISTING		PROPOSED		AS INSTALLED (IOM)					Relative pressure	Proposed	Measured Pressure (H&V)	Min filtration	
							(type)	(type)	Supply (ac/hr)	Extract (ac/hr)	Supply (ac/hr)	Extract (ac/hr)	Room Volume (m3)	Supply (L/s)	Extract (L/s)	Supply (ac/hr)	Extract (ac/hr)				EXISTING	PROPOSED
3-C1.3-035	C1.3	Neuroscience Inpatients - 12 Beds	Patients' Assisted Bathroom	1	Bathroom		Central Dirty Extract		0	10	0	10	37.8	0	106.8	0	10	Negative	Negative		None	
3-C1.3-036			Dirty Utility	1	Dirty utility		Central Dirty Extract		0	6	0	6	37.8	0	68.4	0	7	Negative	Negative		None	
3-C1.3-037			Treatment Room	1	Treatment Room		Central Supply Air		10	0	10	0	43.2	176.4	0	15	0	Positive	Positive		F7	F9 ePM1 90%
3-C1.3-038			Clean Utility	1	Clean Utility		Central Supply Air		6	0	6	0	32.4	85.2	0	9	0	Positive	Positive		F7	F9 ePM1 90%
3-C1.3-039			Dining / Play Room	1	Eating/Drinking		Central Supply and Extract		6 people at 10 l/s per person (5ach)	6 people at 10 l/s per person (5ach)	5	5	43.2	94.8	66	8	6	Balanced	Positive		F7	F9 ePM1 90%
3-C1.3-040			DSR	1	DSR		Central Dirty Extract		0	6	0	6	27	0	43.2	0	6	Negative	Negative		None	
3-C1.3-041			Disposal Hold	1	Disposal Hold		Central Dirty Extract		0	6	0	6	23.9	0	40.8	0	6	Negative	Negative		None	
3-C1.3-001			Corridor	1	Corridor		None		0	0	0	0	345.6					n/a	n/a		None	
3-C1.4-002	C1.4	Haematology / Oncology Inpatients & Daycases - 17 Beds & 2 Chairs	Quiet Study Room	1	Cellular / Ward Offices		Central Supply and Extract		4	3	0	3	27	0	25.2	0	3	Positive	Negative		F7	F9 ePM1 90%
3-C1.4-004			Disposal Hold	1	Disposal Hold		Central Dirty Extract		0	6	0	6	23.5	0	39.6	0	6	Negative	Negative		None	
3-C1.4-005			DSR	1	DSR		Central Dirty Extract		0	6	0	6	16.7	0	28.8	0	6	Negative	Negative		None	
3-C1.4-006			Store - General	1	Storage Area Equipment		Central General Extract		0	3	0	3	27	0	20.4	0	3	Negative	Negative		None	
3-C1.4-007			Patient Interview Room	1	Meeting Room		Central Supply and Extract		4 people at 10 l/s per person (6ach)	4 people at 10 l/s per person (6ach)	0	6	24.3	0	50.4	0	7	Balanced	Negative		F7	F9 ePM1 90%
3-C1.4-008			Complementary Therapy Room	1	Consulting Room		Central Supply and Extract		3	3	0	3	32.4	0	23	0	3	Balanced	Negative		F7	F9 ePM1 90%
3-C1.4-009			Room 11- Ensuite	1	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	13.5	0	39.6	0	11	Negative	Negative	-	None	None
3-C1.4-010			Single Room 11	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4		10	0	45.9	152	0	12	0	+10Pa	+10Pa	+10Pa	F7	H14
3-C1.4-011			Assisted Bathroom	1	Bathroom		Central Dirty Extract		0	10	0	10	43.2	0	132	0	11	Negative	Negative		None	
3-C1.4-012			Touchdown Base 4	1	Staff base		Central Supply Air		1 person at 10l/s/per person (7ach)	0	Part of Corridor	Part of Corridor	5.4	22.8	0	Note 1	Note 1	Positive	Balance		F7	F9 ePM1 90%
3-C1.4-013			Single Room 12	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4		10	0	48.6	152.4	133.2	11	10	+10Pa	+10Pa	+12Pa	F7	H14
3-C1.4-014			Room 12 - Ensuite	1	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	13.5	0	37.2	0	10	Negative	Negative	-	None	None
3-C1.4-015			Social Space	1	Common room/staff room/lounge		Central Supply and Extract		6	8	0	8	64.8	0	180	0	10	Negative	Negative		F7	F9 ePM1 90%
3-C1.4-016			Single Room 14	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4		10	0	45.9	140.4	0	11	0	+10Pa	+10Pa	+10Pa	F7	H14
3-C1.4-017			Room 14 - Ensuite	1	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	13.5	0	42	0	11	Negative	Negative	-	None	None
3-C1.4-018			Single Room 10	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4		10	0	54	189.6	0	13	0	+10Pa	+10Pa	+11Pa	F7	H14
3-C1.4-019			Room 10 - Ensuite	1.0	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	13.5	0	49.2	0	13	Negative	Negative	-	None	None
3-C1.4-021			Hoist Bay	1	Circulation Equipment Storage Bays		None		0	0	0	0	8.1	0	0	0	0	n/a	Balanced		None	
3-C1.4-022			Dirty Utility	1	Dirty utility		Central Dirty Extract		0	6	0	6	37.8	0	62.4	0	6	Negative	Negative		None	
3-C1.4-023			Nursing Staff Office	1	Pharmacy Base		Central Supply and Extract		3	3	3	3	24.3	28.8	27.6	4	4	Balanced	Balanced		F7	F9 ePM1 90%
3-C1.4-024			Multi-Disciplinary Office	1	Multi Disciplinary Work Areas		Central Supply and Extract		4	3	4	3	48.6	112.8	43.2	8	3	Positive	Positive		F7	F9 ePM1 90%
3-C1.4-025			Medical Staff Office	1	Cellular / Ward Offices		Central Supply and Extract		4	3	4	3	54	133.2	50.4	9	3	Positive	Positive		F7	F9 ePM1 90%
3-C1.4-026			Consultant Office (5 person)	1	Cellular / Ward Offices		Central Supply and Extract		4	3	4	3	70.2	97.2	72	5	4	Positive	Positive		F7	F9 ePM1 90%
3-C1.4-027			Store - Equipment	1	Storage Area Equipment		Central General Extract		0	3	0	3	24	0	20.4	0	3	Negative	Negative		None	

Existing Design Data

Proposed Design Data

* All Open to 1-B1-065

** Windows will be locked shut

Rooms associated with Single bedrooms and Multi-bedrooms in Paediatric Critical Care & Single bedrooms and Multi-bedrooms in Haematology and Oncology

Rooms associated with Isolation Rooms in Paediatric Critical Care & Isolation Rooms in Haematology and Oncology

Negative/Negative Isolation Room

Achieves Compliance

Notes

1.Open plan to larger area. Overall supply volume in larger area satisfies compliance.
2. Rooms with no supply air identified achieve fresh air make-up via corridor (excess supply air from other spaces).
3. Isolation bedroom recieves supply air from lobby through pressure stabiliser and extract via ensuite. This room achieves SHTM 03-01 compliance of 10AC/H.
4. Combined extract from bay 1 (3-C1.3-011) plus adjoining toilet (3-C1.3-010) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.
5. Combined extract from bay 2 (3-C1.3-013) plus adjoining toilet (3-C1.3-014) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.

HOARE LEA

Imtech

Room No.	Department		Room Name	Qty	Room Function	SHTM03-01 Appendix A Table 1 Classification	Ventilation													
							EXISTING	PROPOSED	EXISTING		PROPOSED		AS INSTALLED (IOM)					Relative pressure	Proposed	Measured Pressure (H&V)	Min filtration	
							(type)	(type)	Supply (ac/hr)	Extract (ac/hr)	Supply (ac/hr)	Extract (ac/hr)	Room Volume (m3)	Supply (L/s)	Extract (L/s)	Supply (ac/hr)	Extract (ac/hr)				EXISTING	PROPOSED
3-C1.4-028	C1.4	Haematology / Oncology Inpatients & Daycases - 17 Beds & 2 Chairs	Research Staff Office	1	Cellular / Ward Offices		Central Supply and Extract		4	3	4	3	51.3	97.2	72	7	5	Positive	Positive		F7	F9 ePM1 90%
3-C1.4-029			Pharmacy Base	1	Cellular / Ward Offices		Central Supply and Extract		4	3	4	3	40.5	76.8	56.4	7	5	Positive	Positive		F7	F9 ePM1 90%
3-C1.4-030			Senior Charge Nurse Office	1	Cellular / Ward Offices		Central Supply and Extract		4	3	4	3	21.6	32.4	26.4	5	4	Positive	Positive		F7	F9 ePM1 90%
3-C1.4-032			Single Room 9	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4		10	0	48.6	157.2	0	12	0	+10Pa	+10Pa	+10Pa	F7	H14
3-C1.4-033			Room 9 - Ensuite	1.0	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	9.6	0	39.6	0	15	Negative	Negative	-	None	None
3-C1.4-034			Touchdown Base 3	1	staff base		Central Supply Air		1 person at 10l/s/per	0	Part of Corridor	Part of Corridor	4.8	0	0	0	0	Positive	n/a		F7	F9 ePM1 90%
3-C1.4-035			Linen Bay (1 Trolley)	1	Linen Bay		None		0	0	0	0	5.4	0	0	0	0	n/a	n/a		None	
3-C1.4-036			WC - Staff	1	Toilet		Central Dirty Extract		0	10	0	10	7.2	0	24	0	12	Negative	Negative		None	
3-C1.4-037			WC - Staff	1	Toilet		Central Dirty Extract		0	10	0	10	9.5	0	27.6	0	10	Negative	Negative		None	
3-C1.4-038			Clean Utility	1	Treatment Room		Central Supply Air		10	0	10	0	48.6	177.6	0	13.2	0	Positive	Positive		F7	F9 ePM1 90%
3-C1.4-039			Room 8 Lobby	1	Isolation Lobby	Infectious disease Iso Room Lobby	Central Supply	Isolation Room Supply System	61	0	64	0	13.5	264	0	70.4	0	+10Pa to corridor	+10Pa to corridor	+10Pa	H14	H14
3-C1.4-040			Single Room 8 (Isolation)	1	Isolation Bedroom	Infectious disease Iso Room	Supply via lobby	Supply via lobby	10		0	0	45.9	0	0	REFER TO NOTE 3	REFER TO NOTE 3	Balanced	Balanced	-	H14	H14
3-C1.4-041			Room 8 - Ensuite	1	Bathroom	Infectious disease Iso Room Ensuite	Central Dirty Extract	Dirty Extract	0	44	0	40	12.42	0	223	0	65	Negative	Negative	-	None	None
3-C1.4-042			Room 7 - Ensuite	1	Bathroom	Infectious disease Iso Room Ensuite	Central Dirty Extract	Dirty Extract	0	43	0	40	12	0	186	0	56	Negative	Negative	-	None	None
3-C1.4-043			Single Room 7 (Isolation)	1	Isolation Bedroom	Infectious disease Iso Room	Supply via lobby	Supply via lobby	10		0	0	45.9	0	0	REFER TO NOTE 3	REFER TO NOTE 3	Balanced	Balanced	-	H14	H14
3-C1.4-044			Room 7 Lobby	1	Isolation Lobby	Infectious disease Iso Room Lobby	Central Supply	Isolation Room Supply System	64	0	64	0	10.8	264	0	88	0	+10Pa to corridor	+10Pa to corridor	+10Pa	H14	H14
3-C1.4-045			Touchdown Base 2	1	Staff base		Central Supply Air		0	0	Part of Corridor	Part of Corridor	4.8	0	0	0	0	Positive	n/a		F7	F9 ePM1 90%
3-C1.4-046			Single Room 15	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4		10	0	45.9	136.6	0	10.7	0	+10Pa	+10Pa	+10Pa	F7	H14
3-C1.4-047			Room 15 - Ensuite	1	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	12	0	42	0	13	Negative	Negative	-	None	None
3-C1.4-048			Room 6 - Lobby	1	Isolation Lobby	Infectious disease Iso Room Lobby	Central Supply	Isolation Room Supply System	63	0	64	0	13.5	263	0	70.1	0	+10Pa to corridor	+10Pa to corridor	+10Pa	H14	H14
3-C1.4-049			Single Room 6 (Isolation)	1	Isolation Bedroom	Infectious disease Iso Room	Supply via lobby	Supply via lobby	10		0	0	45.9	0	0	REFER TO NOTE 3	REFER TO NOTE 3	Balanced	Balanced	-	H14	H14
3-C1.4-050			Room 6 - Ensuite	1	Bathroom	Infectious disease Iso Room Ensuite	Central Dirty Extract	Dirty Extract	0	42	0	40	12.15	0	192	0	57	Negative	Negative	-	None	None
3-C1.4-051			Room 5 - Ensuite	1	Bathroom	Infectious disease Iso Room Ensuite	Central Dirty Extract	Dirty Extract	0	41	0	40	12	0	185	0	56	Negative	Negative	-	None	None
3-C1.4-052			Single Room 5 (Isolation)	1	Isolation Bedroom	Infectious disease Iso Room	Supply via lobby	Supply via lobby	10		0	0	45.9	0	0	REFER TO NOTE 3	REFER TO NOTE 3	Balanced	Balanced	-	H14	H14
3-C1.4-053			Room 5 - Lobby	1	Isolation Lobby	Infectious disease Iso Room Lobby	Central Supply	Isolation Room Supply System	61	0	64	0	13.5	264	0	70.4	0	+10Pa to corridor	+10Pa to corridor	+10Pa	H14	H14
3-C1.4-054			Resuscitation Trolley Bay	1	Circulation Equipment Storage Bays		None		0	0	0	0	5.4	0	0	0	0	n/a	Balanced		None	
3-C1.4-055			Single Room 16	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4		10	0	45.9	145.2	0	11.4	0	+10Pa	+10Pa	+11Pa	F7	H14
3-C1.4-056			Room 16 - Ensuite	1	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	12	0	45.6	0	14	Negative	Negative	-	None	None
3-C1.4-057			Single Room 17	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4		10	0	45.9	132	0	10.4	0	+10Pa	+10Pa	+11Pa	F7	H14
3-C1.4-058			Room 17 - Ensuite	1	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	12	0	42	0	13	Negative	Negative	-	None	None
3-C1.4-059			Single Room 18	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4		10	0	45.9	139.2	0	10.9	0	+10Pa	+10Pa	+10Pa	F7	H14

Existing Design Data

Proposed Design Data

* All Open to 1-B1-065

** Windows will be locked shut

Rooms associated with Single bedrooms and Multi-bedrooms in Paediatric Critical Care & Single bedrooms and Multi-bedrooms in Haematology and Oncology

Rooms associated with Isolation Rooms in Paediatric Critical Care & Isolation Rooms in Haematology and Oncology

Negative/Negative Isolation Room

Achieves Compliance

Notes

1.Open plan to larger area. Overall supply volume in larger area satisfies compliance.
2. Rooms with no supply air identified achieve fresh air make-up via corridor (excess supply air from other spaces).
3. Isolation bedroom recieves supply air from lobby through pressure stabiliser and extract via ensuite. This room achieves SHTM 03-01 compliance of 10AC/H.
4. Combined extract from bay 1 (3-C1.3-011) plus adjoining toilet (3-C1.3-010) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.
5. Combined extract from bay 2 (3-C1.3-013) plus adjoining toilet (3-C1.3-014) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.

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Room No.	Department		Room Name	Qty	Room Function	SHTM03-01 Appendix A Table 1 Classification	Ventilation														
							EXISTING	PROPOSED	EXISTING		PROPOSED		AS INSTALLED (IOM)					Relative pressure	Proposed	Measured Pressure (H&V)	Min filtration
							(type)	(type)	Supply (ac/hr)	Extract (ac/hr)	Supply (ac/hr)	Extract (ac/hr)	Room Volume (m3)	Supply (L/s)	Extract (L/s)	Supply (ac/hr)	Extract (ac/hr)				EXISTING / PROPOSED
3-C1.4-060	C1.4	Haematology / Oncology Inpatients & Daycases - 17 Beds & 2 Chairs	Room 18 - Ensuite	1	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	9.6	0	38.4	0	14	Negative	Negative	-	None / None
3-C1.4-061			Bay 1 (Beds 1-6)	1	Multi-bed Wards	Critical Care Area	Natural and Central Supply Air	Central Supply Air **	4		10	5	237.6	760.8	397.2	11.5	6	+10Pa	+10Pa	+11Pa	F7 / H14
3-C1.4-062			Bay 1 - Ensuite	1	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	12	0	34.8	0	10	Negative	Negative	-	None / None
3-C1.4-063			Play Room	1	Common room/staff room/lounge		Central Supply and Extract		6	8	0	8	59.4	0	237.6	0	14	Negative	Negative		F7 / F9 ePM1 90%
3-C1.4-064			Ward Kitchen	1	Ward Kitchen		Central General Extract		0	6	0	6	33.6	0	60	0	6	Negative	Negative		None /
3-C1.4-065			Treatment Room	1	Treatment Room		Central Supply Air		10	0	10	0	48.6	200.4	0	14.8	0	Positive	Positive		F7 / F9 ePM1 90%
3-C1.4-066			Clean Utility	1	Clean Utility		Central Supply Air		6	0	6	0	32.4	69.6	0	7.7	0	Positive	Positive		F7 / F9 ePM1 90%
3-C1.4-067			WC - Visitors	1	Toilet		Central Dirty Extract		0	10	0	11	9.6	0	33.6	0	13	Negative	Negative		None /
3-C1.4-068			Waiting Area	1	Waiting Room		Central Supply and Extract		5	5	0	6	43.2	0	85.2	0	7	Balanced	Negative		F7 / F9 ePM1 90%
3-C1.4-069			Reception / Staff Base	1	Reception		Central Supply and Extract		3	3	Part of Corridor	Part of Corridor	12	0	122.4	0	37	Balanced	Negative		F7 / F9 ePM1 90%
3-C1.4-071			Room 4 - Lobby	1	Isolation Lobby	Infectious disease Iso Room Lobby	Central Supply	Isolation Room Supply System	36	0	64	0	13.5	266	0	70.9	0	+10Pa to corridor	+10Pa to corridor	+10Pa	H14 / H14
3-C1.4-072			Single Room 4 (Isolation)	1	Isolation Bedroom	Infectious disease Iso Room	Supply via lobby	Supply via lobby	10		0	0	45.9	0	0	REFER TO NOTE 3	REFER TO NOTE 3	Balanced	Balanced	-	H14 / H14
3-C1.4-073			Room 4 - Ensuite	1	Bathroom	Infectious disease Iso Room Ensuite	Central Dirty Extract	Dirty Extract	0	41	0	40	12	0	160	0	48	Negative	Negative	-	None / None
3-C1.4-074			Single Room 3	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4		10	0	48.6	151.2	0	11.2	0	+10Pa	+10Pa	+11Pa	F7 / H14
3-C1.4-075			Room 3 - Ensuite	1	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	12	0	46.8	0	14	Negative	Negative	-	None / None
3-C1.4-076			Single Room 2	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4		10	0	45.9	133.2	0	10.4	0	+10Pa	+10Pa	+10Pa	F7 / H14
3-C1.4-077			Room 2 - Ensuite	1	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	12	0	42	0	13	Negative	Negative	-	None / None
3-C1.4-078			Single Room 1	1	Bedroom	Critical Care Area	Natural & Central Supply Air	Central Supply Air **	4		10	0	54	212.4	0	14.2	0	+10Pa	+10Pa	+10Pa	F7 / H14
3-C1.4-079			Room 1 - Ensuite	1	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	12	0	56.4	0	17	Negative	Negative	-	None / None
3-C1.4-080			Reception	1	staff base		None		0	0	0	0	8.1	0	0	0	0	n/a	n/a		n/a /
3-C1.4-081			Touchdown Base 1	1	Reception		Central Supply Air		3	0	Part of Corridor	Part of Corridor	8.1	0	0	0	0	Positive	n/a		F7 / F9 ePM1 90%
3-C1.4-083			Dirty Utility	1	Dirty utility		Central Dirty Extract		0	6	0	9	29.7	0	75.6	0	9	Negative	Negative		None /
3-C1.4-084			Bay 2 (Beds 7-9)	1	Multi-bed Wards	Critical Care Area	Natural and Central Supply Air	Central Supply Air **	4		10	0	132.3	438	0	11.9	0	+10Pa	+10Pa	+10Pa	F7 / H14
3-C1.4-085			Bay 2 - Ensuite	1	Bathroom		Central Dirty Extract	Central Dirty Extract	0	10	0	10	12	0	34.8	0	10	Negative	Negative	-	None / None
3-C1.4-086			Equipment Bay	1	Storage Area Equipment		Central General Extract		0	3	Part of Corridor	Part of Corridor	8.1	0	0	0	0	Negative	n/a		None /
3-C1.4-087			Consult Room	1	Consulting Room (Now treatment room)		Central Supply and Extract		3	3	10	6	43.2	168	70	14	6	Balanced	Positive		F7 / F9 ePM1 90%
3-C1.4-088			Beverage Bay	1	Tea Making		None		0	0	0	0	10.8	0	0	0	0	n/a	n/a		None /
3-C1.4-001			Corridor	1	Corridor		None		0	0	0	0	13.5	0	0	0	0	n/a	n/a		None /
3-C1.4-003			Corridor	1	Corridor		None		0	0	0	0	135	0	0	0	0	Balanced	Balanced		None /
3-C1.4-020-2			Corridor	1	Corridor		None		0	0	0	6	383.4	0	600	0	6	Negative	Negative		None /
3-C1.4-031			Corridor	1	Corridor		None		0	0	0	0	59.4	0	0	0	0	n/a	n/a		None /
3-C1.4-082			Corridor	1	Corridor		None		0	0	0	6	170.1	0	300	0	6	Negative	Negative		None /
3-C1.4-070			Switch Cupboard	1	Switch Cupboard		None		0	0	0	0	2.7	0	0	0	0	n/a	n/a		None /

Existing Design Data

Proposed Design Data

* All Open to 1-B1-065

** Windows will be locked shut

Rooms associated with Single bedrooms and Multi-bedrooms in Paediatric Critical Care & Single bedrooms and Multi-bedrooms in Haematology and Oncology

Rooms associated with Isolation Rooms in Paediatric Critical Care & Isolation Rooms in Haematology and Oncology

Negative/Negative Isolation Room

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Notes

1.Open plan to larger area. Overall supply volume in larger area satisfies compliance.
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3. Isolation bedroom recieves supply air from lobby through pressure stabiliser and extract via ensuite. This room achieves SHTM 03-01 compliance of 10AC/H.
4. Combined extract from bay 1 (3-C1.3-011) plus adjoining toilet (3-C1.3-010) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.
5. Combined extract from bay 2 (3-C1.3-013) plus adjoining toilet (3-C1.3-014) and half of the extract air from wetroom (3-C1.3-012) complies with the design ventilation air change rate.

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Room No.	Department		Room Name	Qty	Room Function	SHTM03-01 Appendix A Table 1 Classification	Ventilation														
							EXISTING	PROPOSED	EXISTING		PROPOSED		AS INSTALLED (IOM)					Relative pressure	Proposed	Measured Pressure (H&V)	Min filtration	
							(type)	(type)	Supply (ac/hr)	Extract (ac/hr)	Supply (ac/hr)	Extract (ac/hr)	Room Volume (m3)	Supply (L/s)	Extract (L/s)	Supply (ac/hr)	Extract (ac/hr)				EXISTING	PROPOSED
3-C1.5-002	C1.5	Med / Surg / Neuro / Haemo Shared Support	Store - back up clothing	1	Storage Area Equipment		Central General Extract		0	3	0	3	9.6	0	13.2	0	5	Negative	Negative		None	
3-C1.5-003			Family Sitting Room	1	Common room/staff room/lounge		Central Supply and Extract		6	8	6	8	70.2	172.8	170.4	8.9	9	Negative	Negative		F7	F9 ePM1 90%
3-C1.5-004			Baby Infant / Feeding Room	1	Baby Feeding		Central Dirty Extract		0	10	0	10	9.6	0	28.8	0	11	Negative	Negative		None	
3-C1.5-005			Nappy Change	1	Nappy Change		Central Dirty Extract		0	10	0	10	9.6	0	28.8	0	11	Negative	Negative		None	
3-C1.5-006			Breast Pump Room	1	Baby Feeding		Central Dirty Extract		0	10	0	10	9.6	0	28.8	0	11	Negative	Negative		None	
3-C1.5-007			WC-Wheelchair Accessible	1	Toilet		Central Dirty Extract		0	10	0	10	10.9	0	31.2	0	10	Negative	Negative		None	
3-C1.5-008			WC-Wheelchair Accessible	1	Toilet		Central Dirty Extract		0	10	0	6	12.7	0	30	0	9	Negative	Negative		None	
3-C1.5-001			Corridor	1	Corridor		Central Supply Air		20	0	20	0	31.2	214.8	10	24.8	1	Positive	Positive		F7	F9 ePM1 90%
3-C1.7-002	C1.7	Paediatric Neurophysiology	EEG Review Room	1	Cellular / Ward Offices		Central Supply and Extract		4	3	4	3	43.2	49	40	4.1	3	Positive	Positive		F7	F9 ePM1 90%
3-C1.7-003			EEG Recording Room 2	1	Diagnostic room		Central Supply and Extract		8	8	8	8	43.2	96	96	8	8	Balanced	Balanced		F7	F9 ePM1 90%
3-C1.7-004			EEG Recording Room 1	1	Diagnostic room		Central Supply and Extract		8	8	8	8	43.2	96	96	8	8	Balanced	Balanced		F7	F9 ePM1 90%
3-C1.7-005			Evoked Potential Recording Room	1	Diagnostic room		Central Supply and Extract		8	8	8	8	40.5	89	89	8	8	Balanced	Balanced		F7	F9 ePM1 90%
3-C1.7-001			Corridor	1	Corridor		None		0	0	0	0	51.3	0	0	0	0	Balanced	Balanced		none	

APPENDIX F – IOM CALIBRATION CERTIFICATE

Associated Instruments Repairs
Unit 11 Top Angel Buckingham Industrial Park
Buckingham MK18 1TH England
Tel / Fax +44 (0) 1280 823823
e-mail: air@ttseries.com www.a-i-r.co.uk

CALIBRATION CERTIFICATE

CUSTOMER DETAILS I O M Consulting Ltd

CALIBRATION DETAILS		**INSTRUMENT DETAILS**	
Date Of Calibration:	13/08/2020	**Manufacturer**	TSI Airflow
Next Calibration:	13/08/2021	**Type:**	Balometer
Certificate Number:	47791	**Model:**	PH731
Result	Pass	**Serial Number:**	PH7311922002
Repair required:	No	**Customer S/N:**	N/A
Adjustment required:	Yes	**Manufacturer's Spec:**	±3% of Reading ± 3.3 l/s
TEST ROOM CONDITIONS		**Range:**	30-555 l/sec
Temperature:	26°C±2°C		
Relative Humidity:	55% ± 10% RH		
Barometric Pressure (mbar)	1008 mbar		

Calibration Points: l/sec	30	60	90	150	200	300	400	555
Indicated Readings: Supply	28	56	85	145	195	290	386	536
Indicated Readings: Exhaust	27	56	84	143	191	290	385	541

Notes: Results obtained with a 4 way diffuser.
The above results are obtained on the date of calibration, with no account being taken of the instruments ability to maintain its calibration.

Equipment: Balometer Test Rig: Tested according to BSEN ISO 9001:2000. Orifice plates & volume flow measuring section manufactured in accordance with that specified in ISO 5801:1997

Instrument: Micromanometer: TT 570SV SN 5661, calibrated against Instrument SN T00189 (UKAS Calibration Laboratory No 0157), plus Instrument SN UK19504 (UKAS Calibration Laboratory No 0807) which are both traceable to National Standards.

[redacted]

Calibrated By Hussein Khimji:

NHS Scotland Assure
Quality in the healthcare environment

NHS National Services Scotland

Key Stage Assurance Review Workbook

Outline Business Case

June 2021

Version 1.0

A46676816

Contents

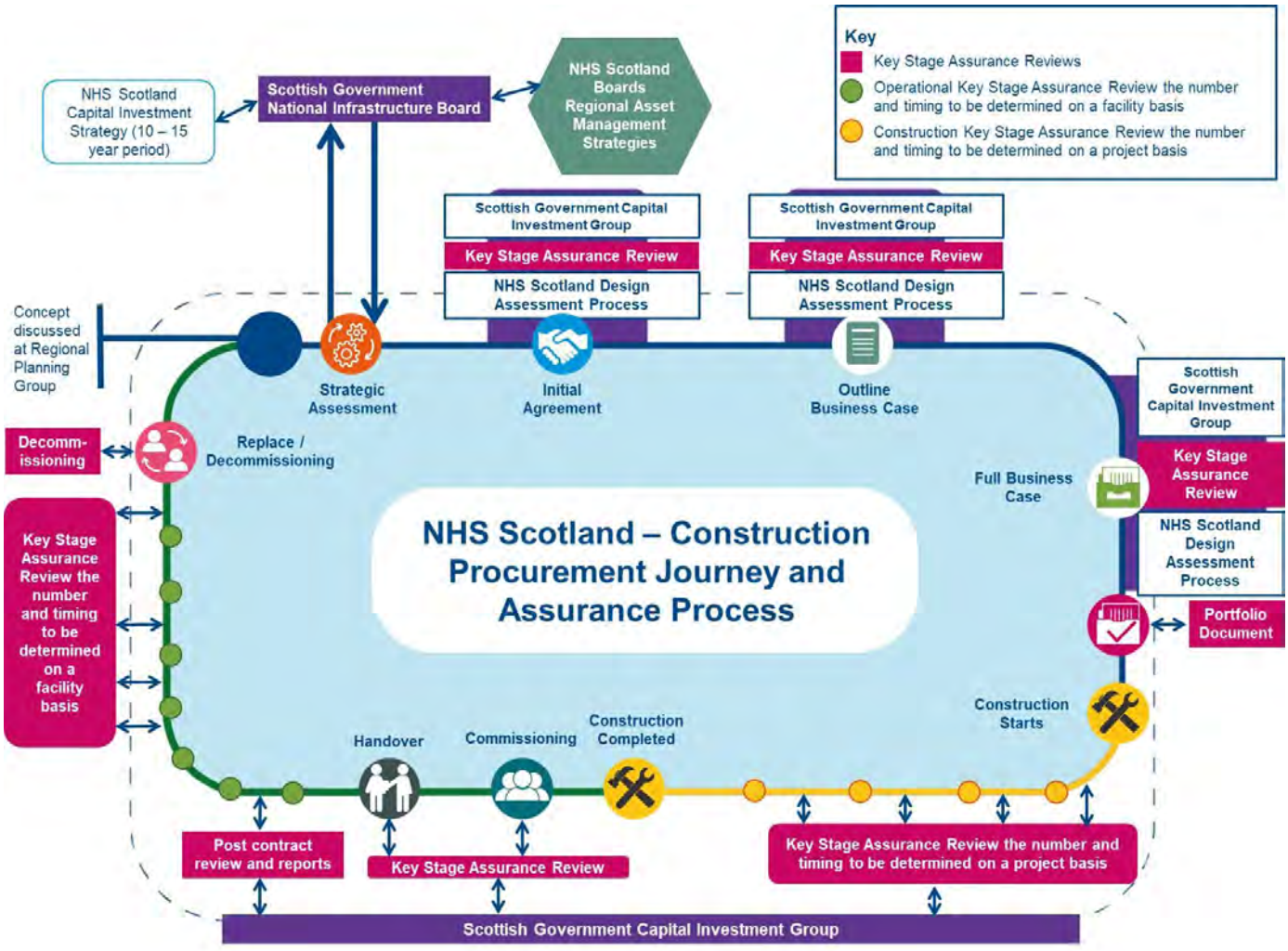
1. About this workbook

This workbook supports the Outline Business Case Key Stage Assurance Review (KSAR), delivered through the NHS Scotland Assure - Assurance Service.

Further information about the NHS Scotland Assure - Assurance Service and KSAR process is provided in section 2.

Figure 1. shows how the Outline Business Case stage in the procurement and construction journey commences following Initial Assessment. The timing and frequency of KSARs during this stage will vary dependent upon the facility. Specific workbooks have been developed for the other stages within this journey.

Figure 1: Construction Procurement Journey



KSARs are of a process ensuring facilities and the teams using them are able to deliver the standards required to provide the best and safest outcomes for patients, staff and visitors in the built environment.

KSARs deliver an independent peer review. NSS staff outside the project use their experience and expertise to examine the progress and likelihood of successful delivery, with a particular emphasis on the safety of the patients, staff and visitors using the facility.

It is vital to receive feedback on the following elements of health facilities - Infection Prevention and Control (IPC), water, ventilation, electrical, plumbing, medical gases

installations and fire. This ensures they are designed, installed and functioning from initial commissioning of a new facility and throughout its lifetime. Health Boards are required to have appropriate governance in place at all stages of the construction procurement journey.

The KSAR workbook provides a transparent, structured framework for all clinical specialisms, facilities and operational management professionals to assess and manage a health care build or refurbishment. Allowing facilities to align with current standards as the assurance reviews are taking place, as well as aligning changes for patient cohort.

Using this workbook

The review at Outline Business Case stage investigates the approach taken by the Health Board in the development of the design, and how the appropriate level of knowledge and awareness of patient and user needs will influence the development of the design.

The purpose of the KSAR at Outline Business Case stage is to confirm there is a good and comprehensive understanding of the category of patient who will use the proposed facility and that the project team consider how appropriate quality and safety standards will influence the design. It looks to provide assurance that the project can proceed to the Full Business Case.

This workbook is predominantly intended to be used by NHS Scotland Assure KSAR review teams, Health Boards are encouraged to use its content to support their own projects. It provides guidance on the review structure and areas of investigation to be addressed by the review team and should be regarded as indicative and not prescriptive.

The review team will consider whether any emerging findings require additional topics to be addressed. If so, evidence relating to these areas, regarding the safety of the patients, staff and visitors should be provided.

2. Key Stage Assurance Review

Introduction to NHS Scotland Assure – Assurance Service

Good management effective control of projects is an essential element to the successful delivery and maintenance of healthcare facilities across NHS Scotland estates.

The initial delivery of the NHS Scotland Assure - Assurance Service will focus upon new builds and major refurbishments in the acute estate, submitted to the Scottish Government Capital Investment Group (CIG). In addition, a number of projects identified as being complex, primarily due to the needs of patients utilising the facilities, will be reviewed by this service. Whilst not an exhaustive list, these projects will cover oncology, maternity, theatre and critical care units, no matter of their financial value.

The NHS Scotland Assure - Assurance Service will deliver KSARs, designed to provide independent assurance to Scottish Government Health and Social Care Directorates (SGHSCD's).

It will assess if Health Boards Project Management teams (inclusive of clinicians, appointed construction consultants, and contractors) are briefed and following best practice procedures in the provision of facilities. We will review if projects are compliant in all aspects of safety, if specific engineering systems are designed, installed and commissioned, and for ongoing safety maintenance including IPC.

The KSAR process is applicable regardless of procurement route chosen.

The KSAR Process

The KSAR process examines projects at key points in their lifecycle. It does not remove any legal or contractual obligations from the NHS Health Board, their designers or contractors. It provides assurance to progress successfully to the next review point and the process will be mandated for projects requiring CIG approval. KSARs focus on the assessment of the delivery approach, and will work with the Health Board's project team to ensure there is comprehensive understanding of the patient cohorts utilising the facility. KSARs also ensure relevant guidance is fully implemented and any technical derogations have been fully reasoned, transparently discussed, the implications understood, recorded and signed off by the Health Board and their advisors.

With a focus on construction elements where previous reviews have demonstrated potential patient safety concerns, KSARs will concentrate on water; ventilation, electrical, plumbing, medical gases installations, fire, and associated IPC guidance. If further issues are raised with the review team, they will fully incorporate those issues into the reporting process.

Value of the KSAR Process

Key Stage Assurance Reviews (KSARs) deliver an independent peer review. NSS staff outside the Health Board's project use their experience and expertise to examine the progress and likelihood of successful delivery, with a particular emphasis on the safety of the patients, staff and visitors using the facility. KSARs provide an external perspective and provide a challenge to the robustness of the Health Board's brief, plans and processes.

This includes work delivered by construction consultants, employed either directly or through construction contractors, and the work being delivered by the primary contractor, their sub-contractors and specialist suppliers.

The KSAR provides an independent report and action plan, which is shared with the Health Board to ensure:

- Appropriate skills and experience are deployed on the project by the Health Board, consultants, primary contractor and all sub-contractors.
- The clinicians and wider stakeholders covered by the project fully understand the project status, aims and the issues involved.
- Appropriate management structures put in place to ensure appropriate infection prevention and control measures are designed into the project to reduce the risk of transmission of infectious agent.
- There is assurance the project can progress to the next stage of development or implementation with particular emphasis on the safety of the patients, staff and visitors utilising the facility.
- Provision of advice and guidance to programme and project teams by fellow Practitioners.

The KSAR report and the Health Board's response and action plan is submitted to CIG along with a recommendation from the NHS Scotland Assure - Assurance Service regarding the projects' progression to the next stage of the construction procurement journey.

KSAR as part of the overall assurance framework

Each NHS Health Board will be fully responsible for the delivery of all projects, and its own internal process and resources for carrying out internal reviews and audits of its activities. The KSAR is seen as a complementary independent review, and not as a replacement for the responsibilities of the Health Board.

NHS Health Boards should have in place an effective framework to provide a suitable level of assurance for their programmes and projects. Health Boards are encouraged and expected to ensure adequate and timely coordination and sharing of information, including plans, between the various internal reviews and functions.

The KSAR process is not a substitute for a rigorous governance framework in the Board to manage key processes including business planning, investment appraisal, business case management, risk management and service and contract management.

The KSAR Process relationship with NHS Scotland Design Assessment Process (NDAP)

The Scottish Government's ambition for NHS Scotland's estate and the need for well-designed healthcare environments is articulated in the Policy on Design Quality for NHS Scotland. Good design in the built environment encompasses a wide range of inter-related factors such as, sustainability, engineering, architecture, fire safety, energy, environment, decontamination, space utilisation, landscaping, security, technology, lighting, access for visitors and mobility impaired persons.

The NDAP process is overseen by Health Facilities Scotland and Architecture and Design Scotland and holistically considers all of the above. It sets the principles for the resolution of potential conflicts of statutory or mandatory compliance to ensure the specific facility provides; the best balance of the technical requirements, meets clinical needs and fulfils the conceptual aims of the policy on Design Quality. The NDAP process begins at the initial agreement stage of a project and provides advice through to the Full Business Case. There is no change to either SCIM or NDAP processes.

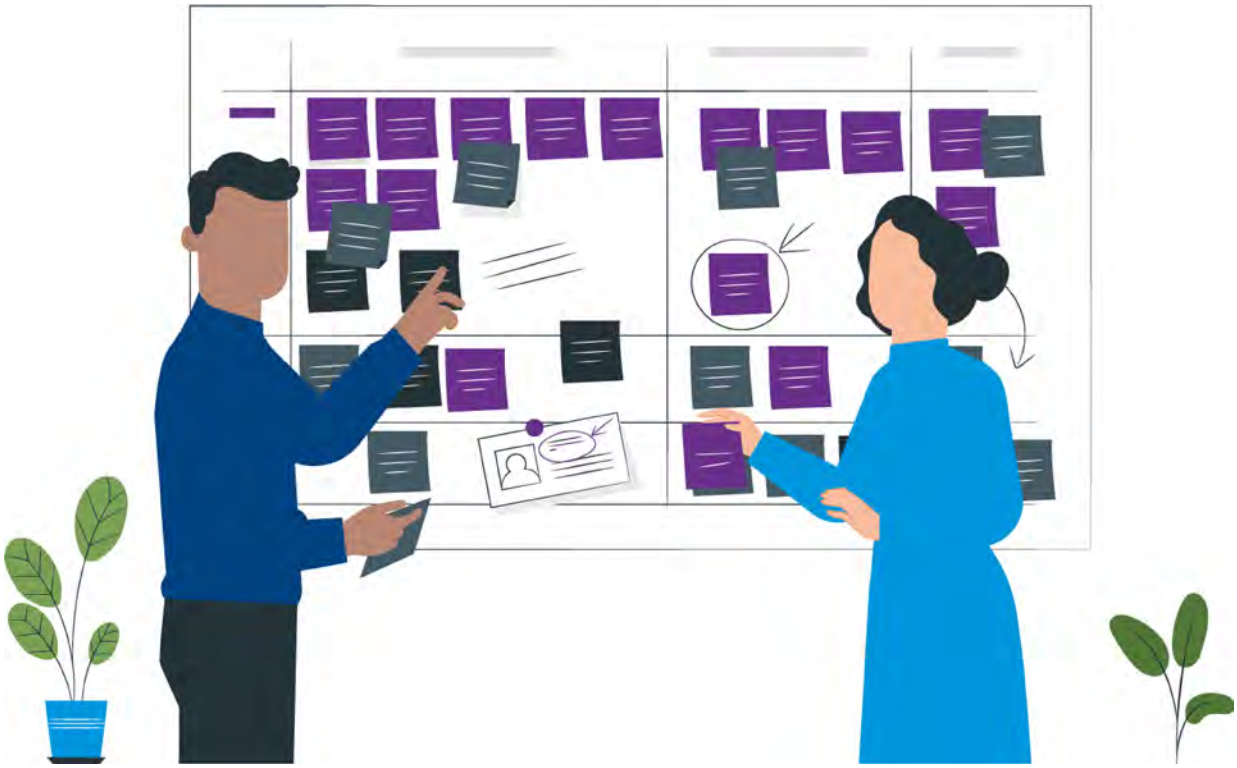
The Scottish Government is progressing policy to improve the safety of the healthcare environment in relation to the built environment risk. The Assurance Service delivered through NHS Scotland Assure is a response to this policy and the KSARs are integral to the compliance work. The aspiration is not to duplicate any of the work included in the NDAP process, but to provide assurance regarding the critical components highlighted throughout this workbook.

Integral to the KSARs will be a review of the balance between sustainability issues and patient safety.

The NDAP, working with Health Boards, will set the principles of the design solution, whereas the KSAR will provide a detailed technical review of the specifics of the design solution. Where possible the two reviews will be aligned to avoid duplication of work. For example, in instances where the NDAP has reviewed detail at a technical level, this will be used by the KSAR team rather than being separately requested and reviewed.

Sustainability

The review will provide assurance that the proposals for the project provide an effective balance in terms of patient, staff and visitors safety, whilst meeting required sustainability outcomes and complying with the guidance standards.



Outline Business Case (OBC) KSAR

This review investigates the approach taken by the Health Board in the development of the design, to confirm that there is a good and comprehensive understanding of the category of patient utilising the proposed facility, and that the project team are aware of how their needs and expectations for appropriate quality and safety standards will influence the design of the accommodation. It looks to provide assurance that the project can proceed to the Full Business Case.

The OBC KSAR will focus on how this understanding of patient needs and expectations have influenced the following critical components of design, particularly in relation to Infection Prevention and Control.

- Water systems
- Ventilation systems
- Plumbing and drainage
- Fire safety
- Electrical systems
- Medical gases
- Any other building or engineering component critical to the safety and welfare of a particular patient cohort (defined by the review team).

At all stages of design development, knowledge of compliance in design and implementation will need to encompass (not limited to) the following:

- NHS Scotland policy letters (DLs,CELs,CMOs)
- Scottish Health Planning Notes (SHPN)
- Scottish Health Facilities Notes (SHFN)
- Scottish Health Technical Memoranda (SHTM)
- Scottish Fire Practice Notes (SFPN)
- Health Building Notes (HBN)
- Health Technical Memoranda (HTM)
- Health Facilities Notes (HFN)
- UK construction industry bodies best practice or design guidance publications e.g. HSE, CIBSE, BRE, IHEEM, IET, BRE, BSRIA, sustainability, dementia and equality.
- Incident Reporting and Investigation Centre (IRIC) Alerts
- Relevant British Standards
- Other statutory requirements: Planning permission; Building Regulations compliance; Equality Act compliance; Health and Safety Executive (HSE) compliance; Construction (Design and Management) Regulations compliance; Fire Scotland Act.
- Other mandatory NHS Scotland use of:
  - Activity Data Base (ADB);
  - Achieving Excellence Design Evaluation Tool;
  - BREEAM Healthcare or equivalent (BRE environmental & sustainability tools);
  - Scottish Government BIM Policy (SPPN 1/2017; implementation of building information modelling within construction projects: March 2017);
  - The implementation of NHS Scotland Soft Landings (SL) guidance
- Confirm there are plans in place for risk management, issue management and these plans are being shared with suppliers and delivery partners.
- Evaluation of actions taken to implement recommendations made in earlier assessment of deliverability.
- Confirm there are plans in place to ensure the requirements of the NHS Scotland National Infection Prevention and Control Manual for Scotland are being incorporated which will allow the staff allocated to the role to deliver the services to the patients.

The review teams consist of experienced operational estates professionals and experienced Infection Control clinicians. The team will work with the Health Board's Project Team, inclusive of their clinicians and their appointed facility management consultants and contractor. Each review will result in a report being prepared for the Programme Director at the Board and a copy of the report will also be provided to Scottish Government Capital Investment Group

An appendix is provided which indicates the typical question set for OBC which the review Team will use as the basis of evidence finding for the KSAR. The review team will amend this as necessary depending on the project and areas of particular interest. The Health Board, their designers and contractors should be aware that this is the information which will be expected and the design should effectively be completed at OBC at the time of the KSAR to ensure the accuracy of the report.

3. Assessment of Delivery Approach

The review at Outline Business Case stage will need to demonstrate an awareness and knowledge of how the above will be used to influence the initial design.

Project Governance and General Arrangements

No.	Areas to probe	Evidence expected
1.1	Evaluation of changes detailed from previous KSAR.	• Assessment of any substantive changes in highlighted areas from previous review stage and all actions have been implemented.
1.2	Verification that CIG recommendations have been implemented with respect to prescribed in scope areas.	• Review of the implementation of all CIG recommendations. Evaluation of any deviation from previous submissions or reviews.
1.3	Has cross-referencing with NDAP and AEDET recommendations been implemented?	• An assessment if there is full compliance with the applicable recommendations and actions from the preceding step.
1.4	Does the Health Board continue to demonstrate service / clinical input into design decisions based on a current and comprehensive knowledge of patient cohorts?	• Recorded and updated input taken from service lead(s) / clinician(s) about relevant patient cohort characteristics and their typical needs in terms of the accommodation's environment, safety and infection control standards. • Demonstrable expertise of service lead(s) / clinician(s) in providing this advice.
1.5	Project team demonstrates a unified and recorded understanding of needs of main users and patient cohorts of the proposed accommodation and how this will influence the design of critical building, engineering and infection prevention and control quality and safety standards.	• Updated and current list available of all stakeholders, service users and patient cohorts impacted by this project, plus the identification of any high risk groups and their specialist needs. • Updated and recorded engagement on these designs issues having taken place between the project team and service lead(s) / clinician(s), infection control team, and other key stakeholders (e.g. Estates, Medical

No.	Areas to probe	Evidence expected
		Physics, IPC, the AEDET, NDAP or other design briefing workshops). • Details available of how service users / patient cohort needs and their expected use of the accommodation are influencing the design brief; including critical building, engineering and infection prevention and control quality and safety standards.
1.6	Planned approach towards determining the necessary standards for this accommodation.	• Updated and current list of the relevant NHS and non-NHS guidance that is being used and adopted (see previous section of workbook OBC KSAR (Page 9) for examples of appropriate guidance). • Updated and current list of all proposed derogations from NHS guidance with a detailed technical narrative on each derogation and / or list of known gaps in guidance that will need to be resolved in order to meet the needs of the patient / user cohort. • Knowledge of the role of infection prevention and control and microbiologist advisors to be used throughout the design stages, and details of the resource plan in place to ensure this advice will be available.
1.7	How does the Health Board demonstrate that there is an effective infection prevention and control management structure in place and how does it relate to the development of the project? How does the Board demonstrate leadership and commitment to infection prevention and control to ensure a culture of continuous quality improvement throughout the organisation, and that there is an effective IPC structure in place and how does it relate to the design development?	• Evidence IPC and clinical teams have been integrated into all decisions regarding any derogations through the design process and are satisfied this will not impact on patient safety such as, specific sign off, supporting meeting minutes, risk assessments, risk registers relating to IPC with evidence of escalation through the agreed NHS board governance process.

No.	Areas to probe	Evidence expected
1.8	Integration with Authority Policies and Operation. How does the Health Board demonstrate implementation of evidence based infection prevention and control measures?	• The Health Board can demonstrate the current version of the National Infection Prevention and Control Manual has been adopted by the organisation and all staff are aware of how and where to access this (ask staff). • IPC are fully embedded in the project team and the OBC programme taking cognisance of any actual or perceived risks identified provided.
1.9	The Health Boards Infection Control Strategy	• Assessment of the Health Boards approach to all IPC related matters in relation to the development of the design, HAISCRIBE etc. • IPCT annual programme of work.
1.10	The Health Boards Monitoring and Records	• Evidence that the Health Board integrating this project with wider IPC requirements within the context of the OBC. For example, evidence that the proposals for equipping incorporate IPC requirements?
1.11	Planned approach for managing the design process to ensure successful compliance with agreed and approved standards.	• The project governance arrangements and resource plan in place to ensure that the necessary decision making authority and technical expertise is available to take responsibility for and deliver the project as planned and agreed. • Details of how gaps in expertise are being filled. • Details of how compliance with the appropriate guidance, design brief and other standards are being agreed, signed off, monitored, reported against and if necessary escalated / adjudicated throughout the design, construction and commissioning stages. • Details of how all stakeholders' interests are being agreed, signed off, monitored, reported against and if necessary escalated / adjudicated

No.	Areas to probe	Evidence expected
		throughout the design, construction and commissioning stages.
1.12	The Health Boards approach on the procurement journey, with evidence of the plans on how the Health Board will provide assurance, particularly emphasis on the critical system identified earlier.	• Evidence on how Infection Prevention and Control are involved with the conceptual procurement approach to the design stage and future plans for project. • Plans to identify any gaps in the procurement approach that may require to be addressed. • Evidence on how the Infection Control procedures and management will fit with the conceptual procurement approach and initial thinking on how it will be managed. • Evidence of a detailed procurement strategy report. • Evidence that the Health Boards selected procurement route has gone through the Health Board's Governance channels.
1.13	The Health Boards approach on those areas of design that the procurement route has provided identification as possibly being Contractors Designed Portions (CDP's).	• Evidence that the Health Board integrating this project with wider IPC requirements within the context of the OBC. For example, evidence that the proposals for equipping incorporate IPC requirements? • Evidence that the procurement of the lead designer will encompass these areas in their oversight and sign off of the complete design. • Evidence that a clear demarcation of design responsibility is being developed.
1.14	Evaluation of the Health Boards commissioning plan.	• Evidence that the Health Board has recorded plans that are comprehensive and adequate to address the needs of the project and that they are fully resourced.
1.15	Evaluation of the Health Boards duty holder matrix.	• Evidence that the Health Board have a fully recorded matrix of the required roles and responsibilities and have a

No.	Areas to probe	Evidence expected
		clear governance structure that is fully resourced together with plans in place for the implementation. • Evidence that Health Boards have appropriate number of competent, qualified staff to carry out specific duties throughout the life cycle of the project e.g., IPC, Engineers, Estates staff etc. The number of competent, qualified staff will depend on the type and size of the Build Project.

Water and Internal Plumbing / Drainage Systems

No.	Areas to probe	Evidence expected
2.1	Has the Health Board completed competency checks on the water and drainage consultant designers?	• Recorded evidence that the design team are experienced and have a comprehensive knowledge of the relevant design standards. • Where anyone does not have a record of extensive health care experience what recorded plans are to be put in place by the Consultant Designers? • Recorded evidence that input from the Health Boards Authorising Engineer for Water (AE(W)) has been requested.
2.2	How does the Health Board ensure that water services are designed in a fashion which will retain space for minor additions and modifications to services in the future?	• Evidence that the engineers are presented their co-ordination drawings (BIM model), with space for future flexibility identified, to the Board. • Evidence that the design consultant has considered and agreed with the Board, space for future flexibility in the service installations. • Evidence that the designers have presented each of the main service runs plus plant rooms to the Board's FM team, to highlight space for future flexibility. • Evidence that the Health Board has agreed a strategy (percentage) for spare capacity and a documented allowance to be incorporated into the design. • Are plant/tank rooms, IPS sections, horizontal distribution runs and risers appropriately sized for the equipment being installed and facilitate safe adequate maintenance.

No.	Areas to probe	Evidence expected
2.3	How does the Health Board assure itself that all variations / derogations which may be required to water systems are investigated and agreed by all parties before they are incorporated in the design?	• Evidence that the each variation / derogation has a detailed technical analysis and has been referred to the Board and agreed with their water management group, clinical, Estates, infection prevention and control and FM teams.
2.4	Water Management Strategy	• Assessment of Health Board proposed water management strategy and how this relates to the proposed specification, guidance and project requirements • What involvement has there been from the water management group?
2.5	Water Governance Arrangements	• Has the Health Board commenced its water governance planning and recorded how it will ensure appropriate numbers of trained staff (AP and CP) and AE(W) will be appointed, is there an established project water management group that ensures the water management strategy is adhered to for the Board, and is it clear how this project will interface with this existing group? • Evidence that the Health Boards AE(W) have been involved with and reviewed the design proposals to date.

Ventilation

No.	Areas to probe	Evidence expected
3.1	Has the Health Board completed competency checks on the ventilation consultant designers?	• Recorded evidence that the design team are experienced and have a comprehensive knowledge of the relevant design standards. • Where anyone does not have a record of extensive health care experience what recorded plans are to be put in place by the Consultant Designers? • Recorded evidence that input from the Health Boards Authorising Engineer for Ventilation (AE(V)) has been requested.
3.2	How does the Health Board ensure that ventilation services are designed in a fashion which will retain space for minor additions and modifications to services in the future and there is an appropriate plant access strategy?	• Evidence that the engineers are presented their co-ordination drawings (BIM model), with space for future flexibility identified, to the Health Board. • Evidence that the design consultant has considered and agreed with the Health Board, space for future flexibility in the service installations. • Evidence that the designers have presented each of the main service runs plus plant rooms to the Board's FM team, to highlight space for future flexibility. • Evidence that the Health Board has agreed a strategy (percentage) for spare capacity and a documented allowance to be incorporated into the design. • Are plant/tank rooms, IPS sections, horizontal distribution runs and risers appropriately sized for the equipment being installed and facilitate safe adequate maintenance? • Evidence that a plant access strategy for the entire ventilation system has been provided to ensure safe, adequate access, including access for cleaning.

No.	Areas to probe	Evidence expected
3.3	How does the Health Board assure itself that all variations / derogations which may be required to the ventilation systems are investigated and agreed by all parties before they are incorporated in the design?	• Evidence that the each variation / derogation has a detailed technical analysis and has been referred to the Board and agreed with their ventilation safety group, clinical, Estates, infection prevention and control and FM teams.
3.4	Does the Health Board have a strategy for ventilation (for rooms where this is permitted within the SHTM/SHPN guidance)?	• Evidence of environmental matrix. • Evidence that the dynamic thermal modelling confirms what the design must include (e.g. structure, solar shading / protection, orientation, equipment optimisation, etc.) to ensure that room temperatures comply with SHTM guidance, in naturally ventilated rooms. • Floor plans with associated plant locations highlighted plus simple schematic of strategy. • This must also identify the air intake and exhaust strategy/locations.
3.5	Is there evidence of stakeholder input to ventilation strategies?	• Addition to or supplement to the Environmental Matrix which confirms the following, on a room by room basis: • a) the type of ventilation (to SHTM 03-01) b) patient group and/or function related to the space. • c) name of the Consultant, Clinical Lead or Department Lead who has agreed to the room requirements. • d) name of the Infection Prevention and Control Doctor or equivalent who has agreed to the room requirements. • e) name of the Infection Prevention and Control Nurse who has agreed to the room requirements. • f) name of the Estates / FM team representative who has agreed to the room requirements. • g) name of the NHS Project Manager who has agreed to the room requirements.

No.	Areas to probe	Evidence expected
		• h) name of the Decontamination Manager who has agreed to the room requirements (where this is part of the project).
3.6	Is there evidence of the Health Board developing Ventilation Commissioning Proposals?	• Evaluation of the suitability of the proposed plans in the context of the OBC, are these sufficient do the meet the requirements of the project, guidance and the design of the system?
3.7	Has the Health Board started developing its ventilation governance arrangements?	• Is the Heath Board considering how it will ensure appropriate numbers of trained staff (AP and CP) and AE(V) for the project? • Evidence that the Health Boards AE(V) have been involved with and reviewed the design proposals to date.

Electrical

No.	Areas to probe	Evidence expected
4.1	Has the Health Board completed competency checks on the electrical consultant designers?	• Recorded evidence that the design team are experienced and have a comprehensive knowledge of the relevant design standards. • Where anyone does not have a record of extensive health care experience what recorded plans are to be put in place by the consultant designers? • Recorded evidence that input from the Health Boards Authorising Engineer for Electrical (AE(E)) has been requested.
4.2	How does the Health Board ensure that electrical services are being designed in a fashion which will provide ease of access for future maintenance and which will retain space for minor additions and modifications to services in the future?	• Evidence that the designers have presented their co-ordination drawings (BIM model) to the Board. • Evidence that the designers have presented each of the main service runs plus plant rooms to the Board's FM team. • Evidence that the Health Board has agreed a strategy (percentage) for spare capacity and a documented allowance to be incorporated into the design. • Are sub stations, switch rooms, distribution board cupboards, horizontal distribution runs and risers appropriately sized for the equipment being installed and facilitate safe, adequate maintenance?
4.3	How does the Health Board assure itself that all variations / derogations which may be required to electrical systems are investigated and agreed by all parties before they are instigated?	• Evidence that the each variation / derogation has a detailed technical analysis and has been referred to the Health Board and agreed with their electrical safety group, clinical, Estates, infection prevention and control and FM teams.

No.	Areas to probe	Evidence expected
4.4	Has the Health Board assured itself of availability of adequate supply from the local utility infrastructure?	• Confirmation from the Regional Electricity Company as to how the supply will be provided from their network and if single or dual supplies are being made available.
4.5	Evidence of provisions for emergency supplies during loss of the utility incoming supply.	• Floor plans with standby generator locations highlighted plus simple schematic of strategy. • Capacity of generators • UPS provision
4.6	Is there a strategy for locating substations?	• Floor plans with substation locations highlighted plus simple schematic.
4.7	Is there a strategy for locating switchrooms?	• Floor plans with switchroom locations highlighted plus simple schematic
4.8	Is there a strategy for locating Medical IT distribution equipment?	• Floor plans with Medical IT board locations highlighted plus simple schematic of strategy. • Compliance with BS7671 section 710 • Compliance with SHTM 06-01
4.9	Is there a strategy for distribution?	• Floor plans with containment distribution routing (horizontal and vertical).
4.10	Is there evidence of the Health Board developing electrical commissioning proposals?	• Evaluation of the suitability of the proposed plans in the context of the OBC, are these sufficient do the meet the requirements of the project, guidance and the design of the system?
4.11	Has the Heath Board starting on its early thinking for the electrical governance arrangements for the operational phase?	• Is the Health Board considering how it will ensure appropriate numbers of trained staff (AP(HV), AP(LV), CP(HV), CP(LV), AE(HV) and AE(LV) for the project, inclusive of third party providers? • Evidence that the Health Boards AE(E) have been involved with and reviewed the design proposals to date.

Medical Gases

No.	Areas to probe	Evidence expected
5.1	Has the Health Board completed competency checks on the medical gases consultant designers?	• Recorded evidence that the design team are experienced and have a comprehensive knowledge of the relevant design standards. • Where anyone does not have a record of extensive health care experience what recorded plans are to be put in place by the Consultant Designers? • Recorded evidence that input from the Health Boards Authorising Engineer for Medical Gases (AE(MG)) has been requested.
5.2	How does the Health Board assure itself that all variations / derogations' which may be required to medical gas systems are being investigated and agreed by all parties before they are instigated?	• Evidence that the each variation / derogation has a detailed technical analysis and has been referred to the Board and agreed with their medical gas management group, clinical, Estates, infection prevention and control and FM teams.
5.3	How does the Health Board ensure that medical gas services are designed in a fashion which will provide ease of access for future maintenance and which will retain space for minor additions and modifications to services in the future?	• Evidence that the designers have presented their co-ordination drawings (BIM model) to the Board. • Evidence that the designer has presented each of the main service runs to the Board's FM team.
5.4	Is there evidence of the Health Board developing medical gases commissioning proposals?	• Evaluation of the suitability of the proposed plans in the context of the OBC, are these sufficient do the meet the requirements of the project, guidance and the design of the system?
5.5	Has the Health Board started developing its medical gases governance arrangements for the operational phase?	• Is the Health Board considering how it will ensure appropriate numbers of trained staff (AP and CP) and AE(V) for the project?

No.	Areas to probe	Evidence expected
		• Evidence that the Health Boards AE(MG) have been involved with and reviewed the design proposals to date.
5.6	Is there recorded evidence of a strategy for bulk gas and bottle gas storage?	• Floor plans with cylinder locations highlighted • Site plan with VIE location(s) • Simple schematic • Confirmation that the medical gas strategy is adequate. • Floor plans with pipework distribution routing and manifold locations.
5.7	Is there recorded evidence of a strategy for medical gas plant?	• Description of medical; gas requirements signed off by clinical colleagues. • Floor plans with pipework distribution (horizontal and vertical) routing. • Details of all medical gas plant areas ensuring safe and adequate access.

No.	Areas to probe	Evidence expected
6.1	Has the Health Board completed competency checks on the Fire Engineering consultant designers?	• Recorded evidence that the design team are experienced and have a comprehensive knowledge of the relevant design standards. • Where anyone does not have a record of extensive health care experience what recorded plans are to be put in place by the Consultant Designers? • Recorded evidence that input from the Health Boards Fire Advisors has been requested.
6.2	Has a written fire strategy been completed and does it provide evidence, where there is a variance from statutory and mandatory guidance, that an equivalent level of safety has been achieved by alternative means?	• Is there documented evidence that fire suppression systems have been considered for life safety and property protection? • Is progressive horizontal evacuation available for all patient areas that continuously moves away from the fire area? • Does the design considerations of the fire and detection system provide L1 coverage including voids? • Does the design provide for a compliant emergency lighting system? • Are free swing arm self-closers fitted to all leafs of doors serving sleeping accommodation? • Have escape lifts been considered for the evacuation of patients and others with mobility issues? • Are multi sensor fire detectors installed to reduce the occurrence of unwanted fire alarm signals? • Are there adequate storage facilities to ensure escape routes are not used for this purpose? • Are measures in place to provide safe charging of electrical and personal electronic equipment? • Have fire hazard rooms been designated based on fire load? • Where there is a mechanical ventilation system - have all compartments, sub-

No.	Areas to probe	Evidence expected
		compartments and corridors serving sleeping accommodation been designed to be fitted with fire and smoke dampers?
6.3	How does the Health Board assure itself that all variations / derogations which may be required to fire systems are investigated and agreed by all parties before they are instigated?	• Evidence that the each variation / derogation and any fire engineering proposals are being referred to the Board and agreed with their fire safety group, clinical, engineering, infection prevention and control and FM teams.
6.4	How does the Health Board assure itself that all fire dampers and fire/smoke dampers are designed to allow for inspection, resetting and maintenance?	• Evidence that the designers have presented their co-ordination drawings (BIM model) to the Board. • Evidence that the designers have presented each of the fire dampers and smoke / fire dampers to the Board's FM team. • Safe and adequate access has been allocated on both sides of all fire dampers for maintenance.
6.5	How does the Health Board assure itself that any fire rated ductwork is correctly installed?	• Evidence that the system is certificated and that the installation follows the installation details which were used for the certification. • Written confirmation from the design consultant.
6.6	How does the Health Board assure itself that any smoke control and/or clearance systems are fit for purpose?	• Evidence that the smoke system is being designed by an accredited Fire Engineer. • Evidence that Building Control are being consulted. • Confirmation from the Building Services Design Consultant that the operating sequence for the smoke system has been discussed regarding being integrated into the control of other building systems.

No.	Areas to probe	Evidence expected
6.7	Evidence that the Health Board is ensuring fire safety input into the design process together with early design decision-making.	• Input from Fire lead(s) and HFS / SFRS on fire safety into site / option selection. Documents e.g. option appraisal report, fire strategy report, meeting minutes. • Demonstrable and appropriate engagement and expertise of relevant Fire lead(s). Signed off documents, e.g. reports, role profiles, minutes. • Evidence that the Health Boards Fire Advisor have been involved with and reviewed the design proposals to date.
6.8	Has the Health Board started the development of the fire system outline commissioning proposals?	• Has the Health Board designed appropriate trained staff and appointed a fire officer for the project, is there an established firer management group that will ensure the fire management strategy is adhered to?

No.	Areas to probe	Evidence expected
7.1	How does the Health Board demonstrate that there is an effective infection prevention and control management structure in place? How does the Board demonstrate leadership and commitment to infection prevention and control to ensure a culture of continuous quality improvement throughout the organisation and that there is an effective IPC structure in place; inputting into the design process?	• The Health Board provides evidence that there is an IPC Management Structure with the necessary. expertise and leadership skills to support the design work. • The Health Board provides evidence that there is an IPC Management Team with the necessary expertise and leadership skills to support the project. • Executive board reports or minutes. Risk registers or equivalent, Minutes from operational and governance groups, (and action points). • Structure of infection prevention and control team (IPCT) and qualifications held, previous experience supporting new build projects. • Evidence IPC and clinical teams have been involved with any derogation through the design process and are satisfied this will not impact on patient safety. This can be meeting minutes, risk assessments, and risk registers. There is IPC evidence of escalation through the agreed NHS board governance process. • Evidence the Executive board member assigned to lead on IPCT has been kept informed of IPC risks identified and associated with the project this can be demonstrated by the board. • Evidence that fixtures fitting and equipment have not been proposed for the project that would represent an IPC risk.
7.2	How does the Health Board demonstrate implementation of evidence based infection prevention and control measures during the design process?	• The Board evidences that: • The Health Board can demonstrate the current version of the National Infection Prevention and Control Manual has been adopted by the organisation and all staff are aware of how and where to access this and it is being referred to during the design process.

No.	Areas to probe	Evidence expected
		• IPC work programme and planned IPC audit programme for new building taking cognisance of any actual or perceived risks identified.
7.3	How does the Health Board assure itself that the designers have a proper understanding of the infection prevention and control procedures and processes required?	• The Health Board evidences that: • All relevant staff within the designers organisation are provided with clear guidance on roles and responsibilities in relation to infection prevention and control. • The contractors organisation will provide evidence of education in relation to infection prevention in the built environment for all staff involved in the project.
7.4	How does the Health Board assure itself that equipment being proposed meets the required IPC standards?	• The IPC Team are involved and IPC advice followed in all procurement decisions for new equipment prior to purchase. IPCT are satisfied that all equipment purchased can be decontaminated safely in line with National Decontamination Guidance, NIPCM and manufacturers' instructions.

4. References

KSAR Master Glossary

Available to download from NHS National Services Scotland website.

5. Bibliography

Scottish Property Advisory Group – Building Design and Construction: Report on Construction Quality Matters
John Donnelly, Chair BDAC
Dated: December 2020

NHS Scotland Assure
Quality in the healthcare environment

NHS National Services Scotland

Key Stage Assurance Review Workbook

Full Business Case

June 2021

Version 1.0

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Contents

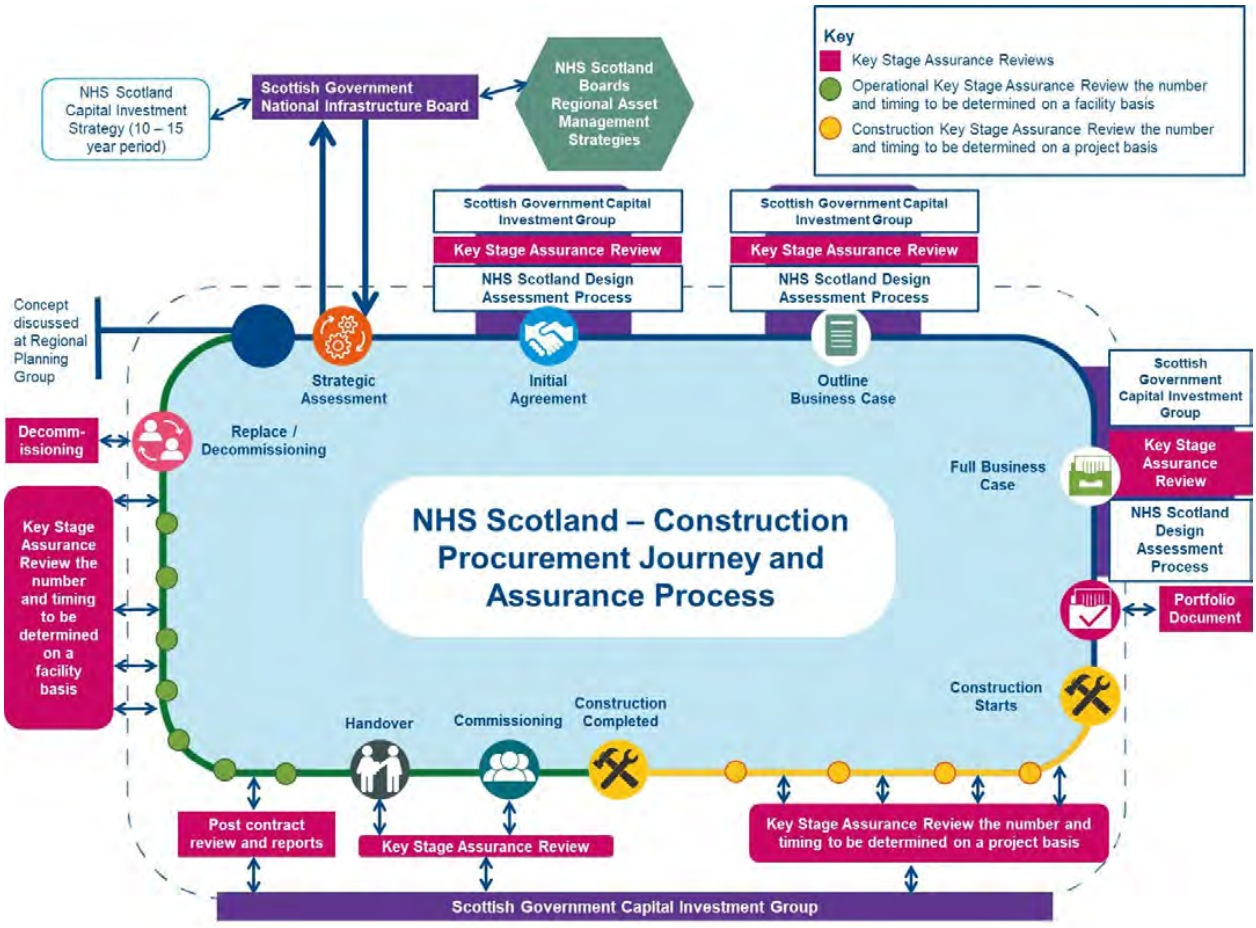
1. About this workbook

This workbook supports the Full Business Case Key Stage Assurance Review (KSAR), delivered by the NHS Scotland Assure Assurance service.

Further information about the NHS Scotland Assure Assurance service and KSAR process is provided in section 2.

Figure 1. shows how the Full Business Case stage in the procurement and construction journey commences following the Outline Buisness Case. The timing and frequency of KSARs during this stage will vary dependent upon the facility. Specific workbooks have been developed for the other stages within this journey.

Figure 1: Construction Procurement Journey



KSARs are of a process ensuring facilities and the teams using them are able to deliver the standards required to provide the best and safest outcomes for patients, staff and visitors in the built environment.

KSARs deliver an independent peer review. NSS staff outside the project use their experience and expertise to examine the progress and likelihood of successful delivery, with a particular emphasis on the safety of the patients, staff and visitors using the facility.

It is vital to receive feedback on the following elements of health facilities - Infection Prevention and Control (IPC), water, ventilation, electrical, plumbing, medical gases installations and fire. This ensures they are designed, installed and functioning from

initial commissioning of a new facility and throughout its lifetime. Health Boards are required to have appropriate governance in place at all stages of the construction procurement journey.

The KSAR workbook provides a transparent, structured framework for all clinical specialisms, facilities and operational management professionals to assess and manage a health care build or refurbishment. Allowing facilities to align with current standards as the assurance reviews are taking place, as well as aligning changes for patient cohort.

Using this workbook

The review at Full Business Case stage investigates the approach taken by the Health Board in the development of the design, and how the appropriate level of knowledge and awareness of patient and user needs will influence the development of the design.

The purpose of the KSAR at Full Business Case stage is to confirm there is a good and comprehensive understanding of the category of patient who will use the proposed facility and that the project team consider how appropriate quality and safety standards will influence the design. It looks to provide assurance that the project can proceed to the Construction phase.

Additionally, the KSAR at Full Business Case will carry out an appropriate level of checking of the design calculations and solutions adopted. This level of checking will be set by the Review Team following their initial discussions on site.

The workbook is predominantly intended to be used by NHS Scotland Assure KSAR review teams, Health Boards are encouraged to use its content to support their own projects. It provides guidance on the review structure and areas of investigation to be addressed by the review team and should be regarded as indicative and not prescriptive.

The review team will consider whether any emerging findings require additional topics to be addressed. If so, evidence relating to these areas, regarding the safety of the patients, staff and visitors, should be provided.

2. Key Stage Assurance Review

Introduction to NHS Scotland Assure – Assurance Service

Good management effective control of projects is an essential element to the successful delivery and maintenance of healthcare facilities across NHS Scotland estates.

The initial delivery of the NHS Scotland Assure - Assurance Service will focus upon new builds and major refurbishments in the acute estate, submitted to the Scottish Government Capital Investment Group (CIG). In addition, a number of projects identified as being complex, primarily due to the needs of patients utilising the facilities, will be reviewed by this service. Whilst not an exhaustive list, these projects will cover oncology, maternity, theatre and critical care units, no matter of their financial value.

The NHS Scotland Assure - Assurance Service will deliver KSARs, designed to provide independent assurance to Scottish Government Health and Social Care Directorates (SGHSCD's).

It will assess if Health Boards Project Management teams (inclusive of clinicians, appointed construction consultants, and contractors) are briefed and following best practice procedures in the provision of facilities. We will review if projects are compliant in all aspects of safety, if specific engineering systems are designed, installed and commissioned, and for ongoing safety maintenance including IPC.

The KSAR process is applicable regardless of procurement route chosen.

The KSAR Process

The KSAR process examines projects at key points in their lifecycle. It does not remove any legal or contractual obligations from the NHS Health Board, their designers or contractors. It provides assurance to progress successfully to the next review point and the process will be mandated for projects requiring CIG approval. KSARs focus on the assessment of the delivery approach, and will work with the Health Board's project team to ensure there is comprehensive understanding of the patient cohorts utilising the facility. KSARs also ensure relevant guidance is fully implemented and any technical derogations have been fully reasoned, transparently discussed, the implications understood, recorded and signed off by the Health Board and their advisors.

With a focus on construction elements where previous reviews have demonstrated potential patient safety concerns, KSARs will concentrate on water; ventilation, electrical, plumbing, medical gases installations, fire, and associated IPC guidance. If further issues are raised with the review team, they will fully incorporate those issues into the reporting process.

Value of the KSAR Process

Key Stage Assurance Reviews (KSARs) deliver an independent peer review. NSS staff outside the Health Board's project use their experience and expertise to examine the progress and likelihood of successful delivery, with a particular emphasis on the safety of the patients, staff and visitors using the facility. KSARs provide an external perspective and provide a challenge to the robustness of the Health Board's brief, plans and processes.

This includes work delivered by construction consultants, employed either directly or through construction contractors, and the work being delivered by the primary contractor, their sub-contractors and specialist suppliers.

The KSAR provides an independent report and action plan, which is shared with the Health Board to ensure:

- Appropriate skills and experience are deployed on the project by the Health Board, consultants, primary contractor and all sub-contractors.
- The clinicians and wider stakeholders covered by the project fully understand the project status, aims and the issues involved.
- Appropriate management structures put in place to ensure appropriate infection prevention and control measures are designed into the project to reduce the risk of transmission of infectious agent.
- There is assurance the project can progress to the next stage of development or implementation with particular emphasis on the safety of the patients, staff and visitors utilising the facility.
- Provision of advice and guidance to programme and project teams by fellow Practitioners.

The KSAR report and the Health Board's response and action plan is submitted to CIG along with a recommendation from the NHS Scotland Assure - Assurance Service regarding the projects' progression to the next stage of the construction procurement journey.

KSAR as part of the overall assurance framework

Each NHS Health Board will be fully responsible for the delivery of all projects, and its own internal process and resources for carrying out internal reviews and audits of its activities. The KSAR is seen as a complementary independent review, and not as a replacement for the responsibilities of the Health Board.

NHS Health Boards should have in place an effective framework to provide a suitable level of assurance for their programmes and projects. Health Boards are encouraged and expected to ensure adequate and timely coordination and sharing of information, including plans, between the various internal reviews and functions.

The KSAR process is not a substitute for a rigorous governance framework in the Board to manage key processes including business planning, investment appraisal, business case management, risk management and service and contract management.

The KSAR Process relationship with NHS Scotland Design Assessment Process (NDAP)

The Scottish Government's ambition for NHS Scotland's estate and the need for well-designed healthcare environments is articulated in the Policy on Design Quality for NHS Scotland. Good design in the built environment encompasses a wide range of inter-related factors such as, sustainability, engineering, architecture, fire safety, energy, environment, decontamination, space utilisation, landscaping, security, technology, lighting, access for visitors and mobility impaired persons.

The NDAP process is overseen by Health Facilities Scotland and Architecture and Design Scotland and holistically considers all of the above. It sets the principles for the resolution of potential conflicts of statutory or mandatory compliance to ensure the specific facility provides; the best balance of the technical requirements, meets clinical needs and fulfils the conceptual aims of the policy on Design Quality. The NDAP process begins at the initial agreement stage of a project and provides advice through to the Full Business Case. There is no change to either SCIM or NDAP processes.

The Scottish Government is progressing policy to improve the safety of the healthcare environment in relation to the built environment risk. The Assurance Service delivered through NHS Scotland Assure is a response to this policy and the KSARs are integral to the compliance work. The aspiration is not to duplicate any of the work included in the NDAP process, but to provide assurance regarding the critical components highlighted throughout this workbook.

Integral to the KSARs will be a review of the balance between sustainability issues and patient safety.

The NDAP, working with Health Boards, will set the principles of the design solution, whereas the KSAR will provide a detailed technical review of the specifics of the design solution. Where possible the two reviews will be aligned to avoid duplication of work. For example, in instances where the NDAP has reviewed detail at a technical level, this will be used by the KSAR team rather than being separately requested and reviewed.

Sustainability

The review will provide assurance that the proposals for the project provide an effective balance in terms of patient, staff and visitors safety, whilst meeting required sustainability outcomes and complying with the guidance standards.

Full Business Case (FBC) KSAR

This review investigates the approach taken by the Health Board in the development of the design, to confirm that there is a good and comprehensive understanding of the category of patient utilising the proposed facility, and that the project team are aware of how their needs and expectations for appropriate quality and safety standards will influence the design of the accommodation. It looks to provide assurance that the project can proceed to the Construction phase.

The FBC KSAR will focus on understanding how patient needs and expectations have influenced the following critical components of design, particularly in relation to Infection Prevention and Control.

- Water systems
- Ventilation systems
- Plumbing and drainage
- Fire safety
- Electrical systems
- Medical gases
- Any other building or engineering component critical to the safety and welfare of a particular patient cohort (defined by the review team).

At all stages of design development, knowledge of compliance in design and implementation will need to encompass (but is not limited to) the following:

- NHS Scotland policy letters (DLs,CELs,CMOs)
- Scottish Health Planning Notes (SHPN)
- Scottish Health Facilities Notes (SHFN)
- Scottish Health Technical Memoranda (SHTM)
- Scottish Fire Practice Notes (SFPN)
- Health Building Notes (HBN)
- Health Technical Memoranda (HTM)
- Health Facilities Notes (HFN)
- Incident Reporting and Investigation Centre (IRIC) Alerts
- Relevant British Standards
- UK construction industry bodies best practice or design guidance publications e.g. HSE, CIBSE, BRE, IHEEM, IET, BRE, BSRIA, sustainability, dementia and equality.
- Incident Reporting and Investigation Centre (IRIC) Alerts
- Relevant British Standards
- Other statutory requirements: Planning permission; Building Regulations compliance; Equality Act compliance; Health and Safety Executive (HSE)

compliance; Construction (Design and Management) Regulations compliance. Fire Scotland Act.

- Other mandatory NHS Scotland use of
  - Activity Data Base (ADB);
  - Achieving Excellence Design Evaluation Tool;
  - BREEAM Healthcare or equivalent (BRE environmental & sustainability tools);
  - Scottish Government BIM Policy (SPPN 1/2017; implementation of building information modelling within construction projects: March 2017).
- The implementation of NHS Scotland Soft Landings (SL) guidance.
- Confirm that there are plans in place for risk management, issue management and that these plans are being shared with suppliers and delivery partners.
- Evaluation of actions taken to implement recommendations made in earlier assessment of deliverability.
- Confirm there are plans in place to ensure the requirements of the NHS Scotland National Infection Prevention and Control Manual for Scotland are being incorporated into the development in a manner which will allow the staff allocated to the role to deliver the services to the patients.

Additionally, the FBC KSAR will carry out an appropriate level of checking of the design calculations and solutions adopted. This level of checking will be set by the review team following their initial discussions on site. One impact of this work may be that the review will take longer than the initial programme, dependant on the conclusions / findings from this in-depth assessment of the design.

The review teams consist of experienced operational estates professionals and experienced Infection Control clinicians. The team will work with the Health Board's Project Team, inclusive of their clinicians and their appointed facility management consultants and contractor. Each review will result in a report being prepared for the Programme Director at the Board and a copy of the report will also be provided to Scottish Government Capital Investment Group

An appendix is provided which indicates the typical question set for OBC which the review Team will use as the basis of evidence finding for the KSAR. The review team will amend this as necessary depending on the project and areas of particular interest. The Health Board, their designers and contractors should be aware that this is the information which will be expected and the design should effectively be completed at OBC at the time of the KSAR to ensure the accuracy of the report.

3. Assessment of Delivery Approach

The review at Full Business Case stage needs to demonstrate an awareness and knowledge of how the above will be used to influence the initial design.

Project Governance and General Arrangements

No.	Areas to probe	Evidence expected
1.1	Evaluation of changes detailed from previous KSAR.	• Assessment of any substantive changes in highlighted areas from previous review stage and all actions have been implemented.
1.2	Verification that CIG recommendations have been implemented with respect to prescribed in scope areas.	• Review of the implementation of all CIG recommendations. Evaluation of any deviation from previous submissions or reviews.
1.3	Has cross-referencing with NDAP and AEDET recommendations been implemented?	• An assessment if there is full compliance with the applicable recommendations and actions from the preceding step.
1.4	Does the Health Board continue to demonstrate service / clinical input into design decisions based on a current and comprehensive knowledge of patient cohorts?	• Recorded and updated input taken from service lead(s) / clinician(s) about relevant patient cohort characteristics and their typical needs in terms of the accommodation's environment, safety and infection control standards. • Demonstrable expertise of service lead(s) / clinician(s) in providing this advice.
1.5	Project team continues to demonstrate a unified and recorded understanding of needs of main users and patient cohorts of the proposed accommodation and how this has influenced the design of critical building, engineering and infection prevention and control quality and safety standards.	• Updated and current list available of all stakeholders, service users and patient cohorts impacted by this project, plus the identification of any high risk groups and their specialist needs. • Updated and recorded engagement on these designs issues having taken place between the project team and service lead(s) / clinician(s), infection prevention and control team, and other key stakeholders (e.g. Estates, Medical Physics, IPC, the AEDET, NDAP or other design briefing workshops).

No.	Areas to probe	Evidence expected
		• Details available of how service users / patient cohort needs and their expected use of the accommodation are influencing the design brief; including critical building, engineering and infection prevention and control quality and safety standards.
1.6	Planned approach towards determining the necessary standards for this accommodation.	• Updated and current list of the relevant NHS and non-NHS guidance that is being used and adopted (see previous section of workbook FBC KSAR (Page 9) for examples of appropriate guidance). • Updated and current list of all proposed derogations from NHS guidance with a detailed technical narrative on each derogation and/or list of known gaps in guidance that will need to be resolved in order to meet the needs of the patient / user cohort. • Knowledge of the role of infection prevention and control advisors (IPCN and ICD) to be used throughout the final design stages, and details of the resource plan in place to ensure continuity into the construction phase.
1.7	How does the Health Board demonstrate that there is an effective infection prevention and control management structure in place and how does it relate to the development of the project? How does the Health Board demonstrate leadership and commitment to infection prevention and control to ensure a culture of continuous quality improvement throughout the organisation and that there is an effective IPC structure in place and how does it relate to the design development?	• Evidence IPC and clinical teams have been integrated into all decisions regarding any derogations through the design process and are satisfied this will not impact on patient safety such as, specific sign off, supporting meeting minutes, risk assessments, risk registers relating to IPC with evidence of escalation through the agreed NHS board governance process.

No.	Areas to probe	Evidence expected
1.8	Integration with Authority Policies and Operation How does the Board demonstrate implementation of evidence based infection prevention and control measures?	• The Health Board can demonstrate the current version of the National Infection Prevention and Control Manual has been adopted by the organisation and all staff are aware of how and where to access this. (Ask staff) • IPC are fully embedded in the project team and the FBC programme taking cognisance of any actual or perceived risks identified provided.
1.9	The Health Boards Infection Prevention and Control Strategy	• Assessment of the Health Boards approach to all IPC related matters in relation to the development of the design, HAISCRIBE etc.
1.10	The Health Boards Monitoring and Records	• Evidence that the Health Board integrating this project with wider IPC requirements within the context of the FBC. For example, evidence that the proposals for equipping incorporate IPC requirements?
1.11	Planned approach for managing the design process to ensure successful compliance with agreed and approved standards	• The project governance arrangements and resource plan in place to ensure that the necessary decision making authority and technical expertise is available to take responsibility for and deliver the project as planned and agreed. • Details of how gaps in expertise are being filled. • Details of how compliance with the appropriate guidance, design brief and other standards are being agreed, signed off, monitored, reported against and if necessary escalated / adjudicated throughout the design, construction and commissioning stages. • Details of how all stakeholders' interests are being agreed, signed off, monitored, reported against and if necessary escalated / adjudicated throughout the design, construction and commissioning stages.

No.	Areas to probe	Evidence expected
1.12	The Health Boards approach on the procurement journey with evidence of the plans on how the Board will provide assurance, particularly emphasis on the critical system identified earlier.	• Evidence on how this requirement is being managed and how it fits with the project governance arrangements • Plans to identify any gaps in the procurement approach that may require to be addressed. • Evidence on how Infection Prevention and Control are involved with the conceptual procurement approach to the design stage and future plans for project. • Evidence that the Health Boards selected procurement route has gone through the Board's Governance channels.
1.13	The Health Boards approach on those areas of design that the procurement route has provided identification as possibly being Contractors Designed Portions (CDP's).	• Evidence that the procurement of the lead designer will encompass these areas in their oversight and sign off of the complete design. • Evidence that a clear demarcation of design responsibility is being developed.
1.14	Evaluation of the Health Boards commissioning plan.	• Evidence that the Health Board has recorded plans that are comprehensive and adequate to address the needs of the project and that they are fully resourced.
1.15	Evaluation of the Health Boards duty holder matrix.	• Evidence that the Health Board have a fully recorded matrix of the required roles and responsibilities and have a clear governance structure that is fully resourced together with plans in place for the implementation. • Evidence that Health Boards have appropriate number of competent, qualified staff to carry out specific duties throughout the life cycle of the project e.g., IPC, Engineers, Estates staff etc. The number of competent, qualified staff will depend on the type and size of the Build Project.

No.	Areas to probe	Evidence expected
2.1	Has the Health Board completed competency checks on the water and drainage consultant designers?	• Recorded evidence that the design team are experienced and have a comprehensive knowledge of the relevant design standards. • Where anyone does not have a record of extensive health care experience what recorded plans are to be put in place by the Consultant Designers? • Recorded evidence that input from the Health Authorising Engineer for Water (AE(W)) has been requested. • Evidence that all contractors and sub-contractor competency checks have been completed and signed off.
2.2	How does the Health Board ensure that water services are designed in a fashion which will retain space for minor additions and modifications to services in the future?	• Evidence that the engineers are presented their co-ordination drawings (BIM model), with space for future flexibility identified, to the Board. • Evidence that the Design Consultant has considered and agreed with the Board, space for future flexibility in the service installations. • Evidence that the designers have presented each of the main service runs plus plant rooms to the Board's FM team, to highlight space for future flexibility. • Evidence that the Board has agreed a strategy (percentage) for spare capacity and a documented allowance to be incorporated into the design. • Are plant/tank rooms, IPS sections, horizontal distribution runs and risers appropriately sized for the equipment being installed and facilitate safe adequate maintenance.
2.3	How does the Health Board assure itself that all variations / derogations which may be required to water systems are	• Evidence that the each variation / derogation has a detailed technical analysis and has been referred to the Board and agreed with their water management group clinical,

No.	Areas to probe	Evidence expected
	investigated and agreed by all parties before they are incorporated in the design?	engineering, Estates, infection prevention and control and FM teams.
2.4	Water Management Strategy	• Assessment of Board proposed water management strategy and how this relates to the specification, guidance and project requirements. • What involvement has there been from the water management group?
2.5	Water governance arrangements	• Has the Board commenced its planning and recorded how it will ensure appropriate numbers of trained staff (AP and CP) and AE(W) will be appointed, is there an established project water management group that ensures the water management strategy is adhered to for the Board and is it clear how this project will interface with this existing group?

2.6	Evidence that the Health Board is developing commissioning proposals.	• Evaluation of the suitability of the proposed plans in the context of the FBC, are these sufficient to meet the requirements of the project, guidance and the design of the system.
		• Evidence that the design has considered the commissioning of the water system including:
		  ○ Safe storage of materials
		  ○ Agreed type of chemical (to avoid warranty and corrosion issues)
		  ○ Adequate time scale
		  ○ Competency checks on all contractors
		  ○ Water sampling scope
		• Water sampling test results and approval process.

2.7	Evaluation of the Health Boards planned preventative maintenance (PPM) proposals.	• Has the Health Board commenced its planning and recorded the PPM requirements and approach to ensure appropriate levels of maintenance, comprehensive statutory compliance

No.	Areas to probe	Evidence expected
		and robust management processes, including: ○ Adequate numbers of staff ○ Water management PPM including all outlets, TMT & TMV, plumbing and drainage systems, etc.?

Ventilation

No.	Areas to probe	Evidence expected
3.1	Has the Health Board completed competency checks on the ventilation consultant designers?	• Recorded evidence that the design team are experienced and have a comprehensive knowledge of the relevant design standards. • Where anyone does not have a record of extensive health care experience what recorded plans are to be put in place by the Consultant Designers? • Recorded evidence that input from the Health Boards Authorising Engineer for Ventilation (AE(V)) has been requested. • Evidence that all contractors and sub-contractor competency checks have been completed and signed off.
3.2	How does the Health Board ensure that ventilation services are designed in a fashion which will retain space for minor additions and modifications to services in the future and there is an appropriate plant access strategy?	• Evidence that the design engineers have presented their co-ordination drawings (BIM model), with space for future flexibility identified, to the Board. • Evidence that the design consultant has considered and agreed with the Board, space for future flexibility in the service installations. • Evidence that the design engineers have presented each of the main service runs plus plant rooms to the Board's Estates team and / or FM team, to highlight space for future flexibility. • Evidence that the ventilation solution has been agreed with clinical and IPC colleagues. • Evidence that the Board has agreed a strategy (percentage) for spare capacity and a documented allowance to be incorporated into the design. • Are plant rooms, horizontal distribution runs and risers appropriately sized for the equipment being installed and facilitate safe adequate maintenance? • Evidence that a plant access strategy for the entire ventilation system has been provided to ensure safe, adequate access, including access for cleaning.

No.	Areas to probe	Evidence expected
3.3	How does the Health Board assure itself that all variations / derogations which may be required to the ventilation systems are investigated and agreed by all parties before they are incorporated in the design?	• Evidence that the each variation / derogation has a detailed technical analysis and has been referred to the Board and agreed with their ventilation safety group, clinical, engineering, Estates, infection control and FM teams.
3.4	Does the Health Board have a strategy for ventilation (for rooms where this is permitted within the SHTM/SHPN guidance)?	• Evidence of agreed environmental matrix. • Evidence that the Dynamic thermal modelling confirms what the design must include (e.g. structure, solar shading/protection, orientation, equipment optimisation, etc.) to ensure that room temperatures comply with SHTM guidance, in naturally ventilated rooms. • Floor plans with associated plant locations highlighted plus simple schematic of strategy. This must also identify the air intake and exhaust strategy / locations.
3.5	Is there evidence of stakeholder input to ventilation strategies?	• Addition to or supplement to the Environmental Matrix which confirms the following, on a room by room basis: • a) the type of ventilation (to SHTM 03-01) b) patient group and / or function related to the space. • c) name of the Consultant, Clinical Lead or Department Lead who has agreed to the room requirements. • d) name of the Infection Prevention and Control Doctor or equivalent who has agreed to the room requirements. • e) name of the Infection Prevention and Control Nurse who has agreed to the room requirements. • f) name of the Estates / FM team representative who has agreed to the room requirements. • g) name of the NHS Project Manager who has agreed to the room requirements.

No.	Areas to probe	Evidence expected
		• h) name of the Decontamination Manager who has agreed to the room requirements (where this is part of the project).
3.6	Is there evidence of the Health Board developing Ventilation Commissioning Proposals?	• Evaluation of the suitability of the proposed plans in the context of the FBC, are these sufficient do the meet the requirements of the project, guidance and the design of the system? • What plans have been made for independent validation of the ventilation systems? • What plans have been made for independent verification of the ventilation system? • What plant and ductwork cleaning has been specified? • What safe adequate access has been allowed for access to dampers?
3.7	Has the Health Board started developing its ventilation governance arrangements?	• Has the Health Board commenced its planning and recorded how it will ensure appropriate numbers of trained staff (AP and CP) staff and appointment of AE(V) for the project and is it clear how this project will interface with the Health Boards existing arrangements for management of the ventilation installations?
3.8	Evaluation of the Health Boards planned preventative maintenance (PPM) proposals.	• Has the Health Board commenced its planning and recorded the PPM requirements and approach to ensure appropriate levels of maintenance, comprehensive statutory compliance and robust management processes?

No.	Areas to probe	Evidence expected
4.1	Has the Health Board completed competency checks on the electrical consultant designers?	• Recorded evidence that the design team are experienced and have a comprehensive knowledge of the relevant design standards. • Where anyone does not have a record of extensive health care experience what recorded plans are to be put in place by the Consultant Designers? • Recorded evidence that input from the Health Boards Authorising Engineer for Electrical (AE(E)) has been requested. • Evidence that all contractors and sub-contractor competency checks have been completed and signed off.
4.2	How does the Health Board ensure that electrical services are being designed in a fashion which will provide ease of access for future maintenance and which will retain space for minor additions and modifications to services in the future?	• Evidence that the designers have presented their co-ordination drawings (BIM model) to the Board. • Evidence that the designers have presented each of the main service runs plus plant rooms to the Health Board's FM team. • Evidence that the Board has agreed a strategy (percentage) for spare capacity and a documented allowance has been incorporated into the design. • Are sub stations, switch rooms, distribution board cupboards, horizontal distribution runs and risers appropriately sized for the equipment being installed and facilitate safe, adequate maintenance.
4.3	How does the Health Board assure itself that all variations / derogations which may be required to electrical systems are investigated and agreed by all parties before they are instigated?	• Evidence that the each variation / derogation has a detailed technical analysis and has been referred to the Board and agreed with their electrical safety group, clinical, Estates, infection prevention and control and FM teams.
4.4	Has the Health Board assured itself of	• Confirmation from the Regional Electricity Company as to how the supply will be

No.	Areas to probe	Evidence expected
	availability of adequate supply from the local utility infrastructure?	provided from their network and if single or dual supplies are being made available. • What is the Health Board's resilience strategy for the electrical infrastructure (including dual supplies, renewables, generators, UPS, etc.)?
4.5	Evidence of provisions for emergency supplies during loss of the utility incoming supply.	• Floor plans with standby generator locations highlighted plus simple schematic.
4.6	Is there a strategy for locating substations?	• Floor plans with substation locations highlighted plus simple schematic of strategy.
4.7	Is there a strategy for locating switchrooms?	• Floor plans with switchroom locations highlighted plus simple schematic.
4.8	Is there a strategy for locating Medical IT distribution equipment?	• Floor plans with Medical IT board locations highlighted plus simple schematic. • Compliance with BS7671 section 710 • Compliance with SHTM 06-01
4.9	Is there a strategy for distribution?	• Floor plans with containment distribution routing (horizontal and vertical).
4.10	Is there evidence of the Health Board developing electrical commissioning proposals?	• Evaluation of the suitability of the proposed plans in the context of the FBC, are these sufficient do the meet the requirements of the project, guidance and the design of the system? • Has sufficient time been allocated for a full commissioning program?
4.11	Has the Health Board starting on its early thinking for the electrical governance arrangements for the operational phase?	• Has the Health Board commenced its planning and recorded how it will ensure appropriate trained staff and appointment of AE for the project and is it clear how this project will interface with the Health Board existing arrangements for management of the electrical installations, inclusive of third party providers?

No.	Areas to probe	Evidence expected
4.12	Evaluation of the Health Boards planned preventative maintenance (PPM) proposals.	• Has the Health Board commenced its planning and recorded the PPM requirements and approach to ensure appropriate levels of maintenance, comprehensive statutory compliance and robust management processes, inclusive of third party providers?

Medical Gases

No.	Areas to probe	Evidence expected
5.1	Has the Health Board completed competency checks on the medical gases consultant designers?	• Recorded evidence that the design team are experienced and have a comprehensive knowledge of the relevant design standards. • Where anyone does not have a record of extensive health care experience what recorded plans are to be put in place by the consultant designers? • Recorded evidence that input from the Health Boards Authorising Engineer for Medical Gases (AE(MG)) has been requested. • Evidence that all contractors and sub-contractor competency checks have been completed and signed off.
5.2	How does the Health Board assure itself that all variations / derogations' which may be required to medical gas systems are being investigated and agreed by all parties before they are instigated?	• Evidence that the each variation / derogation has a detailed technical analysis and has been referred to the Board and agreed with their medical gases management group, clinical, Estates, infection control and FM teams.
5.3	How does the Health Board ensure that medical gas services are designed in a fashion which will provide ease of access for future maintenance and which will retain space for minor additions and modifications to services in the future?	• Evidence that the designers have presented their co-ordination drawings (BIM model) to the Board. • Evidence that the designer has presented each of the main service runs to the Board's FM team.
5.4	Is there evidence of the Health Board developing medical gases commissioning proposals?	• Evaluation of the suitability of the proposed plans in the context of the FBC are these sufficient do the meet the requirements of the project, guidance and the design of the system?

No.	Areas to probe	Evidence expected
5.5	Has the Health Board started developing its medical gases governance arrangements for the operational phase?	• Is the Health Board considering how it will ensure appropriate numbers of trained staff (AP and CP) and AE(V) for the project? And is it clear how this project will interface with the Board existing arrangements for management of the medical gases installations?
5.6	Is there recorded evidence of a strategy for bulk gas and bottle gas storage?	• Floor plans with vacuum insulated evaporator (VIE) locations highlighted plus simple schematic of strategy. • Confirmation that the medical gas strategy is adequate. • Floor plans with pipework distribution routing and manifold locations.
5.7	Evaluation of the Health Boards planned preventative maintenance (PPM) proposals	• Has the Health Board commenced its planning and recorded the PPM requirements and approach to ensure appropriate levels of maintenance, comprehensive statutory compliance and robust management processes?

No.	Areas to probe	Evidence expected
6.1	Has the Health Board completed competency checks on the Fire Engineering consultant designers?	• Recorded evidence that the design team are experienced and have a comprehensive knowledge of the relevant design standards applicable to healthcare premises. • Recorded evidence that input from the Health Boards Fire Advisors has been requested. • Evidence that all contractors and sub-contractor competency checks have been completed and signed off.
6.2	Has a written fire strategy been completed and does it provide evidence, where there is a variance from statutory and mandatory guidance, that an equivalent level of safety has been achieved by alternative means?	• Is there documented evidence that fire suppression systems have been considered for life safety and property protection? • Is progressive horizontal evacuation available for all patient areas that continuously moves away from the fire area? • Does the design considerations of the fire and detection system, for in-patient facilities, provide L1 coverage including voids? • Does the design provide for a compliant emergency lighting system? • Are free swing arm self-closers fitted to all leafs of doors serving sleeping accommodation? • Have escape lifts been considered for the evacuation of patients and others with mobility issues? • Are multi sensor fire detectors installed to reduce the occurrence of unwanted fire alarm signals? • Are there adequate storage facilities to ensure escape routes are not used for this purpose? • Are measures in place to provide safe charging of electrical and personal electronic equipment? • In addition to the prescribed list in the Building Standards Technical Handbook have fire hazard rooms been designated based on fire load? • Where there is a mechanical ventilation system - have all compartments, sub-compartments and corridors serving sleeping

No.	Areas to probe	Evidence expected
		accommodation been designed to be fitted with fire and smoke dampers?
6.3	How does the Health Board assure itself that all variations / derogations which may be required to fire systems are investigated and agreed by all parties before they are instigated?	• Evidence that the each variation / derogation and any fire engineering proposals are being referred to the Board and agreed with their fire safety advisors, NDAP group, clinical, engineering, Infection Prevention and Control, FM teams and regulatory authorities.
6.4	How does the Health Board assure itself that all fire dampers and fire/smoke dampers are designed to allow for inspection, resetting and maintenance?	• Safe and adequate access has been allocated on both sides of all fire dampers for maintenance.
6.5	How does the Health Board assure itself that any smoke control and/or clearance systems are fit for purpose?	• Evidence that the smoke system is being designed by an accredited Fire Engineer. • Evidence that Building Control are being consulted. • Confirmation that the Health Boards fire advisors and NDAP team are satisfied with the design proposal.
6.6	Has the Health Board started the development of the fire system outline commissioning proposals?	• Is there an established fire management group that will ensure the fire strategy is adhered to?
6.7	Has the Health Board started its early thinking for the Fire Safety arrangements for the operational phase?	• Has the Health Board commenced its planning and recorded how it will ensure appropriate trained staff and appointment of Fire Officers for the project in the operational phase and is it clear how this project will interface with the

No.	Areas to probe	Evidence expected
		Health Boards existing arrangements for management of the Fire Safety?

No.	Areas to probe	Evidence expected
7.1	How does the Health Board demonstrate that there is an effective infection prevention and control management structure in place? How does the Board demonstrate leadership and commitment to infection prevention and control to ensure a culture of continuous quality improvement throughout the organisation and that there is an effective IPC structure in place; inputting into the design process?	• The Health Board provides evidence that there is an IPC Management Structure with the necessary expertise and leadership skills to support the design work ○ The Health Board provides evidence that there is an IPC Management Team with the necessary expertise and leadership skills to support the project. ○ Executive board reports or minutes. Risk registers or equivalent, Minutes from operational and governance groups, (and action points). ○ Structure of infection prevention and control team (IPCT) and qualifications held, previous experience supporting new build projects. ○ Evidence IPC and clinical teams have been involved with any derogation through the design process and are satisfied this will not impact on patient safety. This can be meeting minutes, risk assessments, and risk registers. There is IPC evidence of escalation through the agreed NHS board governance process. ○ Evidence the Executive Board Member assigned to lead on IPCT has been kept informed of IPC risks identified and associated with the project this can be demonstrated by the board. ○ Evidence that fixtures fitting and equipment have not been proposed for the project that would represent an identified IPC risk. ○ Evidence that all contractors and sub-contractor competency checks have been completed and signed off.
7.2	How does the Health Board demonstrate implementation of evidence based infection prevention and control	• The Health Board provides evidence ○ The board can demonstrate the current version of the National Infection Prevention and Control Manual has been adopted by the organisation and all staff are aware of how and where to access this

No.	Areas to probe	Evidence expected
	measures during the design process?	and it is being referred to during the design process. ○ The board can demonstrate IPC advisors have been included within the design phase and development of HAISCRIBE.
7.3	How does the Health Board assure itself that the designers have a proper understanding of the infection prevention and control procedures required?	• The Health Board evidences that: ○ All relevant staff within the designers' organisation are provided with clear guidance on roles and responsibilities in relation to infection prevention and control. ○ The contractors' organisation will provide evidence of education in relation to infection prevention in the built environment for all staff involved in the project.
7.4	How does the Health Board assure itself that equipment being proposed meets the required IPC standards?	• The IPC Team are involved and IPC advice followed in all procurement decisions for new equipment prior to purchase. IPCT are satisfied that all equipment purchased can be decontaminated safely in line with National Guidance and manufacturers' instructions.
7.5	Evaluation of the Health Boards planned preventative maintenance (PPM) proposals for equipment issues and the Built Environment in relation to IPC issues.	• Has the Health Board considered how they will undertake assessment of and report cleanliness of the proposed facility and equipment within the healthcare environment, this is inclusive of planned programmes of maintenance? • Does the Health Board plan to seek feedback from patients, staff and visitors for their views? • Is it clear how the work for this project will interface with the Health Board existing arrangements for management of the IPC in the Built Environment in the wider estate?

4. References

KSAR Master Glossary

Available to download from NHS National Services Scotland website.

5. Bibliography

Scottish Property Advisory Group – Building Design and Construction: Report on Construction Quality Matters
John Donnelly, Chair BDAC
Dated: December 2020

NHS Scotland Assure
Quality in the healthcare environment

NHS National Services Scotland

Key Stage Assurance Review Workbook

Construction

June 2021

Version 1.0

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Contents

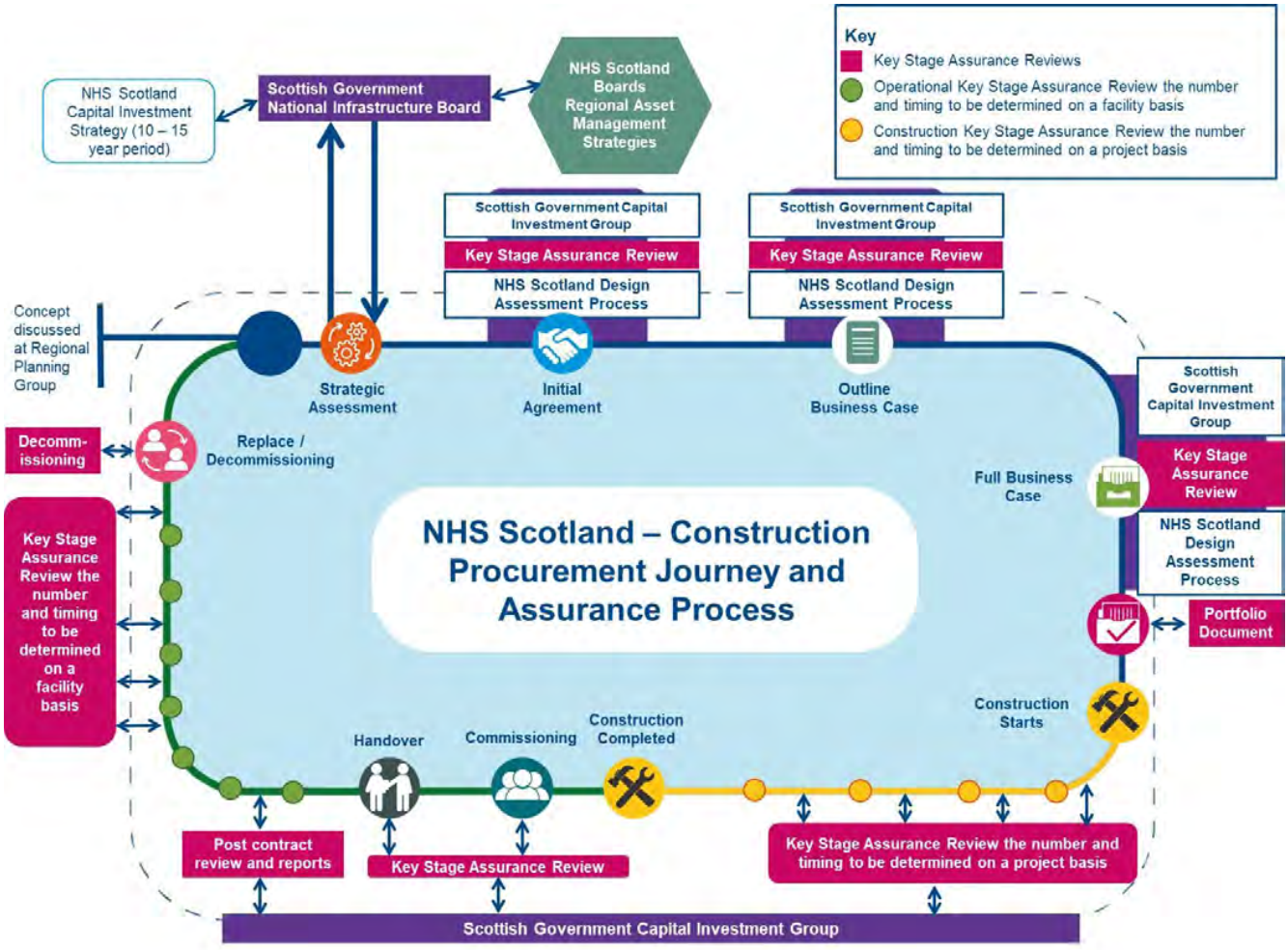
1. About this workbook

This workbook supports the Construction Key Stage Assurance Review (KSAR), delivered by the NHS Scotland Assure Assurance service.

Further information about the NHS Scotland Assure Assurance service and KSAR process is provided in section 2.

Figure 1. shows how the Construction stage in the procurement and construction journey commences following the Full Business Case. The timing and frequency of KSARs during this stage will vary dependent upon the facility. Specific workbooks have been developed for the other stages within this journey.

Figure 1: Construction Procurement Journey



KSARs are of a process ensuring facilities and the teams using them are able to deliver the standards required to provide the best and safest outcomes for patients, staff and visitors in the built environment.

KSARs deliver an independent peer review. NSS staff outside the project use their experience and expertise to examine the progress and likelihood of successful delivery, with a particular emphasis on the safety of the patients, staff and visitors using the facility.

It is vital to receive feedback on the following elements of health facilities - Infection Prevention and Control (IPC), water, ventilation, electrical, plumbing, medical gases installations and fire. This ensures they are designed, installed and functioning from

initial commissioning of a new facility and throughout its lifetime. Health Boards are required to have appropriate governance in place at all stages of the construction procurement journey.

The KSAR workbook provides a transparent, structured framework for all clinical specialisms, facilities and operational management professionals to assess and manage a health care build or refurbishment. Allowing facilities to align with current standards as the assurance reviews are taking place, as well as aligning changes for patient cohort.

Using this workbook

The review investigates at various points during the Build / Construction Stage of the construction of the facility. The timing and number of Build / Construction Reviews will be determined during the design process and by agreement of the NHS Assessment Team and the Client Board.

The workbook is predominantly intended to be used by NHS Scotland Assure KSAR review teams, Health Boards are encouraged to use its content to support their own projects.

This workbook is predominantly intended to be used by NHS Scotland Assure KSAR review teams, Health Boards are encouraged to use its content to support their own projects. It provides guidance on the review structure and areas of investigation to be addressed by the review team and should be regarded as indicative and not prescriptive.

The review team will consider whether any emerging findings require additional topics to be addressed. If so, evidence relating to these areas, regarding the safety of the patients, staff and visitors should be provided.

2. Key Stage Assurance Review

Introduction to NHS Scotland Assure – Assurance Service

Good management effective control of projects is an essential element to the successful delivery and maintenance of healthcare facilities across NHS Scotland estates.

The initial delivery of the NHS Scotland Assure - Assurance Service will focus upon new builds and major refurbishments in the acute estate, submitted to the Scottish Government Capital Investment Group (CIG). In addition, a number of projects identified as being complex, primarily due to the needs of patients utilising the facilities, will be reviewed by this service. Whilst not an exhaustive list, these projects will cover oncology, maternity, theatre and critical care units, no matter of their financial value.

The NHS Scotland Assure - Assurance Service will deliver KSARs, designed to provide independent assurance to Scottish Government Health and Social Care Directorates (SGHSCD's).

It will assess if Health Boards Project Management teams (inclusive of clinicians, appointed construction consultants, and contractors) are briefed and following best practice procedures in the provision of facilities. We will review if projects are compliant in all aspects of safety, if specific engineering systems are designed, installed and commissioned, and for ongoing safety maintenance including IPC.

The KSAR process is applicable regardless of procurement route chosen

The KSAR Process

The KSAR process examines projects at key points in their lifecycle. It does not remove any legal or contractual obligations from the NHS Health Board, their designers or contractors. It provides assurance to progress successfully to the next review point and the process will be mandated for projects requiring CIG approval. KSARs focus on the assessment of the delivery approach, and will work with the Health Board's project team to ensure there is comprehensive understanding of the patient cohorts utilising the facility. KSARs also ensure relevant guidance is fully implemented and any technical derogations have been fully reasoned, transparently

discussed, the implications understood, recorded and signed off by the Health Board and their advisors.

With a focus on construction elements where previous reviews have demonstrated potential patient safety concerns, KSARs will concentrate on water; ventilation, electrical, plumbing, medical gases installations, fire, and associated IPC guidance. If further issues are raised with the review team, they will fully incorporate those issues into the reporting process.

Value of the KSAR Process

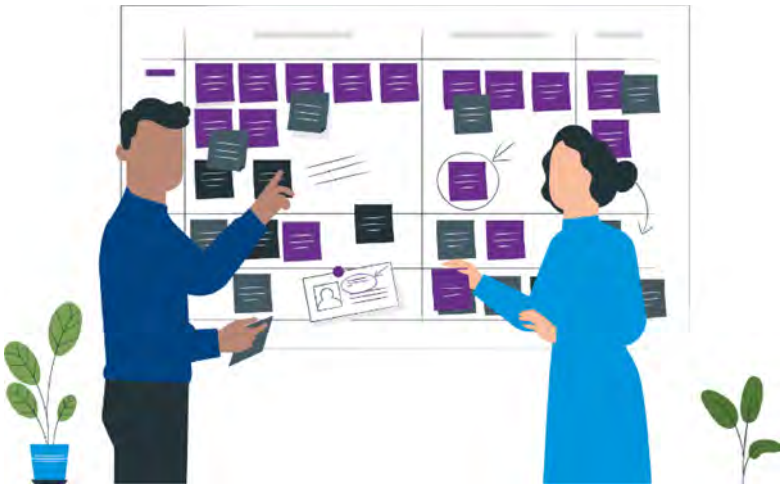
Key Stage Assurance Reviews (KSARs) deliver an independent peer review. NSS staff outside the Health Board's project use their experience and expertise to examine the progress and likelihood of successful delivery, with a particular emphasis on the safety of the patients, staff and visitors using the facility. KSARs provide an external perspective and provide a challenge to the robustness of the Health Board's brief, plans and processes.

This includes work delivered by construction consultants, employed either directly or through construction contractors, and the work being delivered by the primary contractor, their sub-contractors and specialist suppliers.

The KSAR provides an independent report and action plan, which is shared with the Health Board to ensure:

- Appropriate skills and experience are deployed on the project by the Health Board, consultants, primary contractor and all sub-contractors.
- The clinicians and wider stakeholders covered by the project fully understand the project status, aims and the issues involved.
- Appropriate management structures put in place to ensure appropriate infection prevention and control measures are designed into the project to reduce the risk of transmission of infectious agent.
- There is assurance the project can progress to the next stage of development or implementation with particular emphasis on the safety of the patients, staff and visitors utilising the facility.
- Provision of advice and guidance to programme and project teams by fellow Practitioners.

The KSAR report and the Health Board's response and action plan is submitted to CIG along with a recommendation from the NHS Scotland Assure - Assurance Service regarding the projects' progression to the next stage of the construction procurement journey.



KSAR as part of the overall assurance framework

Each NHS Health Board will be fully responsible for the delivery of all projects, and its own internal process and resources for carrying out internal reviews and audits of its activities. The KSAR is seen as a complementary independent review, and not as a replacement for the responsibilities of the Health Board.

NHS Health Boards should have in place an effective framework to provide a suitable level of assurance for their programmes and projects. Health Boards are encouraged and expected to ensure adequate and timely coordination and sharing of information, including plans, between the various internal reviews and functions.

The KSAR process is not a substitute for a rigorous governance framework in the Board to manage key processes including business planning, investment appraisal, business case management, risk management and service and contract management.

The KSAR Process relationship with NHS Scotland Design Assessment Process (NDAP)

The Scottish Government's ambition for NHS Scotland's estate and the need for well-designed healthcare environments is articulated in the Policy on Design Quality for NHS Scotland. Good design in the built environment encompasses a wide range of inter-related factors such as, sustainability, engineering, architecture, fire safety, energy, environment, decontamination, space utilisation, landscaping, security, technology, lighting, access for visitors and mobility impaired persons.

The NDAP process is overseen by Health Facilities Scotland and Architecture and Design Scotland and holistically considers all of the above. It sets the principles for the resolution of potential conflicts of statutory or mandatory compliance to ensure the specific facility provides; the best balance of the technical requirements, meets clinical needs and fulfils the conceptual aims of the policy on Design Quality. The NDAP process begins at the initial agreement stage of a project and provides advice through to the Full Business Case. There is no change to either SCIM or NDAP processes.

The Scottish Government is progressing policy to improve the safety of the healthcare environment in relation to the built environment risk. The Assurance Service delivered through NHS Scotland Assure is a response to this policy and the KSARs are integral to the compliance work. The aspiration is not to duplicate any of the work included in the NDAP process, but to provide assurance regarding the critical components highlighted throughout this workbook.

Integral to the KSARs will be a review of the balance between sustainability issues and patient safety.

The NDAP, working with Health Boards, will set the principles of the design solution, whereas the KSAR will provide a detailed technical review of the specifics of the design solution. Where possible the two reviews will be aligned to avoid duplication of work. For example, in instances where the NDAP has reviewed detail at a technical level, this will be used by the KSAR team rather than being separately requested and reviewed.

Sustainability

The review will provide assurance that the proposals for the project provide an effective balance in terms of patient, staff and visitors safety, whilst meeting required sustainability outcomes and complying with the guidance standards.

Construction KSAR

KSAR reviews are designed to provide independent assessment to Scottish Government Health and Social Care Directorates (SGHSCD's) so that:

- The construction phase is fully defined, and effectively utilises national guidance and construction techniques required to deliver a building which comply with relevant national guidelines and meet the needs of patients who will be using the facility.
- The construction and commissioning teams are skilled in the necessary construction methods and understand the required outcomes.
- The facility complies with:
    - NHS Scotland current guidance; e.g. NHS Scotland policy letters
    - Scottish Health Planning Notes (SHPN)
    - Scottish Health Facilities Notes (SHFN)
    - Scottish Health Technical Memoranda (SHTM)
    - Scottish Fire Practice Notes (SFPN)
    - Health Building Notes (HBN)
    - Health Technical Memoranda (HTM)
    - Health Facilities Notes (HFN)
    - UK construction industry bodies best practice or design guidance publications e.g. HSE, CIBSE, BRE, IHEEM, IET, BRE, BSRIA, sustainability, dementia and equality.
    - Incident Reporting and Investigation Centre (IRIC) Alerts
    - Relevant British Standards
    - Fire Safety

Also, including but not limited to:

- Other Statutory requirements: Planning permission; Building Regulations compliance; Equality Act compliance; Health and Safety Executive (HSE) compliance; Construction (Design and Management) Regulations compliance. Fire Scotland Act
- Other mandatory NHS Scotland requirements – use of:
- Activity Data Base (ADB);
- Achieving Excellence Design Evaluation Tool;
- BREEAM Healthcare or equivalent (BRE environmental & sustainability tools);
- Scottish Government BIM Policy (SPPN 1/2017; implementation of building information modelling within construction projects: March 2017).
- The implementation of NHS Scotland Soft Landings (SL) guidance.
- Confirm that there are plans in place for risk management, issue management and that these plans are being shared with suppliers and delivery partners.

- Evaluation of actions taken to implement recommendations made in earlier assessment of deliverability.

- There are plans in place for the requirements of the NHS Scotland National Infection Prevention and Control Manual for Scotland to be incorporated into the development in a manner to allow the staff allocated to the role to deliver the services to the patients.
- There are plans in place for risk management, issue management and these plans are being shared with suppliers and delivery partners.
- Action taken to implement recommendations made in earlier assessment of deliverability.

At this stage in the facility lifecycle the review will be site based. The review teams will consist of experienced operational estates professionals and experienced Infection Prevention Control clinicians. This team will work with the Health Board's project team, inclusive of their clinicians and their appointed consultants and contractor. Each review will result in a report being prepared for the Programme Director at the Health Board and a copy of the report will be provided to the Scottish Government Capital Investment Group.

The appendix is provided indicates the typical question set for Construction the review Team use as the basis of evidence finding for the KSAR. The review team amend this as necessary depending on the project and areas of particular interest. The Health Board, their designers and contractors should be aware this is the information expected and the design should effectively be completed at Construction at the time of the KSAR to ensure the accuracy of the report.

3. Assessment of Delivery Approach

General approach to the Governance of Quality on the Project

No.	Areas to probe	Evidence expected
1.1	Has suitable plans and documentation been put in place for the project to manage and monitor Quality Management and Assurance?	• Project Quality Plan. • Inspection and Test Plans. • Inspection and Test Schedule / Register.
1.2	Has suitable arrangements been implemented on the project for document control processes for Quality Assurance and Management?	• Process for ensuring latest drawings approved and used. • Processes for ensuring latest specification and details approved and used. • Approach to management of non-conformances. • Approach to change management control. • Document management recording and structure.
1.3	How has the Health Board approached Quality Assurance on the project to ensure processes and procedures are being adhered?	• Evidence of regular Quality Assurance audits / reports undertaken on the project.
1.4	How does the Health Board assure itself that Testing and Commissioning of services and systems have / are being developed and put in place to meet the project needs?	• Evidence of Testing and Commissioning monitoring / witness of tests. • Evidence of Testing and Commissioning review of results. • Evidence of Testing and Commissioning acceptance of results. • Testing and Commissioning programme. • Plans have / are being developed for collating information and documents. • Have additional checks (external parties) been carried out to review the Contractors T&C's proposed plans.
1.5	How does the Health Board assure itself that the management of defects have / are being developed and put in	• Systems and process for recording and management defects. • Process for the rectification and close out of defects prior to handover. • Plans have / are being developed for collating information and documents.

No.	Areas to probe	Evidence expected
	place to meet the project needs?	
1.6	How does the Health Board assure itself that the management of the Handover process have / are being developed and put in place to meet the project needs?	• Soft Landings process. • Plans have / are being developed for collating as installed information and documents.
1.7	How does the Health Board assure itself that the works are following the procedures as laid out in HAISCRIBE?	• Evidence that the Contractor in charge of the works has read, understood and signed the HAISCRIBE. • Evidence that Infection Control have carried out interim site inspections at points where setting out of the rooms are underway to pick up implications of any Contractor's onsite adjustments. • For works inside of or adjacent to healthcare spaces which are in use, evidence that a task specific HAISCRIBE has been produced and that compliance is monitored by the Board.
1.8	How does the Health Board continue to assure itself that the clinical needs of the facility are clearly understood by each section of the client organisation?	• Updated description of each department of the facility review process evidenced. • All specifications are being related back to the Portfolio Document (PD). • An updated and live Derogation document.
1.9	Are the Principal Designers regularly carrying out site inspections and providing reports to the Board and Principal Contractor?	• Regular (fortnightly) reports being provided to the clients' project management team, certifying installation is being provided in accordance with the CD. • Regular comment on each of the installing contractors' quality safety plan and work delivered. • If the Principal Designer is not employed to carry out site inspections, evidence that the Board has alternative, adequate means of design / construction quality control in place.

No.	Areas to probe	Evidence expected
1.10	The Health Boards approach on the procurement journey with evidence of the plans on how the Board will provide assurance, particularly emphasis on the critical system identified earlier.	• Evidence on how this requirement is being managed and how it fits with the project governance arrangements • Plans to identify any gaps in the procurement approach that may require to be addressed. • Evidence on how Infection Prevention and Control are involved with the procurement approach to future plans for project. • Evidence that the Health Boards selected procurement route has gone through the Board's Governance channels.
1.11	Evaluation of the Health Boards commissioning plan.	• Evidence that the Health Board has recorded plans that are comprehensive and adequate to address the needs of the project and that they are fully resourced. • Evidence that the Board has had all pre-commissioning checks audited and approved by an independent organisation.
1.12	Evaluation of the Health Boards duty holder matrix.	• Evidence that the Health Board have a fully recorded matrix of the required roles and responsibilities and have a clear governance structure that is fully resourced together with plans in place for the implementation. • Evidence that Health Boards have appropriate number of competent, qualified staff to carry out specific duties throughout the life cycle of the project e.g., IPC, Engineers, Estates staff etc. The number of competent, qualified staff will depend on the type and size of the Build Project.

Water and Plumbing / Drainage Systems

No.	Areas to probe	Evidence expected
2.1	How does the Health Board assure itself that all plumbers are trained to understand the needs (including special requirements) for the installation of water and plumbing/drainage systems in the healthcare environment?	• Evidence of a vetted list of site plumbers which confirms qualifications and healthcare experience. • Evidence that the site induction with respect to working on water and plumbing/drainage services has been developed, implemented and agreed with the Board. • Where anyone does not have previous healthcare experience, evidence should be provided of the relevant onsite training which was provided to them before they commence work on site. • Evidence that all contractors and sub-contractor competency checks have been completed and signed off.
2.2	How does the Health Board assure itself that the plumbing contracting company have the relevant experience to direct and manage their staff on the site for a healthcare environment?	• Evidence of similar, previous healthcare projects by the contractor. • Evidence of site management structure. • Evidence of HAI and SHPN 30 training.
2.3	How does the Health Board ensure that the water and plumbing / drainage systems are being installed to the correct standard and reflect the agreed design?	• Written and photographic, monthly evidence for the progress of work produced by a body which is independent of the contractor and which confirms compliance of the works to date.
2.4	How does the Health Board ensure that precautions are taken throughout the works to avoid open pipe ends for a period beyond the time needed to make a joint on that pipe end?	• Photographic and written evidence for the progress of work produced by a body which is independent of the contractor (on a monthly basis).
2.5	How does the Health Board ensure that water services are installed in a fashion which will provide ease of access for future maintenance?	• Evidence that the contractor has presented their co-ordination drawings (BIM model) to the Board. • Evidence that the contractor has presented their co-ordination drawings (BIM model) to

No.	Areas to probe	Evidence expected
		the design consultant and that they have agreed them for construction. • Evidence that the contractor has presented each of the main service runs plus plant rooms to the Board's FM team. • Evidence that the plant access strategy is being adhered too.
2.6	How does the Health Board ensure that water and plumbing / drainage services are installed in a fashion which will retain space for minor additions and modifications to services in the future?	• Evidence that the contractor has presented their co-ordination drawings (BIM model), with space for future flexibility identified, to the Board. • Evidence that the design consultant has considered and agreed with the Board, space for future flexibility in the service installations. • Evidence that the contractor has presented their co-ordination drawings (BIM model), with space for future flexibility identified, to the design consultant and that they have agreed them for construction. • Evidence that the contractor has presented each of the main service runs plus plant rooms to the Board's FM team, to highlight space for future flexibility. • Evidence that the Health Board has agreed a strategy (percentage) for spare capacity and a documented allowance to be incorporated into the design. • Are plant/tank rooms, IPS sections, horizontal distribution runs and risers appropriately sized for the equipment being installed and facilitate safe adequate maintenance?
2.7	How does the Health Board assure itself that all plumbers materials are stored on site in an environment which protects them from deterioration and from the entry of contaminants into the parts of the component which will be in contact with the water?	• Written, monthly evidence for the progress of work produced by a body which is independent of the contractor and which confirms inspection of the site storage of materials. • Photographic evidence of the site storage of materials produced by a body which is independent of the contractor (on a monthly basis).
2.8	How does the Health Board assure itself that all pre-commissioning	• Evidence that adequate pre-commissioning check sheets (SHTM 04-01

No.	Areas to probe	Evidence expected
	inspections are completed and recorded before commissioning can commence?	Part A) have been completed and signed off. • Evidence that the Health Board has had all pre-commissioning checks audited and approved by an independent organisation.
2.9	How does the Health Board assure itself that all variations which may be required to water and plumbing and drainage systems after tender are investigated and agreed by all parties before they are instigated?	Evidence that the each variation / derogation has a detailed technical analysis and has been referred to the Board and agreed with their water management group, clinical, Estates, infection control and FM teams.

Ventilation

No.	Areas to probe	Evidence expected
3.1	How does the Health Board assure itself that all duct and plant installers are trained to understand the needs (including special requirements) for the installation of ventilation systems in the healthcare environment?	• Evidence of a vetted list of duct and plant installers which confirms qualifications and healthcare experience. • Evidence that the site induction with respect to working on ducts and plant services has been developed, implemented and agreed with the Board. • Evidence that all contractors and sub-contractor competency checks have been completed and signed off.
3.2	How does the Health Board assure itself that the ventilation contracting company and their plant installers have the relevant experience to direct and manage their staff on the site for a healthcare environment?	• Evidence of similar, previous healthcare projects by the contractor. • Evidence of site management structure.
3.3	How does the Health Board ensure that the ventilation systems are being installed to the correct standard and reflect the agreed design?	• Written, monthly evidence for the progress of work (including photographs) produced by a body which is independent of the contractor and which confirms compliance of the works to date.
3.4	How does the Health Board ensure that precautions are taken throughout the works to avoid open duct or plant ends for a period beyond the time needed to make a joint on that duct / plant end?	• Photographic and written evidence for the progress of work produced by a body which is independent of the Contractor (on a monthly basis).
3.5	How does the Health Board ensure that ventilation services are installed in a fashion which will provide ease of access for future maintenance?	• Evidence that the Contractor has presented their co-ordination drawings (BIM model) to the Board. • Evidence that the Contractor has presented their co-ordination drawings (BIM model) to the Design Consultant and that they have agreed them for construction. • Evidence that the Contractor has presented each of the main service runs plus plant rooms to the Board's FM team.

No.	Areas to probe	Evidence expected
		• Safe and adequate access has been provided.
3.6	How does the Health Board ensure that ventilation services are installed in a fashion which will retain space for minor additions and modifications to services in the future?	• Evidence that the contractor has presented their co-ordination drawings (BIM model), with space for future flexibility identified, to the Board. • Evidence that the design consultant has considered and agreed with the Board, space for future flexibility in the service installations. • Evidence that the contractor has presented their co-ordination drawings (BIM model), with space for future flexibility identified, to the design consultant and that they have agreed them for construction. • Evidence that the contractor has presented each of the main service runs plus plant rooms to the Board's Estates team and / or, to highlight space for future flexibility. • Evidence that the ventilation solution has been agreed with clinical and IPC colleagues. • Evidence that the Board has agreed a strategy (percentage) for spare capacity and a documented allowance to be incorporated into the design. • Are plant rooms, horizontal distribution runs and risers appropriately sized for the equipment being installed and facilitate safe adequate maintenance?
3.7	How does the Health Board assure itself that all ventilation materials are stored on site in an environment which protects them from deterioration and from the entry of contaminants into the parts of the component which will be in contact with the air flow?	• Written and photographic, monthly evidence for the progress of work produced by a body which is independent of the contractor and which confirms inspection of the site storage of materials. • Photographic evidence of the site storage of materials produced by a body which is independent of the contractor (on a monthly basis).
3.8	How does the Health Board assure itself that all pre-commissioning inspections are completed and	• Evidence that adequate pre-commissioning check sheets (CIBSE, BSRIA) have been completed and signed off.

No.	Areas to probe	Evidence expected
	recorded before commissioning can commence?	• Evidence that the Board has had all pre-commissioning checks audited and approved by an independent organisation.
3.9	How does the Health Board assure itself that all variations which may be required to ventilation systems after tender are investigated and agreed by all parties before they are instigated?	• Evidence that the each variation / derogation has a detailed technical analysis and has been referred to the Board and agreed with their clinical, Estates, infection control and FM teams.

Electrical

No.	Areas to probe	Evidence expected
4.1	How does the Health Board assure itself that all electricians are trained to understand the needs (including special requirements) for the installation of electrical systems in the healthcare environment?	• Evidence of a vetted list of site electricians which confirms qualifications and healthcare experience. • Evidence that the site induction with respect to working on electrical services has been developed, implemented and agreed with the Board. • Evidence that all contractors and sub-contractor competency checks have been completed and signed off.
4.2	How does the Health Board assure itself that the electrical contracting company have the relevant experience to direct and manage their staff on the site for a healthcare environment?	• Evidence of similar, previous healthcare projects by the contractor. • Evidence of site management structure. • Electricians completed approved current BS 7671 training course. • Evidence that commissioning contractors have completed relevant test and commissioning courses. • Evidence of trained operatives (AP and CP) to SHTM 06-02.
4.3	How does the Health Board ensure that the electrical systems are being installed to the correct standard and reflect the agreed design?	• Written, monthly evidence for the progress of work produced by a body which is independent of the contractor and which confirms compliance of the works to date. • Photographic and written evidence for the progress of work produced by a body which is independent of the contractor (on a monthly basis).
4.4	How does the Health Board ensure that electrical services are installed in a fashion which will provide ease of access for future maintenance?	• Evidence that the contractor has presented their co-ordination drawings (BIM model) to the Health Board. • Evidence that the contractor has presented their co-ordination drawings (BIM model) to the design consultant and that they have agreed them for construction. • Evidence that the contractor has presented each of the main service runs plus plant rooms to the Health Board's FM team.
4.5	How does the Health Board ensure that electrical services are installed in a	• Evidence that the contractor has presented their co-ordination drawings

No.	Areas to probe	Evidence expected
	fashion which will retain space for minor additions and modifications to services in the future?	(BIM model), with space for future flexibility identified, to the Health Board. • Evidence that the design consultant has considered and agreed with the Health Board, space for future flexibility in the service installations. • Evidence that the contractor has presented their co-ordination drawings (BIM model), with space for future flexibility identified, to the design consultant and that they have agreed them for construction. • Evidence that the contractor has presented each of the main service runs plus plant rooms to the Health Board's FM team, to highlight space for future flexibility. • Evidence that the Health Board has agreed a strategy (percentage) for spare capacity and a documented allowance to be incorporated into the design. • Are sub stations, switch rooms, distribution board cupboards, horizontal distribution runs and risers appropriately sized for the equipment being installed and facilitate safe, adequate maintenance?
4.6	How does the Health Board assure itself that all electrical materials are stored on site in an environment which protects them from deterioration and from the entry of contaminants into the operational parts of the component?	• Written, monthly and photographic evidence for the progress of work produced by a body which is independent of the contractor and which confirms inspection of the site storage of materials. • Photographic evidence of the site storage of materials produced by a body which is independent of the contractor (on a monthly basis).
4.7	How does the Health Board assure itself that all pre-commissioning inspections are completed and recorded before commissioning can commence?	• Evidence that adequate pre-commissioning check sheets (e.g. SHTM 06-01 Part A, , BS7671, etc.) have been completed and signed off. • Evidence that the Health Board has had all pre-commissioning checks audited and approved by an independent organisation.
4.8	How does the Health Board assure itself that all	• Evidence that the each variation / derogation has a detailed technical

No.	Areas to probe	Evidence expected
	variations which may be required to electrical systems after tender are investigated and agreed by all parties before they are instigated?	analysis and has been referred to the Health Board and agreed with their clinical, Estates, infection control and FM teams.

No.	Areas to probe	Evidence expected
5.1	How does the Health Board assure itself that all medical gas installers are trained to understand the needs (including special requirements) for the installation of medical gas systems in the relevant healthcare environment?	• Evidence of a vetted list of site medical gas installers which confirms qualifications and healthcare experience. • Evidence that the site induction with respect to working on medical gas services has been developed, implemented and agreed with the Board. • Evidence that all contractors and sub-contractor competency checks have been completed and signed off.
5.2	How does the Health Board assure itself that the medical gas contracting company have the relevant experience to direct and manage their staff on the site for the relevant healthcare environment?	• Evidence of similar, previous healthcare projects by the contractor. • Evidence of site management structure. • AP and CP training to SHTM 02-01 for operatives.
5.3	How does the Health Board ensure that the medical gas systems are being installed to the correct standard and reflect the agreed design?	• Written and photographic, monthly evidence for the progress of work produced by a body which is independent of the contractor and which confirms compliance of the works to date.
5.4	How does the Health Board ensure that precautions are taken throughout the works to avoid open pipe ends for a period beyond the time needed to make a joint on that pipe end?	• Photographic and written evidence for the progress of work produced by a body which is independent of the contractor (on a monthly basis).
5.5	How does the Health Board ensure that medical gas services are installed in a fashion which will provide ease of access for future maintenance?	• Evidence that the contractor has presented their co-ordination drawings (BIM model) to the Board. • Evidence that the contractor has presented their co-ordination drawings (BIM model) to the design consultant and that they have agreed them for construction. • Evidence that the contractor has presented each of the main service runs plus plant rooms to the Health Board's FM team.

No.	Areas to probe	Evidence expected
5.6	How does the Health Board ensure that medical gas services are installed in a fashion which will retain space for minor additions and modifications to services in the future?	• Evidence that the contractor has presented their co-ordination drawings (BIM model), with space for future flexibility identified, to the Health Board. • Evidence that the design consultant has considered and agreed with the Board, space for future flexibility in the service installations. • Evidence that the contractor has presented their co-ordination drawings (BIM model), with space for future flexibility identified, to the design consultant and that they have agreed them for construction. • Evidence that the contractor has presented each of the main service runs plus plant rooms to the Health Board's FM team, to highlight space for future flexibility.
5.7	How does the Health Board assure itself that all medical gas materials are stored on site in an environment which protects them from deterioration and from the entry of contaminants into the parts of the component which will be in contact with the gas?	• Written, monthly evidence for the progress of work produced by a body which is independent of the contractor and which confirms inspection of the site storage of materials. • Photographic evidence of the site storage of materials produced by a body which is independent of the contractor (on a monthly basis).
5.8	How does the Health Board assure itself that all pre-commissioning inspections are completed and recorded before commissioning can commence?	• Evidence that adequate pre-commissioning check sheets (e.g. SHTM 02-01 Part A) have been completed and signed off. • Evidence that the Health Board has had all pre-commissioning checks audited and approved by an independent organisation.
5.9	How does the Health Board assure itself that all variations which may be required to medical gas systems after tender are investigated and agreed by all parties before they are instigated?	• Evidence that the each variation / derogation has a detailed technical analysis and has been referred to the Board and agreed with their medical gas management group, clinical, Estates, infection control and FM teams.

No.	Areas to probe	Evidence expected
6.1	How does the Health Board assure itself that all fire stopping specialists are trained to understand the needs (including special requirements) for the installation of fire stopping systems in the healthcare environment?	• Evidence of a vetted list of site fire stopping specialists which confirms qualifications and healthcare experience. • Evidence that the site induction with respect to working on fire stopping services has been developed, implemented and agreed with Board. • Evidence that all contractors and sub-contractor competency checks have been completed and signed off.
6.2	How does the Health Board assure itself that the fire stopping contracting company have the relevant experience to direct and manage their staff on the site for a healthcare environment?	• Evidence of similar, previous healthcare projects by the contractor. • Evidence of site management structure.
6.3	How does the Health Board ensure that the fire stopping systems are being installed to the correct standard and reflect the agreed design?	• Written, monthly evidence for the progress of work produced by a body which is independent of the contractor and which confirms compliance of the works to date.
6.4	How does the Health Board ensure that precautions are taken throughout the works to avoid openings in fire barriers to occupied spaces during the works?	• Written and photographic evidence for the progress of work produced by a body which is independent of the contractor (on a monthly basis).
6.5	How does the Health Board ensure that fire stopping systems are installed on ventilation, electrical, plumbing and drainage services where they penetrate fire barriers?	• Photographic and written evidence for the progress of work produced by a body which is independent of the contractor (on a monthly basis).
6.6	How does the Health Board ensure that fire stopping is installed in electrical containment (trunking / tray systems) systems where they penetrate fire barriers?	• Photographic and written evidence for the progress of work produced by a body which is independent of the contractor (on a monthly basis).

No.	Areas to probe	Evidence expected
6.7	How does the Health Board assure itself that all fire stopping materials are stored on site in an environment which protects them from deterioration?	• Written, monthly evidence for the progress of work produced by a body which is independent of the contractor and which confirms inspection of the site storage of materials. • Photographic evidence of the site storage of materials produced by a body which is independent of the contractor (on a monthly basis).
6.8	How does the Health Board assure itself that all fire detection and alarm systems are installed in the correct locations and are easily maintained?	• Written evidence for the progress of work produced by a body which is independent of the contractor (on a monthly basis). • Demonstration by the contractor that any detectors which are above 3m from floor level or in ceiling voids, to the Board's FM team, have suitable access for maintenance.
6.9	How does the Health Board assure itself that all variations which may be required to fire stopping systems after tender are investigated and agreed by all parties before they are instigated?	• Evidence that the each variation has been referred to the Health Board and agreed with their clinical, engineering, infection control and FM teams.
6.10	How does the Health Board assure itself that all fire dampers and fire/smoke dampers can be accessed for inspection, resetting and maintenance?	• Evidence that the contractor has presented their co-ordination drawings (BIM model) to the Health Board. • Evidence that the contractor has presented their co-ordination drawings (BIM model) to the design consultant and that they have • agreed them for construction. • Evidence that the contractor has presented each of the fire dampers and smoke / fire dampers to the Health Board's FM team.
6.11	How does the Health Board assure itself that any fire rated ductwork is correctly installed?	• Evidence that the system is certificated and that the installation follows the installation details which were used for the certification. • Written confirmation from the design consultant.

No.	Areas to probe	Evidence expected
6.12	How does the Health Board assure itself that any smoke control and / or clearance systems are fit for purpose?	• Evidence that the smoke system has been designed by an accredited Fire Engineer. • Evidence that Building Control have accepted the solution. • Confirmation from the Building Services Design Consultant that the operating sequence for the smoke system has been agreed and integrated into the control of other building systems.
6.13	How does the Health Board assure itself that all pre-commissioning inspections are completed and recorded before commissioning can commence?	• Evidence that the Health Board has had all pre-commissioning checks audited and approved by an independent organisation.

No.	Areas to probe	Evidence expected
7.1	How does the Health Board demonstrate that there is an effective infection prevention and control management structure in place? How does the Health Board demonstrate leadership and commitment to infection prevention and control to ensure a culture of continuous quality improvement throughout the organisation and that there is an effective IPC structure in place?	**The Health Board provides evidence that there is an IPC Management Structure with the necessary expertise and leadership skills to support the organisation:** • The Health Board provides evidence that there is an IPC Management Team with the necessary expertise and leadership skills to support the project. The board are compliant with content of HDL (2008) role of the ICM / CNO 22.12.16. • Executive board reports or minutes. Risk registers or equivalent, Minutes from operational and governance groups, (and action points). • Structure of infection prevention and control team (IPCT) and qualifications held, previous experience supporting new build projects. • Evidence IPC and clinical teams have been involved with any derogation through the build process and are satisfied this will not impact on patient safety, evidence could be through meeting minutes, risk assessments, risk registers relating to IPC with evidence of escalation through the agreed NHS board governance process. • Evidence the Executive Board Member assigned to lead on IPCT has been kept informed of IPC risks identified and associated with the project this can be demonstrated by the board. • Evidence IPCT advice has been followed, such as IPCT walk round audits during the construction process. • Evidence that fixtures fitting and equipment have not been incorporated into the project that would represent an identified IPC risk. • Evidence that all contractors and sub-contractor competency checks have been completed and signed off.
7.2	How does the Health Board demonstrate implementation of evidence based infection prevention and control	**The Health Board provides evidence:** • The board can demonstrate the current version of the National Infection Prevention and Control Manual has been adopted by the organisation and all staff are aware of how and where to access this

No.	Areas to probe	Evidence expected
	measures during the construction process?	and it is being referred to during the construction process. • IPC risks (actual or perceived) risks identified during the work programme or through the KSAR evidence review are provided. • Evidence of walk rounds during the construction process and these are being fed back to clinical staff and the executive team to provide assurance that the requirements of the CD are being adhered with.
7.3	How does the Health Board assure itself that the contractors have a proper understanding of the infection prevention and control procedures required by the CD and that the contractors work is being rigorously managed in this respect?	**The Health Board evidences that:** • All relevant staff within the contractors' organisation are provided with clear guidance on roles and responsibilities in relation to infection prevention and control. • The contractors' organisation provides an education programme that meets the need of staff which includes mandatory induction, training and updates on HAI guidance, policies and procedures.
7.4	How does the Health Board assure itself that equipment meets the required IPC standards?	• The IPC Team are involved and IPC advice followed in all procurement decisions for new equipment prior to purchase. IPCT are satisfied that all equipment purchased can be decontaminated safely in line with National Guidance and manufacturer's instructions.

4. References

KSAR Master Glossary

Available to download from NHS National Services Scotland website.

5. Bibliography

Scottish Property Advisory Group – Building Design and Construction: Report on Construction Quality Matters
John Donnelly, Chair BDAC
Dated: December 2020

NHS Scotland Assure
Quality in the healthcare environment

NHS National Services Scotland

Key Stage Assurance Review Workbook

Handover

December 2022

Version d0.15

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Contents

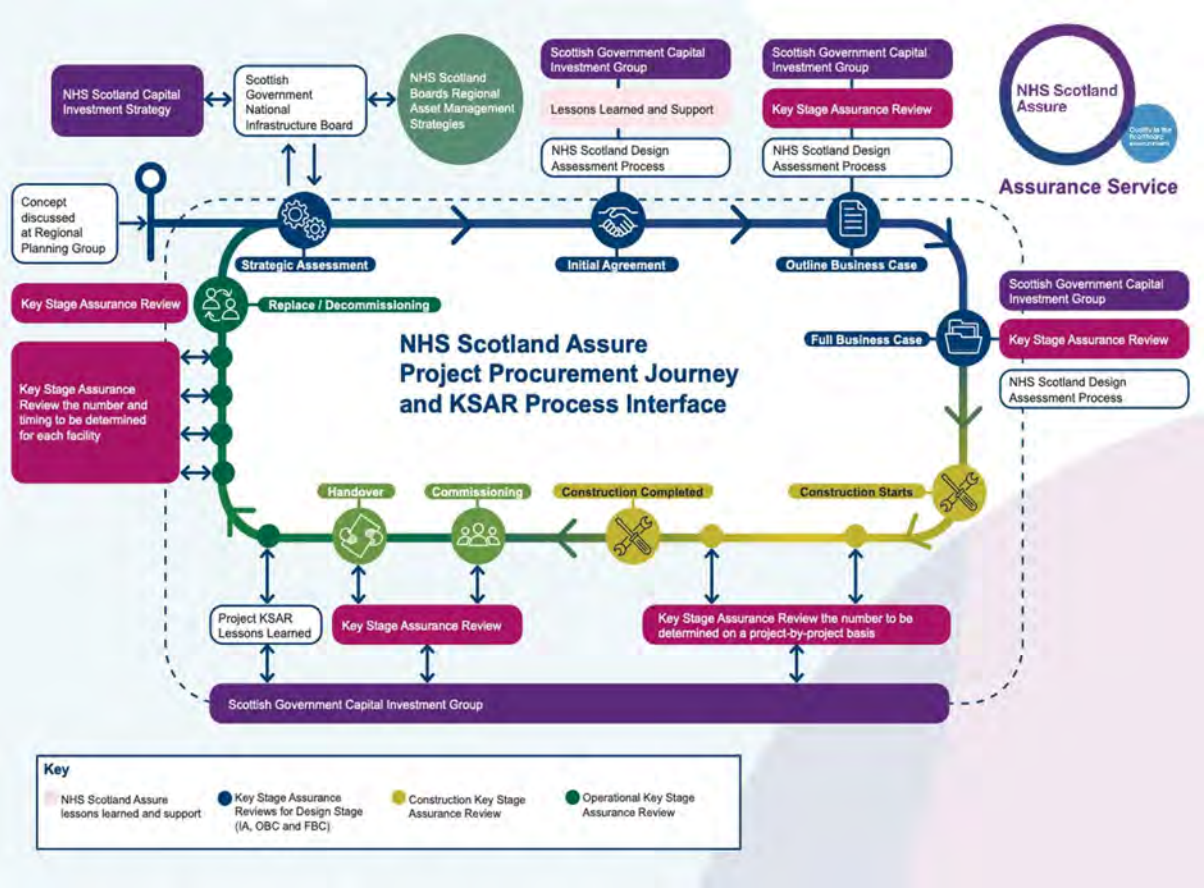
1. About this workbook

This workbook supports the Handover Key Stage Assurance Review (KSAR), delivered by the NHS Scotland Assure Assurance service.

Further information about the NHS Scotland Assure Assurance service and KSAR process is provided in Section 2.

Figure 1. shows how the Handover stage in the procurement and construction journey. The timing and frequency of KSARs during this stage will vary dependent upon the facility. Specific workbooks have been developed for the other stages within this journey.

Figure 1: Construction Procurement Journey



The KSAR process and workbooks provide a transparent, structured framework for all clinical specialisms, facilities and operational management professionals to assess and manage a healthcare build or refurbishment. In turn this assists health boards to provide the best and safest outcomes for patients, staff and visitors in the built environment.

KSARs deliver an independent peer review. NHS Scotland Assure staff, outside the project, use their experience and expertise to examine the progress and likelihood of successful delivery, with a particular emphasis on the safety of the patients, staff and visitors using the facility. KSARs also focus on how projects are able to demonstrate compliance with relevant guidance and standards.

It is vital to receive feedback on the following elements of health facilities - Infection Prevention and Control (IPC), water, ventilation, electrical, plumbing, medical gas installations and fire. This ensures they are designed, installed and functioning from the initial commissioning of a new facility and throughout its lifetime. Health boards are required to have appropriate governance in place at all stages of the construction procurement journey.

Using this workbook

The review at Handover stage investigates the approach taken by the health board and other stakeholders during this critical stage of the project to ensure that there continues to be an appropriate level of knowledge and awareness of the importance of the Handover stage on patient, staff and visitor safety.

The purpose of the KSAR at Handover stage is to confirm there is a continued good and comprehensive understanding of the category of patient who will use the proposed facility, and that the project team consider how appropriate quality and safety standards will influence the handover of the various systems. It looks to provide assurance that the project can proceed to the Operational phase.

Additionally, the KSAR at Handover will carry out an appropriate level of checking of the handover documentation. This level of checking will be set by the review team following their initial discussions on site.

The KSAR workbook is a tool for both NHS Scotland Assure to undertake project reviews and for health boards to support the development of their own projects. It provides guidance on the review structure and areas of investigation to be addressed by the review team and should be regarded as indicative and not prescriptive. The review team will consider whether any emerging findings require additional topics to be addressed. If so, evidence relating to these areas, regarding the safety of the patients, staff and visitors, should be provided.

2. Key Stage Assurance Review

Introduction to NHS Scotland Assure – Assurance Service

Good management and effective control of projects are essential elements to the successful delivery and maintenance of healthcare facilities across NHS Scotland estates.

The NHS Scotland Assure Assurance Service will deliver KSARs, designed to provide independent assurance to Scottish Government Health and Social Care Directorates (SGHSCDs).

It will assess if health board's project management teams (inclusive of clinicians, appointed construction consultants, and contractors) are briefed and following best practice procedures in the provision of facilities. We will review if projects are compliant in all aspects of safety, if specific engineering systems are designed, installed and commissioned, and for ongoing safe maintenance including IPC consideration.

The KSAR process is applicable regardless of procurement route chosen.

The KSAR Process

The KSAR process examines projects at key points in their lifecycle. It does not remove any legal or contractual obligations from the NHS health board, their designers or contractors. It provides assurance to progress successfully to the next review point. KSARs focus on the assessment of the delivery approach and the review team will work with the health board's project team to ensure there is comprehensive understanding of the patient cohorts utilising the facility. KSARs also ensure relevant guidance is fully implemented and any technical derogations have been fully reasoned, transparently discussed, the implications understood, recorded and signed-off by the health board and their advisors.

KSARs will concentrate on project governance related to the core review topics of water, ventilation, electrical, plumbing, medical gases installations, fire, and associated IPC guidance. If further issues are raised with the review team, they will fully incorporate those issues into the reporting process.

Value of the KSAR Process

Key Stage Assurance Reviews (KSARs) deliver an independent peer review. NSS staff outside the health board's project use their experience and expertise to examine the progress and likelihood of successful delivery, with a particular emphasis on the safety of the patients, staff and visitors using the facility. KSARs provide an external perspective and provide a challenge to the robustness of the health board's brief, plans and processes.

This includes work delivered by construction consultants, employed either directly or through construction contractors, and the work being delivered by the primary contractor, their sub-contractors and specialist suppliers.

The KSAR provides an independent report and recommended action plan, which is shared with the health board to ensure:

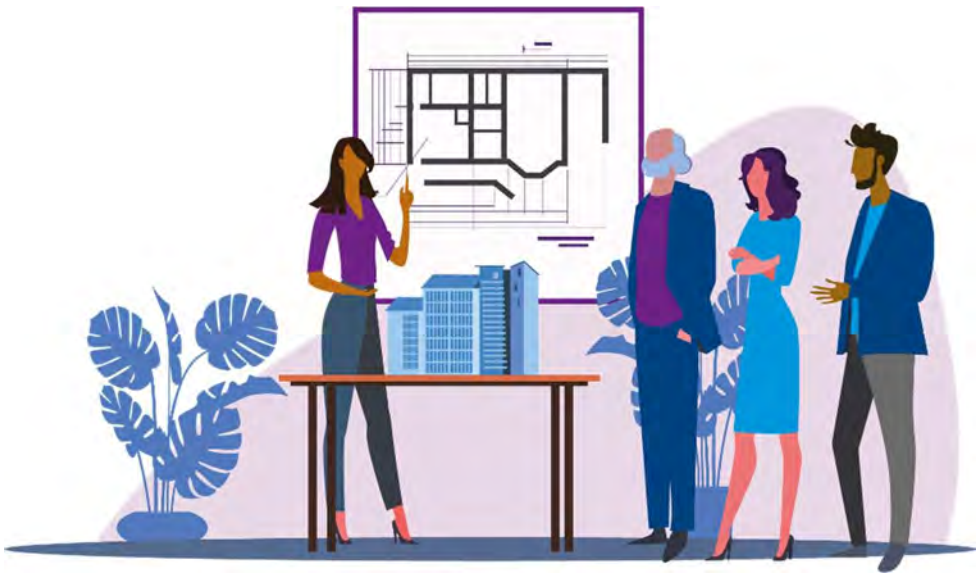
- Appropriate skills and experience are deployed on the project by the health board, consultants, primary contractor and all sub-contractors.
- The clinicians and wider stakeholders covered by the project fully understand the project status, aims and the issues involved.
- Appropriate management structures, put in place to ensure appropriate infection prevention and control measures, are designed into the project to reduce the risk of transmission of infectious agents.
- There is assurance the project can progress to the next stage of development or implementation, with particular emphasis on the safety of the patients, staff and visitors utilising the facility.
- Provision of advice and guidance to programme and project teams by fellow practitioners.

KSAR as part of the overall assurance framework

Each NHS health board will be fully responsible for the delivery of all projects, and its own internal process and resources for carrying out internal reviews and audits of its activities. The KSAR is seen as a complementary independent review, and not as a replacement for the responsibilities of the health board.

NHS health boards should have in place an effective framework to provide a suitable level of assurance for their programmes and projects. Health boards are encouraged and expected to ensure adequate and timely coordination and sharing of information, including plans, between the various internal reviews and functions.

The KSAR process is not a substitute for a rigorous governance framework being put place by the health board to manage key processes including business planning, investment appraisal, business case management, risk management and service and contract management.



The KSAR Process relationship with NHS Scotland Design Assessment Process (NDAP)

The Scottish Government's ambition for NHS Scotland's estate and the need for well-designed healthcare environments is articulated in the Policy on Design Quality for NHS Scotland. Good design in the built environment encompasses a wide range of inter-related factors such as:

- access for visitors and mobility impaired persons
- architecture
- decontamination
- energy
- engineering
- environment
- fire safety
- landscaping
- lighting
- security
- space utilisation
- sustainability
- technology.

The mandated NHS Scotland Design Assessment Process (NDAP) process is undertaken by NHS Scotland Assure, Architecture and Design Scotland, and considers all of the above. It sets the principles for the resolution of potential conflicts of statutory or mandatory compliance to ensure the specific facility provides; the best balance of the technical requirements, meets clinical needs and fulfils the conceptual aims of the policy on Design Quality. The NDAP process begins at the Initial Agreement stage of a project and provides advice through to the Full Business Case (FBC). There is no change to either Scottish Capital Investment Manual (SCIM) or NDAP processes.

The Scottish Government is progressing policy to improve the safety of the healthcare environment in relation to the built environment risk. The Assurance Service delivered through NHS Scotland Assure is a response to this policy and the KSARs are integral to the compliance work. The aspiration is not to duplicate any of the work included in the NDAP process but to provide assurance regarding the critical components highlighted throughout this workbook.

Integral to the KSARs will be a review of the balance between sustainability issues and patient safety.

Where possible the two reviews will be aligned to avoid duplication of work. For example, in instances where the NDAP has reviewed detail at a technical level, this will be used by the KSAR team rather than being separately requested and reviewed.

Sustainability

The review will provide assurance that the proposals for the project provide an effective balance in terms of patient, staff and visitors safety, whilst meeting required sustainability outcomes and complying with the guidance standards.

Handover KSAR

The Handover KSAR will be an independent “peer review” in which NHS Scotland Assure (NHS SA) subject matter experts, independent of the project, use their experience and expertise to review and assess the proposed pre-Handover and Handover stage documentation. It is anticipated that the implementation of the Handover KSAR will differ from other reviews, as it will predominately take the form of a site-based audit of the processes and documentation associated with the Handover phase.

Any areas of concern found during this KSAR will be immediately raised with the NHS health board.

The Handover KSAR will consider (particularly with respect to IPC measures):

- Water systems.
- Ventilation systems.
- Plumbing and drainage.
- Fire safety.
- Electrical systems.
- Medical gases.
- Any other building or engineering component critical to the safety and welfare of a particular patient cohort (defined by the review team).
- The requirements of Infection Prevention & Control Guidance have been incorporated and implemented, including the NHS Scotland National Infection Prevention and Control Manual, to allow staff to deliver the health services in a safe and comprehensive manner.

At all stages of the Handover phase, knowledge of compliance in design and implementation will need to encompass (but is not limited to) the following:

- NHS Scotland policy letters (DLs, CELs, CMOs).
- Scottish Health Planning Notes (SHPN).
- Scottish Health Facilities Notes (SHFN).
- Scottish Health Technical Memoranda (SHTM).
- Scottish Fire Practice Notes (SFPN).
- Health Building Notes (HBN).
- Health Technical Memoranda (HTM).
- Health Facilities Notes (HFN).
- Incident Reporting and Investigation Centre (IRIC) Alerts.
- Relevant British Standards.
- UK construction industry bodies best practice or design guidance publications e.g., HSE, CIBSE, BRE, IHEEM, IET, BRE, BSRIA, sustainability, dementia and equality.
- Incident Reporting and Investigation Centre (IRIC) Alerts.
- The implementation of NHS Scotland Soft Landings (SL) guidance.
- Confirm that there are plans in place for risk management, issue management and that these plans are being shared with suppliers and delivery partners.
- Evaluation of actions taken to implement recommendations made in earlier assessment of deliverability.
- Confirm there are plans in place to ensure the requirements of IPC Guidance, including the NHS Scotland National Infection Prevention and Control Manual for Scotland, are being incorporated into the development in a manner which will allow the staff allocated to the role to deliver the services to the patients.
- Other statutory requirements: Planning permission; Building Regulations compliance; Equality Act compliance; Health and Safety Executive (HSE) compliance; Construction (Design and Management) Regulations compliance. Fire Scotland Act.
- Other mandatory NHS Scotland use of:
  - Activity Data Base (ADB).
  - Achieving Excellence Design Evaluation Tool.
  - Sustainable Design and Construction (SDaC).
  - Scottish Government BIM Policy (SPPN 1/2017; implementation of building information modelling within construction projects: March 2017).

Additionally, the Handover KSAR will carry out an appropriate level of checking of the commissioning results, as-installed drawings, health and safety documents, manufacturers' literature and solutions adopted.

This level of checking will be set by the review team following their initial discussions on site. One impact of this work may be that the review will take longer than the initial programme, dependant on the conclusions / findings from this assessment of the design.

The review teams consist of experienced professionals and Infection Control clinicians. The team will work with the health board's project team, inclusive of their clinicians and their appointed facility management consultants and contractor. Each review will result in a report being prepared for the Programme Director at the Board and a copy of the report will also be provided to Scottish Government Capital Investment Group.

Section 3 below provides the typical question sets for each discipline that the review team will use as the basis for the Handover KSAR review process. The team will amend this as necessary depending on the project and areas of particular interest. The health board, their designers and contractors should be aware that this is the information which will be expected, and the project should effectively be completed and ready for acceptance at the time of the KSAR to ensure the accuracy of the report.

3. Assessment of Delivery Approach

It is anticipated that Project Handover may be phased as determined by the scale and complexity of the building and systems.

The review should focus on Governance, management, planning, resources, risk assessments, method statements, validation and health board acceptance of Commissioning results. Those responsible for Project Handover should have the appropriate level of competency to undertake the receipt of the systems which they are responsible for. The Handover process should be carried out in accordance with the Board Contract Requirements (BCR).

A suite of documents should be specified for handover to include health and safety files and operations and maintenance manuals. Further, project handover plan checklist should be completed by all relevant parties confirming system completion, system acceptance, training, certification and as installed document handover.

Project Governance and General Arrangements

No.	Areas to probe	Evidence expected
1.1	How does the health board assure itself that actions from the previous Key Stage Assurance Review have been appropriately closed out?	• Evidence of a completed action plan, with reference to evidence, to demonstrate appropriate close out of actions.
1.2	How does the health board ensure that all Commissioning activities have been completed successfully, appropriately validated (including witnessing) and documented, prior to handover?	• Evidence that commissioning / validation processes are complete, and that the Contractor has issued a verification letter to confirm that the systems have been installed and commissioned in line with specification and guidance. • Evidence of commissioning and witnessing activities, including any independent 3rd party validation. • Completed commissioning and validation records for all mechanical, electrical and public health (MEP) systems. • Completed commissioning and validation records for all fire safety systems. • Completed commissioning and validation records for all MEP plant, including plant associated with incoming utilities.

No.	Areas to probe	Evidence expected
1.3	How does the health board ensure that all relevant information from the Commissioning and Handover phases has been collated, appropriately documented and reviewed prior to Handover?	• Evidence of the completed, final Commissioning records which demonstrate design conditions and actual commissioned conditions. • Evidence of completed O&M information in line with the requirements of guidance, the BCRs and BSRIA BG 79. • Evidence of record drawings. • Evidence of the completed Health and Safety file. • Evidence of digital information exchange in line with Employers Information Requirements (EIRs). (Graphical and non-graphical data, e.g. Federated BIM model, COBie data, asset lists etc.). • Evidence of an updated access and maintenance strategy. • Evidence that any derogations from standards have been agreed by the health board and signed-off prior to Handover. • Evidence of processes in place to allow stakeholders to review and comment on Handover documentation prior to Handover. • Completed handover checklists. • Evidence that testing commissioning and validation processes are complete, and documentation has been received and reviewed by key stakeholders from the health board (e.g. WSG/VSG/ESG, AEs, IPC etc.) in line with their governance processes.
1.4	How does the health board ensure that the works have been completed to the required safety and quality standards?	• Evidence of a quality monitoring role having been undertaken with associated supporting documentation e.g. actioned observation trackers. • Evidence there is a process in place to track the close out of any observations / defects prior to handover, including review by key health board stakeholders. • Evidence of contractor/designer approvals of completed works.

No.	Areas to probe	Evidence expected
1.5	How does the health board assure itself that key stakeholders have been involved in the handover process?	• Evidence of a roles and responsibilities document for all individuals involved in the handover process. • Evidence of how the health board assures themselves that relevant stakeholders (e.g., IPC / AE / AP) are available for handover activities as required. • Evidence that maintenance procedures and operational processes have been completed with clinical and IPC stakeholders (to consider access requirements etc).
1.6	How does the health board ensure that there is sufficient resource allocated to manage the accommodation post-handover?	• Evidence that health boards (and/or their appointed FM provider) have appropriate number of competent, qualified staff appointed to carry out specific duties during operation e.g., IPC, Estates staff, APs, CPs etc. • Evidence that the health board (and/or their appointed FM provider) has a fully recorded duty holder matrix, stating the required roles and responsibilities. • Evidence there is a Handover plan in place for staff assuming responsibility for ongoing maintenance and operation of the systems.
1.7	How does the health board ensure that adequate site familiarisation training has been provided?	• Evidence of processes in place to deliver relevant site training / familiarisation sessions to key stakeholders (including end users, IPC, Estates, Hard FM / Soft FM). • Evidence of site visits and walk-rounds by end users.
1.8	How does the health board ensure that adequate technical training has been provided?	• Evidence of demonstrations/ training of system operation for those who will operate and maintain the installed systems, including routine planned preventive maintenance activities. • Evidence that dedicated training has been provided to clinical staff on the operation of technical systems (for example theatre control panels, magnehelic gauges, staff call systems, etc). • Evidence of attendance at training sessions / demonstrations. • Evidence of any training resources / materials provided. • Evidence that all required tools, spares and consumables have been received, along with an inventory. • Evidence of maintenance processes in place.

No.	Areas to probe	Evidence expected
1.9	How does the health board ensure that knowledge of the project is transferred to operational teams? How does the health board ensure that Soft Landings processes are being implemented?	• Evidence of a detailed Handover programme encompassing all Handover activities, as agreed with the health board. • Evidence of PPM activities undertaken in the period between commissioning and handover. • Evidence of Soft Landings review meetings. • Evidence of user guides provided for systems. • Evidence of an aftercare team in place, with delivery plan for in-use support and monitoring. • Evidence of Post Occupancy Evaluation plan. • Evidence of a process for fine tuning, measuring performance and capturing lessons learned from the building operation following Handover.
1.10	How does the health board ensure that there is a process in place for managing Statutory Compliance (including use of the NHS Scotland SCART system)	• Evidence of SCART question review. • Evidence of personnel allocated to compliance. • Evidence of policies and procedures in place for managing and operating engineering systems. • Evidence of process for storing and managing documentation and statutory maintenance records associated with the project.

IPC Built Environment

No.	Areas to probe	Evidence expected
2.1	How does the health board assure itself that IPC specialists have been fully involved in the handover process?	• Evidence of Executive Board reports. • Evidence of Board Minutes. • Evidence of Minutes and actions from Governance and Operational Groups relevant to the project, including IPCC. • Evidence of completed Stage 4 HAI-SCRIBE.
2.2	How does the health board assure itself that those IPC specialists involved in the Handover process are appropriately qualified and experienced?	• Evidence of the structure of IPCT with details of qualifications held and previous experience in commissioning new builds, refurbishments, or special projects. • Evidence that this has been reviewed and recorded by the health board.
2.3	How has the health board ensured that the IPC specialists engaged in the handover process have access to all relevant Commissioning completion documentation for all water, ventilation, and decontamination equipment?	• Evidence that the respective technical commissioning experts have liaised with IPC on final commissioning results, including consideration of any residual IPC risks. Evidence of minutes and actions from governance and operational groups relevant to the project, including IPCC and Water / Ventilation Safety Groups.
2.4	How has the health board assured itself that staff in the facility will be able to comply with the requirements of IPC guidance including the National Infection Prevention and Control Manual?	• Evidence of HAI-SCRIBE documentation. • Evidence of minutes and actions from governance and operational groups relevant to the project, including IPCC. • Evidence of a process in place for access to NIPCM across the facility/organisation.
2.5	How has the health board assured itself that proposed cleaning schedules will meet the requirements of the National Cleaning Specification?	• Evidence that proposed cleaning schedules have been matched against the National Cleaning Specification. • Details of facilities, clinical and IPC teams' involvement in drawing up proposed cleaning schedules.

Fire

No.	Areas to probe	Evidence expected
3.1	Have there been any changes to the fire strategy since the previous Key Stage Assurance Review?	• Evidence of written confirmation of any changes that have been made to the fire strategy.
3.2	Has a Fire Risk Assessment been carried out in accordance with SHTM 86?	• Evidence of Fire Risk Assessment Documentation.
3.3	Have the findings of the Fire Risk Assessment generated a significant findings report?	• Evidence of significant findings Action Plan. • Evidence of the timeline for completion of actions has been documented.
3.4	Are appropriate members of the management team including the Nominated Officer (fire) aware of their responsibility for fire safety management procedures?	• Written documentation and verbal verification from responsible persons. • Evidence of the Board Fire Safety Policy. • Evidence of the Board fire safety procedures.
3.5	Has an Emergency Fire Action Plan (EFAP) been produced in accordance with SHTM 83?	• Evidence of the Emergency Fire Action Plan (EFAP) documentation. • Evidence that this is available to staff. • Details of Emergency response team and their expected actions in response to fire.
3.6	Is there a fire safety induction-training programme in place in line with SHTM 83 Part 2: Fire Safety Training?	• Evidence of the training syllabus. • Evidence of all training programmes and materials. • Evidence of training records.
3.7	Are commissioning documents such as completed for all passive and active fire safety measures?	• Evidence of documentation such as OEM manuals, testing/inspection reports, as-installed information and certificates for all passive and active fire safety measures? • Evidence that the documents are available to relevant staff.
3.8	Has a Fire Safety Manual been produced?	• Evidence of Fire Safety Manual documentation. • Evidence that the document is available to relevant staff.

4. Appendix

KSAR Master Glossary

Please refer to NHS Scotland Assure – Assurance Service Master Glossary document.

Scottish Health Technical Memorandum 2025

(Part 1 of 4)

Overview and management responsibilities

Ventilation in healthcare premises

The production of this document was jointly funded by the Scottish Executive Health Department and the NHSScotland Property and Environment Forum.

NHSScotland, P&EFEx, June 2001

Contents

1. Introduction

General

1.1 Ventilation is used extensively in healthcare premises for primary patient treatment eg. in operating departments, intensive treatment units and isolation suites. It is also installed to ensure compliance with quality assurance of manufactured items in pharmacy and sterile supply departments and to protect staff from harmful organisms and toxic substances for example in laboratories.

1.2 This edition of Scottish Health Technical Memorandum 2025; *Ventilation in healthcare premises* is published in four separate parts. It is equally applicable to both new and existing sites. It gives comprehensive advice and guidance to healthcare management, design engineers, estates' managers and operations' managers on the legal requirements, design implications, maintenance and operation of specialist ventilation in all types of healthcare premises.

1.3 Current statutory legislation requires both "management" and "staff" to be aware of their collective responsibility.

1.4 "Ventilation" is provided in healthcare premises for the comfort of the occupants of buildings. More specialised ventilation will also provide comfort but its prime function will be to closely control the environment and air movement in the space that it serves in order to contain, control and reduce hazards to patients and staff from airborne contaminants, dust and harmful micro-organisms.

1.5 Ventilation systems, in themselves, present little danger to patients or staff; however, they do possess the ability to transmit hazards arising from other sources to large numbers of people. The danger may not become apparent until many patients and staff have been affected.

1.6 The sophistication of ventilation systems in healthcare premises is increasing. Patients and staff have a right to expect that the systems will be designed, installed, operated and maintained to standards that will enable them to fulfil their desired functions reliably and safely.

2. Management responsibilities

Statutory requirements

2.1 The Health and Safety at Work etc Act 1974 (HSW Act 1974) is the core legislation that applies to ventilation installations. As these installations are intended to prevent contamination, closely control the environment, dilute contaminants or contain hazards, their very presence indicates that risks to health have been identified.

2.2 The Control of Substances Hazardous to Health (COSHH) Regulations 1999 regulations place upon management an obligation to ensure that suitable measures are in place to protect their staff and others affected by the work activity. These methods may include both safe systems of work and the provision of a specialist ventilation system. In laboratories the requirements are often met by the provision of fume cupboards and safety cabinets.

2.3 The existing requirements to provide ventilation, implicit under HSW Act 1974 and COSHH, have been made explicit by the Management of Health and Safety at Work Regulations 1999, the Workplace (Health, Safety and Welfare) Regulations 1992 and the Provision and Use of Work Equipment Regulations 1998, all issued as a result of European Directives.

2.4 Where specialist ventilation plant is provided as part of the protection measures there is a statutory requirement that it be correctly designed, installed, commissioned, operated and maintained. The local exhaust ventilation (LEV) section of the COSHH regulations requires that the plant be inspected and tested at least every 14 months by an independent organisation and that management maintains comprehensive records of its performance, repair and maintenance.

2.5 Certain substances have Occupational Exposure Limits (OEL) set out in Guidance Note EH 40 published annually by the Health and Safety Executive. If special ventilation systems are provided to meet these standards they will also be subject to the COSHH regulations as above.

2.6 All ventilation systems should conform to the principles set out in the *Approved Code of Practice on the Prevention and Control of Legionellosis* published by the Health and Safety Commission and Scottish Health Technical Memorandum SHTM 2040;*The control of legionellae in healthcare premises – a code of practice*.

2.7 Special ventilation plants installed in laboratories dealing with research, development or testing, whether involving drugs, animals or genetically modified organisms, may be subject to particular legislation with regard to their operation in addition to that mentioned above. Further information is given by the Health and Safety Commission Health Services Advisory Committee in:

a. safe working and prevention of infection in clinical laboratories;

b. safe working and prevention of infection in clinical laboratories: model rules for staff and visitors;

c. safe working and prevention of infection in clinical laboratories in the mortuary and post-mortem room.

2.8 Plants installed in units manufacturing medicinal products to the standards set out in the current European Guide to Good Manufacturing Practice may also be subject to particular legislation with regard to their operation in addition to that mentioned above.

2.9 Records and log books should be kept of the commissioning information, operational management, monitoring and maintenance of the equipment. The Health and Safety Executive, Medicines Inspectorate and other interested bodies have a statutory right to inspect them at any time. All records should be kept for at least five years.

2.10 The fire regulations require that if ventilation ductwork penetrates the fabric of a building it should be designed and installed so as to contain the spread of fire. It is a management responsibility to ensure that the standards applied during the design and installation are not reduced during the operation and maintenance of the equipment.

2.11 In the event of a reportable incident connected with ventilation equipment or any area that it serves, all records and plant log books will need to be collected as evidence. Proven breaches of the statutory requirements can result in prosecution and may also give rise to a civil suit against the operators.

Other responsibilities

2.12 Management has a general responsibility to ensure that ventilation systems are operated at a standard suitable for the purpose for which they were installed.

2.13 While ventilation plant itself has not been shown to pose a high risk to health, it does have the ability to transfer a hazard, originating from another source, to a large number of people, without them becoming immediately aware of it.

2.14 Increased health risks to patients will occur if the more specialised ventilation systems installed to supply high quality air to operating departments do not achieve and maintain the required standards. The link between post-operative infection and theatre air quality has been well established. Plants serving conventional operating departments, for instance, will be required to ensure the separation of areas within the suite by maintaining a specific direction of air flow between rooms, even when doors are opened. They will also maintain the selected operating department environmental conditions regardless of changes in the outside air conditions or activities within the space. In addition ultra-clean operating ventilation systems which are designed to provide an effectively particle-free zone around the patient while the operation is in progress have been shown to significantly reduce post-operative infection in patients undergoing deep wound surgery. Their use for similar forms of surgery may well be indicated.

2.15 Ventilation systems that can be shown to be inappropriate, inadequate or ineffective and that give rise to proven failures can result in a civil suit by the patient against the operators. The same may be true of other ventilation applications.

2.16 If the plant has been installed to dilute or contain harmful substances, its failure may expose people to unacceptable levels of contamination, again without their becoming immediately aware of it. Proven failures can give rise to a civil suit against the operators by the individuals who have been affected. This would be in addition to the actions brought as a result of breaching the statutory requirements.

Summary of requirements

Requirement	Reason	Location
Statutory	Health and Safety at Work etc Act	Operating departments. Laboratories. Pharmacies Post Mortem Rooms
	COSHH regulations (including Local exhaust ventilation requirements)	Areas containing identified biological or chemical hazards. Areas containing oxygen displacing gases. Enclosed work-spaces. Workshops.
	Building regulations	Any room which cannot be naturally ventilated.
Functional	Comfort	Situations where the quality of the environment for staff and patient is critical to their general performance and well-being.
Clinical	Post-operative infection reduction	Operating suites used for general surgery, casualty, obstetrics/gynaecological and maternity procedures.
	Reduction of deep wound sepsis	Ultra-clean operating suites for transplant, deep wound surgery, hip replacement, bone grafting and bone marrow transplant procedures.
	Control of infection	Isolation rooms Barrier nursing rooms Treatment rooms Plaster rooms

Operational management

2.17 When new ventilation systems are accepted for use, full information as to their designed mode of operation together with recommended maintenance procedures should be provided as part of the handover procedure.

2.18 Those required to monitor and/or maintain ventilation equipment will need to show that they are competent to do so. As a minimum they should have sufficient knowledge of its correct operation in order to be able to recognise and report faults. Training in the correct operation and routine maintenance of the equipment will be required as part of the handover procedure at the end of the commissioning period.

2.19 Routine maintenance procedures can cause risks to the health of staff carrying out the work and those receiving air from the plant. All those involved

should be made aware of the risks, safe systems of work should be agreed, and suitable safety equipment should be provided and training in its use given.

2.20 Staff engaged in the service and maintenance of ventilation extract systems from pathology departments or laboratories may be particularly at risk. In these cases the risk should be identified and assessed, the means by which the system can be rendered safe to work on should be determined, training in the exact procedures should be adopted and given to all staff involved and a permit-to-work scheme on the system should be implemented.

2.21 Regular tests, at intervals agreed with the local fire prevention officer, will need to be carried out in order to demonstrate the continuing efficiency of the fire detection and containment systems. Records of these tests should be kept.

2.22 A periodic review of the need for, and operational condition of, ventilation equipment will need to be undertaken.

2.23 Training in the use of safety equipment and a safe system of work will need to be repeated periodically in order to cater for changes in staff. Records of the training provided should be kept and maintenance procedures reviewed periodically to ensure that they remain appropriate.

Designated staff functions

2.24 A person intending to fulfil any of the staff functions specified below should be able to prove that they possess sufficient skills, knowledge and experience so as to be able to perform safely the designated tasks.

2.25 **Management** - management is defined as the owner, occupier, employer, general manager, chief executive or other person who is ultimately accountable for the safe operation of premises.

2.26 **Authorised person** - a person appointed or contracted by the general manager to review and witness documentation on validation and provide auditing and advice on ventilation installations and their application.

2.27 **Test person** - a person or organisation contracted by the general manager to carry out commissioning, validation and routine testing of ventilation installations.

2.28 **Maintenance person** - a member of the maintenance staff, ventilation equipment manufacturer or maintenance organisation employed by the general manager to carry out maintenance duties on ventilation installations.

2.29 **Infection control officer** - or consultant microbiologist, if not the same person, nominated by the management to advise on monitoring infection control policy and microbiological performance of the systems. Major policy decisions should be made through an infection control committee.

2.30 **Plant operator** - any person who operates a ventilation installation.

2.31 **User** - the person responsible for the management of the unit in which the ventilation system is installed, for example, head of department, operating theatre manager, head of laboratory, production pharmacist, head of research or other responsible person.

2.32 **Contractor** - the person or organisation responsible for the supply of the ventilation equipment, its installation, commissioning and validation. This person may be a representative of a specialist ventilation organisation or a member of the general manager/chief executive's staff.

2.33 A record should be kept of those appointed to carry out the staff functions listed above. The record should clearly state the extent of the post holders duties and responsibilities and to whom they are to report.

2.34 Any training given should be recorded together with the date of delivery and topics covered.

2.35 Substitute or replacement staff should be designated in order to cover for sickness, holidays and staff transfers.

3. Functional overview

Terms in use

3.1 The terms “ventilation” and “air-conditioning” are often used interchangeably to describe the same equipment. A general explanation of the terms is given below.

Ventilation

3.2 Ventilation is a means of removing and replacing the air in a space. In its simplest form this may be achieved by opening windows and doors. Mechanical ventilation systems provide a more controllable method. Basic systems consist of a fan and collection or distribution ductwork; more complex systems may include the ability to heat and filter the air passing through them. Ventilating equipment may be required in order to remove smells, dilute contaminants and ensure that a supply of “fresh” air enters a space.

Air-conditioning

3.3 Air-conditioning is the ability to heat, cool, humidify, dehumidify and filter air. This means that the climate within a space being supplied by an air-conditioning plant can be maintained at a specific level within a specified range regardless of changes in the outside air conditions or the activities within the space. Air-conditioning equipment may be required in order to provide “comfort conditions” within a space.

Special ventilation

3.4 In healthcare premises, certain activities will necessitate the provision of ventilation equipment with additional special features in order to achieve and maintain specific conditions. These may be needed in order to assist with the treatment of patients or maintain the health and safety of staff. The precise reason for providing special ventilation will depend upon its intended application. The list below indicates some of the more typical reasons:

a. to provide “close” control of temperature;

b. to provide “close” control of humidity;

c. to remove, contain or dilute specific contaminants and fumes;

d. to ensure the isolation of one space from another;

e. to preserve a desired air flow path from a “clean” to a “less clean” area;

f. to provide control of the cleanliness of a space.

3.5 The following departments will usually have specialist ventilation requirements, either for a single room or throughout a suite:

a. an operating suite;
b. a laser surgery unit;
c. an intensive treatment unit;
d. an infectious diseases isolation unit;
e. a manufacturing pharmacy and cytotoxic drug units;
f. a specialist X-ray and scanning unit;
g. pathology department;
h. a mortuary and dissection suites;
i. research laboratories and associated animal houses;
j. sterilizing and disinfecting unit (SDU).

Equipment requirements

3.6 Ventilation may be provided in a wide variety of ways. These will include extensive purpose-built air-conditioning units housed in their own plantrooms, proprietary "packaged" systems often sited outside on a roof or wall-mounted electric fans located at the point of use.

3.7 Specialist ventilation systems utilising full air-conditioning are expensive so they are only used where there is a specific need to control closely the environment within a space, for example an operating department, intensive treatment suite or laboratory.

3.8 A fixed volume of air may be supplied, usually expressed as a number of air changes per hour (ac/h) or cubic metres per second (m^3/s) that the plant is set to deliver, or the volume of air supplied may be varied in order to maintain a specific pressure relationship between the area supplied by a special ventilation system and other surrounding areas.

3.9 An uncontaminated air supply to the plant is essential. In order to achieve this the air intake will be positioned so that air from extract systems or other dubious sources cannot be drawn in. The area surrounding the intake will need to be kept clean and free of waste material in order to reduce the possibility of bio-hazards or fire. The intake itself will be protected by a louvre and mesh screen to prevent rain water, vermin and insects etc from entering the system

3.10 Most modern plants are fitted with the means to recover energy from the extract air without causing contamination of the incoming supply air.

3.11 Ultra-clean systems use the same basic plant and equipment as standard air-conditioning but are in addition fitted with a terminal device that supplies the air in a uni-directional manner to the working area. Their standard of filtration

is also higher and is capable of delivering air with a very low particle count to the space that they serve.

3.12 Local exhaust ventilation (LEV) is a term used to describe systems installed to prevent hazardous substances from entering the general atmosphere of the room in which they are being used. Their primary function is to protect staff from the effects of their work activity.

3.13 Simple LEV systems comprise a capture hood, extract ductwork and fan. These are used to contain industrial types of hazard such as fumes from welding processes, gas discharges from standby battery banks and dust from woodworking machinery. The vapour given off when large quantities of chemicals are decanted into ready-use containers and fumes from X-ray film processing units are examples of chemical hazards often controlled by LEV systems.

3.14 In laboratories, pharmaceutical manufacturing facilities and operating suites, LEV systems usually take the form of semi-open fronted cabinets within which the hazardous substance is manipulated. These cabinets either have their own filtered air supply or are fed with air from the room. The air extracted from the cabinet is passed through a high-efficiency filter before being discharged either to the atmosphere or back into the room. Microbiological safety cabinets, laboratory fume cupboards, cytotoxic drug cabinets, and fixed or mobile glutaraldehyde disinfecting enclosures are all examples of this type of facility.

3.15 Mortuaries and dissection suites may have LEV systems incorporated within the dissection table, specimen bench and bone saw.

4. Management summary

4.1 The guidance contained in this SHTM should not be applied retrospectively; however, there is an obligation to review existing installations and ensure that they are of a safe standard. The guidance should be applied in full to new installations and major refurbishments of existing installations.

4.2 Ventilation will need to be provided:

a. as a requirement for patient care;

b. in order to fulfil a statutory duty.

In assessing the need for more specialist ventilation and the standards desired for patient care, managers will need to be guided by their medical colleagues and by information published by the Department of Health.

4.3 The statutory need for ventilation falls into two categories:

a. in the first, the need for specialist ventilation and the standards to be adopted are clearly set out in specific pieces of legislation. An excellent example of this is the current legislation surrounding the manufacture of medicinal products in the European Community. The managers of the departments affected by this type of legislative requirement should be aware of their needs and be able to advise on the standards to be achieved;

b. the second type of statutory requirement arises due to the interpretation of both the Health and Safety at Work etc Act and the Control of Substances Hazardous to Health (COSHH) regulations. The person tasked with conducting COSHH assessments will be able to advise as to the need for, and standard of, ventilation in each particular case.

4.4 It is a management responsibility to ensure that the standards applied during the design and installation of ventilation systems are not reduced during the operation and maintenance of the equipment.

4.5 Clear lines of managerial responsibility should be in place so that no doubt exists as to who is responsible for the safe operation and maintenance of the equipment. A periodic review of the management systems should take place in order to ensure that the agreed standards are being maintained.

4.6 These objectives will only be achievable if the personnel engaged have the necessary experience and training to undertake their designated tasks.

Appendix 1

Use and function of typical equipment used in ventilation plants

1. Typical equipment used in ventilation plants is listed below together with a brief description of both function and use.

General

2. The equipment built into the ductwork should be of a type that will neither cause nor sustain combustion.

3. No materials that could sustain biological activity should be used in the construction or assembly of the plant.

Air intake

4. As an uncontaminated air supply is essential, it is positioned so that air from extract systems or other dubious sources cannot be drawn in. The area surrounding the intake will be kept clean and free of waste material in order to reduce the possibility of bio-hazards or fire. The intake itself will be protected by a louvre and mesh screen to prevent rain water, vermin and insects etc entering the system.

Damper

5. Several types may be fitted:

   a. automatic dampers fitted immediately behind the air intake and extract louvres. They will automatically close when the plant is shut down in order to prevent an uncontrolled circulation of air;

   b. balance dampers are fitted into each branch of the air distribution ductwork system so that the design air flow rate can be set during the commissioning process;

   c. where ductwork passes through a fire compartment wall, ceiling or floor a fire and/or smoke damper may be required;

   d. plant isolating dampers are fitted so that the main plant can be isolated from its air distribution duct system. They are manually operated and enable cleaning and maintenance of the air-conditioning equipment to be carried out.

Ducting

6. The means by which air is conveyed from the intake to its point of use. Ducting is usually constructed of galvanised steel and will normally be insulated to reduce noise and conserve energy. Ducts can also be formed in concrete, brickwork, stainless steel or plastic and may be rigid or flexible.

Fan

7. A series of rotating blades that move the air in the direction required. Fans are usually powered by electric motors either directly connected to them or driven through belts and pulleys. A fan may be arranged to either force air into or draw air from a ductwork system.

Attenuator/silencer

8. A device that will contain and absorb the noise emitted by a fan. They may be required to reduce disturbance caused by noise breaking out through the air intake and also noise transmitted along the ductwork to the conditioned space.

Filter

9. A filter consists of a labyrinth of fibrous material contained in a frame. It is designed to capture and hold particles being carried in the airstream. Because of the size, range and number of particles that exist in air, no filter can remove them all. The purpose of filtration is to reduce their number, size and range to an acceptable level. Filters of progressively higher grades are fitted through the ventilation system:

   a. primary filters (coarse) are designed to collect the larger particles and are intended to keep the air conditioning plant clean;

   b. secondary filters (fine) will remove the staining particles from air and keep the conditioned space visibly clean;

   c. high efficiency particulate air filters (HEPA/absolute) will remove virtually all particles from air. These may be required in order to reduce contamination in the working area either biologically or in terms of particle count.

10. Filters may be fitted to extract systems in order to remove biological, radiation or chemical hazards. If so they are often contained in a “safe change” facility in order to protect those carrying out their maintenance.

11. Activated carbon filters will reduce odours in extracted or recirculated air.

Heater battery/heater coil

12. A series of coils with or without fins through which steam or hot water is circulated. Heat is given up to the air passing over the battery thus increasing its temperature. Heating is usually carried out in stages, the final battery being controlled by the end user. Small batteries may be electric.

Humidifier

13. A device for increasing the humidity of air by adding moisture. For ventilation in healthcare premises this is normally achieved by releasing “clean” steam into an air supply duct. The steam will be completely absorbed into the air, increasing its humidity. The level of humidity may be preset or controlled by the end user.

Cooler battery/cooling coil

14. A series of finned coils mounted in the air supply duct. Either chilled water or refrigerant is circulated through the coils causing heat to be removed from the air. This will reduce its temperature and may also condense moisture out of the air. As free moisture in a duct can be a source of contamination the coil will be fitted with an eliminator and drainage system.

Eliminator

15. A device for catching and removing water droplets from an air stream. It may form part of a cooling coil or be a separate device.

Drainage system

16. A means of removing water from ductwork and disposing of it safely. Typically it will consist of a tray mounted in the duct to catch moisture, a glass water seal trap, continuously falling drainage pipework and an air break in the drain run to prevent waste water returning and contaminating the duct.

Access and observation ports

17. Doors and removable panels providing access for routine maintenance and cleaning. The doors should be fitted with glazed ports and suitable lighting provided so that the correct operation of devices such as cooling coils, humidifiers and filters can be easily observed.

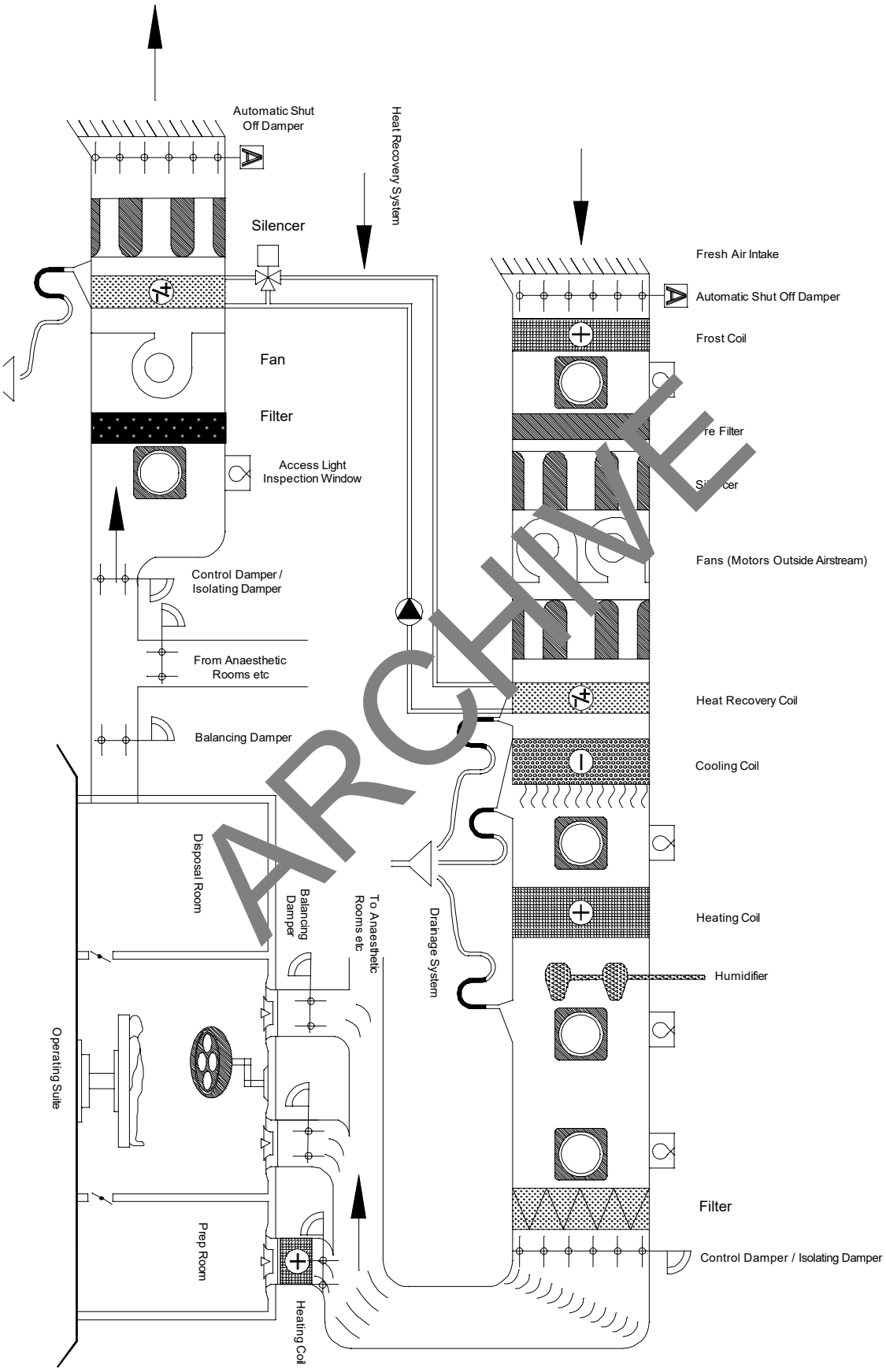
Energy recovery

18. Most modern plants are fitted with the means to recover energy from the extract air without causing contamination of the incoming supply air. These devices will be fitted with both an eliminator and a drainage system. Several types of energy recovery systems are available.

Typical plant

19. The layout of a typical plant designed to serve an operating suite is shown in Figure 1. It contains most of the equipment described above. Full details of the plant illustrated and its mode of operation are given in Part 2; 'Design considerations' of this SHTM.

Figure 1: A typical operating suite ventilation plant



Appendix 2: Abbreviations

BS	British Standards
COSHH	Control of Substances Hazardous to Health
HMSO	Her Majesty's Stationary Office
HTM	Health Technical Memorandum
LEV	Local exhaust ventilation
NHS	National Health Service
P&EF	Property and Environment Forum
P&EFEx	Property and Environment Forum Executive
SHTM	Scottish Health Technical Memorandum
SHTN	Scottish Health Technical Note
SI	Statutory Instrument
WRC	Water Research Centre

References

NOTE:
Where there is a requirement to address a listed reference, care should be taken to ensure that all amendments following the date of issue are included.

Publication ID	*Title*	*Publisher*	*Date*	*Notes*
Acts and Regulations				
	Building (Scotland) Act	HMSO	1959	
	Clean Air Act	HMSO	1993	
	Electricity Act	HMSO	1989	
	Health and Safety at Work etc Act	HMSO	1974	
	Registered Establishments (Scotland) Act	HMSO	1998	
	Water (Scotland) Act	HMSO	1980	
SI 2179 & 187	The Building Standards (Scotland) Regulations (as amended)	HMSO	1990	
	Building Standards (Scotland) Regulations: Technical Standards Guidance	HMSO	1998	
SI 1460	Chemicals (Hazard Information and Packaging for Supply) Regulations (CHIP2)	HMSO	1997	
SI 3140	Construction (Design and Management) Regulations	HMSO	1994	
SI 437	Control of Substances Hazardous to Health Regulations (COSHH)	HMSO	1999	
SI 1057	Electricity Supply Regulations (as amended)	HMSO	1988 (amd 1994)	
SI 635	Electricity at Work Regulations	HMSO	1989	
SI 2372	Electromagnetic Compatibility Regulations (as amended)	HMSO	1992	
SI 2451	Gas Safety (Installation and Use) Regulations	HMSO	1998	
SI 2792	Health and Safety (Display Screen Equipment) Regulations	HMSO	1992	
SI 917	Health & Safety (First Aid) Regulations	HMSO	1981	
SI 682	Health & Safety (Information for Employees) Regulations	HMSO	1989	

Publication ID	Title	Publisher	Date	Notes
SI 1380	Health and Safety (Training for Employment) Regulations	HMSO	1990	
SI 341	Health and Safety (Safety Signs and Signals) Regulations	HMSO	1996	
SI 2307	Lifting Operations and Lifting Equipment Regulations 1998 (LOLER)	HMSO	1998	
SI 2793	Manual Handling Operations Regulations	HMSO	1992	
SI 3242	Management of Health and Safety at Work Regulations	HMSO	1999	
SI 1790	Noise at Work Regulations	HMSO	1989	
SI 3139	Personal Protective Equipment (EC Directive) Regulations (as amended)	HMSO	1992	
SI 2966	Personal Protective Equipment at Work (PPE) Regulations	HMSO	1992	
SI 128	Pressure Systems Safety Regulations (PSSR)	HMSO	2000	
SI 2306	Provision and Use of Work Equipment Regulations (PUWER)	HMSO	1998	
SI 3163	Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR)	HMSO	1995	
SI 3004	Workplace (Health, Safety and Welfare) Regulation	HMSO	1992	
British Standards				
BS 848	**Part 1:** Part 1: for general purpose performance testing using standardized airways	BSI Standards	1997	
BS 1710	**Specification for identification of pipelines and services**	BSI Standards	1984	
BS 3928	**Method for sodium flame test for air filters (other than for air supply to I.C. engines and compressors)**	BSI Standards	1969	
BS 4533	**Luminaires. Particular requirements. (Relevant parts)**	BSI Standards		
BS 4718	**Methods of tests for silencers in air distribution systems**	BSI Standards	1971	
BS 4979	**Methods for aerodynamic testing of constant and variable dual or single duct boxes**	BSI Standards	1986	
BS 5295	**Environmental cleanliness in enclosed spaces** **Parts 1 & 2**	BSI Standards	1989	

Publication ID	*Title*	*Publisher*	*Date*	*Notes*
BS 5410	**Code of practice for oil firing. Installations of 44kW and above capacity for space heating, hot water and steam supply purposes** **Part 2**	BSI Standards	1978	
BS 5440	**Installation of flues and ventilation for gas appliances**	BSI Standards	1990	
BS 5588	**Fire precautions in the design, construction and use of buildings** **Part 9:** Code of practice for ventilation and air-conditioning ductwork	BSI Standards	1999	
BS 5720	**Code of practice for mechanical ventilation and air-conditioning in buildings**	BSI Standards	1979	
BS 5726	**Microbiological Safety Cabinets** **Part 1:** Specification for design construction and performance	BSI Standards	1992	
BS 5726	**Microbiological safety cabinets** **Part 4:** Recommendation for selection, use and maintenance	BSI Standards	1992	
BS 6281	**Devices without moving parts for the prevention of contamination of water by backflow** **Part 1:** Specification for type A gaps for inlet or feed pipes.	BSI Standards	1992	
BS 6798	**Specification for installation of gas-fired boilers of rated input not exceeding 70 kW net**	BSI Standards	2000	
BS 7258	**Laboratory Fume Cupboards** **Parts 1 & 2**	BSI Standards	1994	
BS 7258	**Laboratory fume cupboards.** **Part 3:** Recommendations for selection, use and maintenance	BSI Standards	1994	
BS 8313	**Code of practice for accommodation of building services in ducts**	BSI Standards	1997	
BS EN 255	**Air conditioners liquid chilling packages and heat pumps with electrically driven compressors**	BSI Standards	1997	
BS EN 12469	**Biotechnology. Performance Criteria for microbiological safety cabinets**	BSI Standards	2000	
BS EN 60651	**Specification for sound level meters**	BSI Standards	1994	

Publication ID	*Title*	*Publisher*	*Date*	*Notes*
PO 6609	**Insitu aerosol testing of HEPA filtration- an explanatory supplement to BS 5295 Part 1**	BSI Standards	1996	
Scottish Health Technical Guidance				
SHTM 2005	Building management systems	P&EFEx	2001	CD-ROM
SHTM 2007	Electrical services supply and distribution	P&EFEx	2001	CD-ROM
SHTM 2011	Emergency electrical services	P&EFEx	2001	CD-ROM
SHTM 2020	Electrical safety code for low voltage systems (Escode – LV)	P&EFEx	2001	CD-ROM
SHTM 2023	Access and accommodation for engineering services	P&EFEx	2001	CD-ROM
SHTM 2040	Control of legionellae in healthcare premises – a code of practice	P&EFEx	2001	CD-ROM
SHTM 2045	Acoustics	P&EFEx	2001	CD-ROM
SHPN 1	Health service building in Scotland	HMSO	1991	
SHPN 2	Hospital briefing and operational policy	HMSO	1993	
SHTN 1	Post commissioning documentation for health buildings in Scotland	HMSO	1993	
SHTN 4	General Purpose Estates and Facilities Model Safety Permit-to-Work System	EEF	1997	
	NHS in Scotland – PROCODE	P&EFEx	2001	Version 1.1
NHS in Scotland Fi[illegible]cod				
SHTM 81	Fire precautions in new hospitals	P&EFEx	1999	CD-ROM
SHTM 82	Alarm and detection systems	P&EFEx	1999	CD-ROM
SHTM 83	Fire safety in healthcare premises: general fire precautions	P&EFEx	1999	CD-ROM
SHTM 84	Fire safety in NHS residential care properties	P&EFEx	1999	CD-ROM
SHTM 85	Fire precautions in existing hospitals	P&EFEx	1999	CD-ROM
SHTM 86	Fire risk assessment in hospitals	P&EFEx	1999	CD-ROM
SHTM 87	Textiles and furniture	P&EFEx	1999	CD-ROM
SFPN 3	Escape bed lifts	P&EFEx	1999	CD-ROM
SFPN 4	Hospital main kitchens	P&EFEx	1999	CD-ROM
SFPN 5	Commercial enterprises on hospital premises	P&EFEx	1999	CD-ROM
SFPN 6	Arson prevention and control in NHS healthcare premises	P&EFEx	1999	CD-ROM

Publication ID	*Title*	*Publisher*	*Date*	*Notes*
SFPN 7	Fire precautions in patient hotels	P&EFEx	1999	CD-ROM
SFPN 10	Laboratories on hospital premises	P&EFEx	1999	CD-ROM
Health and Safety Publications				
EH 40	HSE Occupational Exposure limits	HSE	Annual	
MES	Model Engineering Specifications	NHS Estates	1997	As required
Miscellaneous References				
	Buffalo Forge Co. Fan Engineering	Buffalo Forge Co. Woods		
	CIBSE Guides and Commissioning Codes, A, W and R	CIBSE	1986	
	HVCA: Specification for sheet metal ductwork	HVCA		
DW/143	Ductwork leakage testing			
DW/TM2	Cleanliness of new ductwork			
CM0101	HVCA: Standard maintenance specification for mechanical services in buildings: CM0101 Volume 1 Heating and Pipework Services Volume 2 Ventilating and Air Conditioning Volume 3 Control, energy and building management systems Volume 4 Ancillaries, plumbing and sewerage Volume 5 Electrics in buildings	HVCA		
	Model Water Byelaws: Dept. of the Environment	HMSO	1986	
	Water Supplies Byelaws Guide	WRC		

Certificate of Practical Completion

Issued by:	Arcadis LLP (previously EC Harris LLP)
Address:	34 York Way, London, N1 9AB
Project Co:	IHS Lothian Limited
Address:	13 Queen's Road, Aberdeen, AB15 4YL
Board:	Lothian Health Board
Address:	Waverley Gate, 2-4 Waterloo Place, Edinburgh EH1 EG
Contractor:	Multiplex Construction Europe Limited (previously Brookfield Multiplex Construction Europe Limited)
Address:	99 Bishopsgate, Second floor, London EC2M 3XD
Issue date:	22nd February 2019
Works:	Re-provision of RHSC and DCN at Little France
Situated at:	Little France Crescent, Edinburgh EH16 4TJ

Under the terms of the above-mentioned Project Agreement and as subsequently amended and supplemented by the Settlement Agreement and Supplemental Agreement relating to the Project Agreement. (Concluded and implemented 22/02/2019)
We certify that the Actual Completion Date of the Works was achieved on 22nd February 2019.

To be signed by or for the issuer named above.

Signed

[redacted]

On of Arcadis LLP

CC Lothian Health Board
IHS Lothian Limited
Multiplex Construction Europe Ltd

RHCYP & DCN

AHU Remedials Cover Sheet

The enclosed sheets represent the individual reviews of each Air Handling Unit (36 Total). Where items were deemed unsatisfactory at first visit this has been recorded at line 24 in the table. A sub table has then been included showing the items that were deemed deficient. If satisfactory at the second visit all items have been recorded as such. A third table contains the list of reviewers for sign off.

Additionally a summary sheet has been produced identifying maintenance items Bouygues need to continually be aware of when carrying out maintenance on the units.

As discussed and agreed between the Board and the AE's representing IOM and Turner PES and to satisfy board governance, could all participants in the AHU review process please sign each individual AHU sheet as well as in the table below recording that the unit meets the criteria set out in Section 8 of SHTM 03-01 and return a scanned copy. All reviewers will be given a complete copy once all signatures are received.

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL – Commissioning Manager – Hard FM	Ronnie Henderson	[redacted]	6/5/20
NHSL - Infection Control Lead	Lindsay Guthrie		
NHSL - Infection Control Consultant Microbiologist	Donald Inverarity		
Technical Advisor - Mott MacDonald	Ian Brodie	[redacted]	
AE NHSL - Turner PES	John Rayner		6 May 2020
AE Independent Validation - IOM	Paul Jameson		6/5/20
HFS*	David McNeill*		

***HFS Confirmatory signature once all others have signed**

AHU 02-01

Item Number	Source of Reference	Description	Date of 1st Visit: 04.02.20 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-01	Fresh air inlet plenum debris	24.03.20	Y
	Pre-filters & F7 final filters some panels wrong orientation top row		Y
	Pre-filter sliders & spaces missing on floor		Y
	Exposed cables at fans		Y
	Motorised damper not closing fully		Y
	Return filter door clashing with cable tray		Y
	Inaccessible channels for cleaning at metalwork		Y
	AHU not labelled to SHTM standard		Y
	Mud on inside face side of ductwork after final supply VCD non access door		Y
	Muddy footprint on inside top face of ductwork after final supply VC		Y

Date re-inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	R HANDREW	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald		[redacted]	
AE NHSL - Turner PES	JM [illegible] NEVIL		6 May 20
AE Independant Validation - IOM	PAUL JAMES		6/5/20
HFS			

AHU 02-02

Item Number	Source of Reference	Description	Date of 1st Visit: 11.12.19 Satisfactory Y/N	Date of 2nd Visit: 10.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-02	F7 final filter wrong orientation	10.03.20	Y
	Debris inside AHU at G4 fresh air pre-filter section		Y
	Frost coil control valve passing		Y
	Drain fitted to fresh air inlet ductwork		Y
	G4 extract filters incorrect orientation		Y
	Leaks around drip tray		Y

Date re-inspected - 10.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Date
NHSL - Commissioning Manager - Hard FM	R Hannen	6/5/20
NHSL - Infection Control Lead		
NHSL - Infection Control Consultant Microbiologist		
Technical Advisor - Mott MacDonald		
AE NHSL - Turner PES		6 May 20
AE Independant Validation - IOM	PAUL JAMESON	6/5/20
HFS		

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AHU 02-03

Item Number	Source Reference	Description	Date of 1st Visit: 11.12.19 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-03	Misaligned backdraught damper	24.03.20	Y
	G4 fresh air inlet filters incorrect orientation		Y
	F7 final filter wrong orientation (Photo 4)		Y
	Drainage on fresh air inlet but not a glass trap, Paul indicated on site a trap isn't required		Y

Date re-inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	R Hodgson	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald		[redacted]	
AE NHSL - Turner PES	Tom RAYNER		6 May 20
AE Independant Validation - IOM	PAUL JAMESON		6/5/20
HFS			

Item Number	Source of Reference	Description	Date of 1st Visit: 11.12.19 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-04	G4 fresh air inlet filters incorrect orientation	24.03.20	Y
	Misaligned backdraught damper blades		Y
	F7 final filter wrong orientation		Y
	Air leakage from ductwork access door on bend on the first section of ductwork immediately down-stream of the		Y
	Damaged & incomplete thermal insulation of fresh air intake ductwork, not full width of duct		Y
	Electrical conduit copex has air leak		Y
	Air leak from cooling coil drain connection		Y
	Filter gauge not marked up		Y

Date re-inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM		[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PFS			6 May 20
AE Independant Validation - IOM			6/5/20
HFS			

Item Number	Source of Reference	Description	Date of 1st Visit: 14.01.20 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-05	Fresh air inlet plenum debris	24.03.20	Y
	Dirty internal face of door		Y
	F7 final filter wrong orientation - Old AAF stock, light leakage around filter frame		Y
	Air leakage at access panel edges		Y
	Damaged thermal insulation on vertical supply ductwork		Y

Date re-inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:

"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	L Hamilton	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist		[redacted]	
Technical Advisor - Mott MacDonald	JM Rayner		6 May 20
AE NHSL - Turner PES	P.W. Thomson		6/5/20
AE Independant Validation - IOM			
HFS			

AHU 02-06

Item Number	Source of Reference	Source of Reference	Date of 1st Visit: 27.09.19 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-06	Pre-filters & F7 final filters some panels wrong orientation	24.03.20	Y
	Pre-filter sliders & spaces missing on floor		Y
	Motorised damper not closing fully		Y
	Dust on internal surfaces, requires cleaning		Y
	Air leakage from various points		Y

Date re-inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	A-HOWDEN	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald		[redacted]	
AE NHSL - Turner PES	JAMES TAYLOR		6 May 20
AE Independant Validation - IOM	PAUL JAMESON		6/5/20
HFS			

AHU 02-07

Item Number	Source of Reference	Description	Date of 1st Visit: 11.12.19 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	ate RE-Inspecte	Corrected (Y/N)
02-07	G4 fresh air pre-filter no stops on top edge of bottom row of filters, some horizontal not vertical pleats (Photo 10)	24.03.20	Y
	F7 final filter wrong orientation		Y
	Misaligned backdraught damper		Y
	Insulation tape on cooling coil drain connection see (1) above (Photo 8&9)		Y
	Debris inside AHU at G4 fresh air pre-filter section		Y
	Filter wedge supports are 100mm sections, should these be continuous, some cardboard frames bunched where forced		Y
	G4 return filters showing some gaps between panels		Y
	Evidence of mark ups for prospective new cleaning access hatches		Y

Date re-inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	A Thomson	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	S.M. Aswal		6/5/20
AE Independant Validation - IOM	P.W JAMIESON		6/5/20
HFS			

AHU 02-08

Item Number	Source of Reference	Description	Date of 1st Visit: 13.11.19 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02.03	Filter orientation incorrect	24.03.20	Y
	Debris and swarf in cooling coil drip tray		Y
	Glass trap to be provided to inlet drain		Y
	Wear on backdraught damper securing mechanism		Y
	Labelling to test point should be permanent and include duct size		Y
	Filters not positioned correctly on slider rail and top rail missing		Y

Date re-inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	A Hardman	[redacted]	6/11/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	Ian Rayner		6 May 20
AE Independant Validation - IOM	P W Jimmeson		6/5/20
HFS			

AHU 02-09

Item Number	Source of Reference	Description	Date of 1st Visit: 14.01.20 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-09	BYES noted the colling coil drip tray can be removed	24.03.20	Y
	Drip tray stained and needs cleaning, trap fill point in wrong location		Y
	F7 final filter wrong orientation, old AAF stock		Y
	Corrosion on fan guard mesh		Y
	Tech screw spikes in pan inlet plenum as a result on additional metalwork neither cut or capped, HAZARD for someone in the unit		Y
	Water in trap not clean		Y

Date re-Inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	A MONDRAM	[redacted]	6/11/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist		[redacted]	
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	Jas RAYNER		6 May 20
AE Independant Validation - IOM	P.W. JAMES		6/5/20
HFS			

AHU 02-10

Item Number	Source of Reference	Description	Date of 1st Visit: 04.02.20 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspecte	Corrected (Y/N)
02-10	Gaps in metalwork	24.03.20	Y
	Dust present on inner door faces, floor after frist coil. Unit not cleaned		Y
	F7 final filter wrong orientation		Y
	Tech screw spikes in fan inlet plenum as a result on additional metalwork neither cut or capped, hazard for someone in the unit		Y
	Water in trap not clean, milky appearance		Y
	Thermal insulation metal-cladding to be repaired after the new access door has been installed		Y
	Access door wont close at pre-filter catching door frame		Y

Date re-inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	R Hardman	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	Jon Haynes		6 May 20
AE Independant Validation - IOM	P.W James		6/5/20
HFS			

AHU 02-11

Item Number	Source of Reference	Description	Date of 1st Visit: 04.02.20 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-11	Pre-filters & F7 final filters partial wrong orientation	24.03.20	Y
	Fresh air inlet plenum debris		Y
	Tech screw spikes in fan inlet plenum as a result on additional metalwork neither cut or capped, hazard for someone in the unit		Y
	Dust present on inner door faces return filter access door		Y
	Drip tray has debris needs cleaning		Y

Date re-Inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	R Monaghan	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES			6 May 20
AE Independant Validation - IOM	P.W. JAMESON		6/5/20
HFS			

AHU 02-12

Item Number	Source of Reference	Description	Date of 1st Visit: 04.02.20 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-12	Pre-filters & F7 final filter some panels wrong orientation	24.03.20	Y
	Debris in pre-filter section		Y
	Inlet motorised damper not closing on spring return		Y
	Drip tray stained and needs cleaned		Y
	There is rfeverse flow of air from the Theatre back to the AHU when the fan is off and the access doors open, possibly due to		Y

Date re-Inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[illegible]	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	[illegible]		6 May 20
AE Independant Validation - IOM	P.W. JAMES		6/5/20
HFS			

AHU 02-13

Item Number	Source of Reference	Description	Date of 1st Visit: 25.02.20 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-13	In future humidifier section drain outlet to be capped flush with a future removal tempoary plug/ plate with silicone seal or equal &	24.03.20	Y
	Metalwork uneven gaps at edges gasket not flush to outside edge and other joints not sealed at junction		Y
	Cable containment at fan motor not sealed		Y
	Air bypassing at prefilter fitted incorrectly so slider to hold in place		Y
	Pre-filters & F7 final filters some panels wrong orientation top row		Y
	Pre-filter spacers on AHU floor		Y
	Drip tray dirty		Y
	Test point only H&V sticker not correctly labelled		Y
	Access panel not airtight		Y

Date re-inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	R Hammond	[redacted]	5/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	Jim Gaynor		6 May 20
AE Independant Validation - IOM	P. W James		6/5/20
HFS			

AHU 02-14

Item Number	Source of Reference	Description	Date of 1st Visit: 25.02.20 Satisfactory Y/N	Date of 2nd Visit: 24.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-14	Return filter facing wrong direction with respect to airflow	24.03.20	Y
	Metalwork uneven gaps at edges gasket not flush to outside edge		Y
	Screw lying in drip tray		Y
	Pre-filter wrong orientation		Y
	Drip tray removal restricted by pipework likely to foul removal		Y
	Exposed wiring at fan, not possible to provide full containment. Exposed cables in partition in fan chamber not enclosed		Y
	F7 final filter wrong orientation		Y

Date re-inspected - 24.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[redacted]	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	[redacted]	[redacted]	6 May 20
AE Independant Validation - IOM	[redacted]	[redacted]	6/5/20
HFS			

Item Number	Source of Reference	Description	Date of 1st Visit: 13.11.19 Satisfactory Y/N	Date of 2nd Visit: 10.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-15	Filter orientation incorrect	10.03.20	Y
	Screws and debris in cooling battery drip tray		Y
	Labelling to test point should be permanent and include duct size		Y
	Filter clamps and retaining system not adequately securing filters		Y

Date re-inspected - 10.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[illegible]	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	Jim GARDNER		6 May 20
AE Independant Validation - IOM	P.W JAMESON		6/5/20
HFS			

AHU 02-16

Item Number	Source of Reference	Description	Date of 1st Visit: 13.11.19 Satisfactory Y/N	Date of 2nd Visit: 10.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-16	Filter orientation incorrect	10.03.20	Y
	Pre filters incorrectly positioned on slider rail		Y
	Top slider rain on pre filters missing		Y
	Debris and swarf in cooling coil drip tray		Y
	Glass trap empty		Y
	Unit generally not clean		Y
	Labelling to test point should be permanent and include duct size		Y

Date re-inspected - 10.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	A McGeown	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES			6 May 20
AE Independant Validation - IOM	P W Jamieson		6/5/20

AHU 02-17

Item Number	Source of Reference	Description	Date of 1st Visit: 14.01.20 Satisfactory Y/N	Date of 2nd Visit: Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-17	F7 final filter old AAF stock.	10.03.20	Y
	No water in drainage trap		Y
	Access door not fully installed in inlet ductwork		Y
	Test points not marked H&V label on ductwork.		Y

Date re-inspected - 10.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[illegible]	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald	[illegible]		
AE NHSL - Turner PES	[illegible]		6 May 20
AE Independant Validation - IOM	[illegible]		6/5/20
HFS			

AHU 02-18

Item Number	Source of Reference	Description	Date of 1st Visit: 14.01.20 Satisfactory Y/N	Date of 2nd Visit: 10.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-18	F7 final filter wrong orientation, old AAF stock	10.03.20	Y
	G4 pre filter still not fitting well		Y
	AHU not labelled to SHTM standard		Y
	Drip tray stained and needs cleaning		Y
	Test points not marked on supply and extract ductwork		Y

Date re-Inspected - 10.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[illegible]	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	[illegible]		6 May 20
AE Independant Validation - IOM	[illegible]		6/5/20
HES			

AHU 02-19

Item Number	Source of Reference	Description	Date of 1st Visit: 14.01.20 Satisfactory Y/N	Date of 2nd Visit: 10.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-19	F7 final filter wrong orientation, old AAF stock	10.03.20	Y
	Fresh air inlet plenum debris		Y
	Drip tray has debris in it and needs cleaning		Y

Date re-inspected - 10.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	A MONDESIR	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	J M KAY NEVIL		6 May 20
AE Independant Validation - IOM	P W JAMESON		6/5/20

AHU 02-20

Item Number	Source of Reference	Description	Date of 1st Visit: 11.12.19 Satisfactory Y/N	Date of 2nd Visit: 10.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, Item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
[redacted]	Misaligned backdraught damper	10.03.20	Y
	G4 fresh air inlet filters incorrect orientation		Y
	Missing slider plate end-stop on extract G4 return filter bottom row		Y
	Missing filter sliders		Y

Date re-inspected - 10.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[illegible]	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	[illegible]		6 May 20
AE Independant Validation - IOM	[illegible]		6/5/20
HFS			

AHU 02-21

Item Number	Source of Reference	Description	Date of 1st Visit: 11.12.19 Satisfactory Y/	Date of 2nd Visit: 10.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y
General		BMS set point for dirty filter condition to be adjusted and set point advised.		

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	ate RE-Inspect	Corrected (Y/N)
02-21	Magnahelic gauge not marked G4 fresh air pre-filter	10.03.20	Y
	Filter slider tabs missing		Y
	Black granular debris in fan inlets behind finger guards not easily accessible as guard is not removable.		Y
	Debris inside AHU at G4 fresh air pre-filter section (Photo 23)		Y
	Gaps between body and sealed containment at thermal wheel section (Photo 21&23)		Y
	One of the G4 return filters top row is installed the wrong way round with respect to airflow		Y
	Surface rust upstream of fan on cut edges around thermal wheel		Y

Date re-inspected - 10.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[redacted]	[redacted]	6/5/22
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES			6 May 22
AE Independant Validation - IOM			6/5/22
HFS			

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Item Number	Source of Referenc	Description	Date of 1st Visit: 13.11.19 Satisfactory Y/N	Date of 2nd Visit: 10.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y
General		BMS set point for dirty filter condition to be adjusted and set point advised.		

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-22	Glass trap to be provided to inlet drain	10.03.20	Y
	Hatch size to inlet section too small (BYES to identify other locations by survey)		Y
	Labelling to test point should be permanent and include duct size		Y

Date re-inspected- 10.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager Hard FM	A Hodgson	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	Jim Rayner		6 May 20
AE Independant Validation - IOM	P.W. Jamieson		6/5/20
HFS			

AHU 02-23

Item Number	Source of Reference	Description	Date of 1st Visit: 11.12.19 Satisfactory Y/N	Date of 2nd Visit: 02.04.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-23	G4 return filter wrong orientation	02.04.2020	Y
	G4 fresh air inlet filter showing signs of bypass		Y
	Fresh air inlet plenum debris		Y
	Drip tray stained and needs cleaning		Y
	AHU not labelled to SHTM standard		Y
	Test points not marked on supply & with H&V label on extract ductwork		Y

Date re-inspected - 02.04.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[illegible]	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	[illegible]		6 May 20
AE Independant Validation - IOM	[illegible]		6/5/20
HFS			

AHU 02-24

Item Number	Source of Reference	Description	Date of 1st Visit: 14.1.20 Satisfactory Y/N	Date of 2nd Visit: 10.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-24	G4 fresh air inlet filter showing signs of discolouration	10.03.20	Y
	Water in trap not clean		Y
	Test points not marked on extract & with H&V label on supply ductwork		Y
	AHU not labelled to SHTM standard		Y
	F7 final filter old AAF stock		Y
	No water in drainage trap		Y
	Access door not fully installed in inlet ductwork		Y
	Test points not marked H&V label on ductwork		Y

Date re-inspected - 10.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definiton contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	A Hamilton	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	Jim Rayner		10 May 20
AE Independant Validation - IOM	PP James Gal		6/5/20
HFS			

AHU 02-25

Item Number	Source of Reference	Description	Date of 1st Visit: 11.12.19 Satisfactory Y/N	Date of 2nd Visit: 10.03.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-25	Part new filters to ISO standard, part old filters to BSEN do they have the same characteristic's? (There are 49 new filter types in 4 groups V 9 old filter types.)	10.03.20	Y
	There are some significantly large gaps along the edges of metalwork containment in this unit, the most likely cause it is too difficult to achieve a better fit, but it is questionable if this is an improvement. (Photos 18 & 19)		Y

Date re-inspected - 10.03.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	R Mason	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	JM Rayner		6 May 20
AE Independant Validation - IOM	PW James		6/5/20
HFS			

AHU 02-26

Item Number	Source of Reference	Description	Date of 1st Visit: 04.02.20 Satisfactory Y/N	Date of 2nd Visit: 02.04.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
02-2:	Fresh air F7 final filter incorrect orientationinlet plenum debris	02.04.20	Y
	G4 freshait inlet filter missing sliders & spacers		Y
	Fresh air inlet plenum corrosion inside face and access door		Y
	Dirty pre-filters		Y
	Corrosion on fan inlet guard edges		Y
	Tech screw spikes in fan inlet plenum as a result on additional metalwork neither cut or capped, hazard for someone in the unit		Y
	AHU not labelled to SHTM standard		Y
	Test points not in plantroom reported as in adjacent changing room		Y

Date re-inspected - 02.04.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[redacted]	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES			6 May 20
AE Independant Validation - IOM			6/5/20
HFS			

AHU 02-27

Item Number	Source of Reference	Description	Date of 1st Visit: 04.02.20 Satisfactory Y/N	Date of 2nd Visit: 02.04.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspecte	Corrected (Y/N)
02-27	F7 final filter panels incorrect orientation top row	02.04.20	Y
	Pre-filters not correct placement 600X600mm and 300X600mm panels not aligned with frame posts		Y
	Return filter top row incorrect orientation		Y
	Corrosion on inlet plenum floor		Y
	AHU not labelled to SHTM standard		Y
	Drip tray not clean		Y
	Air leakage 1 access panel		Y

Date re-inspected - 02.04.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	A Monaghan	[redacted]	6/7/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	Jim Rayner		6 May 20
AE Independant Validation - IOM	P.W. James		6/5/20
HFS			

AHU 04-01

Item Number	Source of Reference	Description	Date of 1st Visit: 25.02.20 Satisfactory Y/N	Date of 2nd Visit: 02.04.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, Item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
04-01	Screw spikes upto 5cm long in supply ductwork down stream of AHU discharge after manual damper.	02.04.20	Y
	Pre-filters slider plates missing		Y
	Plant labelling font too small		Y
	Tech screw spikes in fan inlet plenum as a result on additional metalwork		Y

Date re-inspected - 02.04.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[illegible]	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	[illegible]		6 May 20
AE Independant Validation - IOM	[illegible]		6/5/20
HFS			

AHU 04-02

Item Number	Source of Reference	Description	Date of 1st Visit: 25.02.20 Satisfactory Y/N	Date of 2nd Visit: 02.04.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
04-02	Reheat coil door access restricted by manometer/ pipework clash	02.04.20	Y

Date re-inspected - 02.04.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[illegible]	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	[illegible]		6 May 20
AE Independant Validation - IOM	[illegible]		6/5/20
HFS			

AHU 04-03

Item Number	Source of Reference	Description	Date of 1st Visit: 25.02.20 Satisfactory Y/N	Date of 2nd Visit: 02.04.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
04-03	Pre-filters & F7 final filters some panels wrong orientation	02.04.20	Y
	Pre-filter sliders missing		Y
	Tech screw spikes and unsealed holes in AHU side wall		Y
	Supply spring closed damper actuator not on spindle		Y
	Air leakage at bottom corner casing joint of attenuator section		Y
	Metal filings in drip tray		Y
	No access to inside face of louvre		Y
	Metalwork exposed cabling to extract fan only half encased possibly due to restricted access if cannot install metalwork how is cabling		Y
	Previous plastic conduit exposed above cooling coil eliminator plates no metalwork containment provided, eliminator plated not		Y
	Drip tray dirty		Y
	Plant labelling font too small		Y
	No H&V stickers at test point		Y

Date re-inspected - 02.04.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[illegible]	[redacted]	6/4/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	[illegible]		6 May 20
AE Independant Validation - IOM	[illegible]		6/5/20
HFS			

AHU 04-04

Item Number	Source of Reference	Description	Date of 1st Visit: 25.02.20 Satisfactory Y/N	Date of 2nd Visit: 02.04.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU 04-01	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
	Pre-filter incorrect orientation	02.04.20	Y
	Fresh air inlet section paper towel small rags on floor of AHU from cleaning		Y
	Fresh air intake louvre poor access to rear face, footprints on ductwork		Y
	Plant labelling too small		Y
	Drip tray dirty		Y
	Missing seal or poor sealing fresh air inlet motorised damper top room centre, light visible through blades		Y
	Pre-filter wrong orientation		Y
	Tech screw spikes in fan inlet plenum as a result on additional metalwork neither cut or capped, hazard for someone in the unit		Y

Date re-Inspected - 02.04.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[illegible]	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	[illegible]		6 May 20
AE Independant Validation - IOM	[illegible]		6/5/20
HFS			

AHU 04-05

Item Number	Source of Reference	Description	Date of 1st Visit: 25.02.20 Satisfactory Y/N	Date of 2nd Visit: 02.04.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-inspected	Corrected (Y/N)
04-05	Metalwork not sealed in 2 locations with supply fan section bottom of vertical top corner to controls cubicle	02.04.20	Y
	Pre-filters & F7 final filters partial wrong orientation		Y
	Extract section door access restricted by clash with metal conduit		Y
	No suitable to fresh air intake ductwork to clean nside face of louvre		Y
	Provide large print label to confirm location of main AHU test points which are in adjoining non-clinical room		Y
	Extract section rust spots on AHU floor at thermal wheel		Y
	Restricted access at cooling coil section due to pipework connections		Y
	Return filter top row wrong orientation		Y
	Plant labelling font too small		Y

Date re-inspected - 02.04.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	A Mandrell	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	P. W. James		6/5/20
AE Independant Validation - IOM			
HFS			

AHU 04-06

Item Number	Source of Reference	Description	Date of 1st Visit: 04.02.20 Satisfactory Y/N	Date of 2nd Visit: 02.04.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
04-06	Pre-filter slider tabs missing	02.04.20	Y
	Air leakage at cooling pipework		Y
	Frost coil access door catching on pipework below door		Y
	Metalwork at supply fan multiple ridges and channels		Y

Date re-Inspected - 02.04.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[illegible]	[redacted]	6/7/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	[illegible]		6/May/20
AE Independant Validation - IOM	[illegible]		6/5/20
HFS			

AHU 04-07

Item Number	Source of Reference	Description	Date of 1st Visit: 04.02.20 Satisfactory Y/N	Date of 2nd Visit: 02.04.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
04-07	F7 final filter bag trapped in front of frame	02.04.20	Y
	Pre-filter slider tabs missing		Y
	Tech screw spikes in fan inet plenum as a result of additional metalwork neither cut or capped, hazard for someone in the unit		Y
	Return filter door wont open fullt as manometer hitting pipework		Y
	Difficult to clean channels at metalwork in thermal wheel section		Y
	Air leakage at reheat coil pipework		Y

Date re-inspected - 02.04.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	R MANSELL	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	TOM RAYNER		6 May 20
AE Independant Validation - IOM	P W JAMESON		6/5/20
HFS			

AHU 04-08

Item Number	Source of Reference	Description	Date of 1st Visit: 04.02.20 Satisfactory Y/N	Date of 2nd Visit: 02.04.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, Item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
04-08	F7 final filter panels incorrect orientation	02.04.20	Y
	Pre-filter slider tabs missing		Y
	Drip tray cannot be removed due to pipework installed in front		Y
	1 slide removable access panel showing signs of over pressure bulge at Sandometal label, poor overlap of catchers		Y
	Pipework leaking at cooling coil control valve		Y
	No metal cladding on split coil AHU internal pipework with closed cell thermal insulation		Y

Date re-inspected - 02.04.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	RHONDA S	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	[illegible]		6 May 20
AE Independant Validation - IOM	P W JAMIESON		6/5/20
HFS			

AHU 04-09

Item Number	Source of Reference	Description	Date of 1st Visit: 04.02.20 Satisfactory Y/N	Date of 2nd Visit: 02.04.20 Satisfactory Y/N
1	29	Cabling inside AHU's – All cabling run through the length of the AHU to be encapsulated in a cleanable metal finish to the same specification as the AHU sections. This to be sealed using a gasket and sealant that can also be cleaned. All materials selected should meet the requirements of SHTM 03-01, Part A, Clause 1.41		Y
2	30	Filter pleat orientation – All filters to be installed with pleats in vertical orientation to prevent collapse		Y
3	31	Pre filters showing signs of bypass – All filters to be correctly installed and any gaps to the frame sealed to prevent, or minimise to within acceptable limits, air bypass.		Y
4	39	Motorised dampers take a long time to close – Adjustments made by Schneider, item now closed		Y
5	40	Plant labelling incorrect – Labelling of AHU and main branch ducting to be clear and legible with agreed names and locations served indicated.		Y
6	43	Motors running 95% – Report provided demonstrating that AHU's are capable of overcoming dirty filter condition and remaining spare capacity, item is closed.		Y
7	50	AHU Pressure controls – Reviewed by IOM and agreed closed.		Y
8	52	Temperature control – Temperature log received and reviewed by NHSL and IOM and agreed closed.		Y
9	57	Inverters – All inverters currently installed within the AHU to be removed		Y
10	58	Dampers (backdraught) – Damaged blades of backdraught dampers to be repaired		Y
11	60	Cleaning – Evidence of bird droppings and fouling of AHU 04-01 and associated pipework and cable tray, this to be fully cleaned		Y
12	61	Cleaning – Evidence of dead bird or rodent in inlet section of AHU 04-05, this to be removed and section fully cleaned		Y
13	62	Cleaning – Internals of all AHU's to be fully cleaned		Y
14	64	Inlet section – Appropriate means of draining AHU inlet section to be installed		Y
15	A	Air tightness – All penetrations for pipework, cables hoses etc should be sealed to prevent air leakage		Y
16	B	AHU access – NHSL require confirmation that all access doors to AHU's are free from opening restrictions		Y
17	C	Position of light switches – NHSL requires that light switches installed at high level are re-positioned to a convenient height from floor level. Bouygues have confirmed that they have a safe system of work for the switches in their current location, all agreed item closed		Y
18	D	Ductwork section changes – These may give rise to turbulence, however, provided this is not transferred to the area served all agreed that this item can now be closed.		Y
19	E	AHU Intake Louvres – Appropriate access is required for cleaning and after survey some hatches have been resized or relocated. Bouygues have confirmed that they have a safe system of work for this activity with the hatches in their current size and location. All agreed item closed.		Y
20	F	AHU Drainage – All AHU drainage traps to be clean. Bouygues to confirm that a PPM regime is in place to ensure they are maintained and kept in a clean condition		Y
21	G	AHU Drainage – AHU drainage to have appropriate fall to drain and that there is a minimum air gap of 15mm		Y
22	H	AHU 04-07 drainage – Brackets and impediments to be removed to allow correct installation of drainage pipework. Inspection of this unit showed satisfactory resolution and this item is now closed		Y
23	I	Air flow test points – Appropriate and correctly labelled airflow test points should be available on major branches to main ducts		Y
24	N/A	**OVERALL ASSESSMENT OF UNIT AT INSPECTION VISIT**	N	Y

AHU	ISSUES IDENTIFIED AT FIRST INSPECTION	Date RE-Inspected	Corrected (Y/N)
04-09	Pre-filters bypassing not sitting in frame correctly	02.04.20	Y
	Return filter panels wrong orientation		Y
	Motorised inlet damper not closing		Y
	Pre-filter slider tabs missing		Y

Date re-inspected - 02.04.20

Satisfactory Y/N - Y

The signatories below confirm that the AHU meets the definition contained in section 8 of SHTM 03-01 as follows:
"The system will be acceptable to the client if at the time of validation it is considered fit for purpose and will only require routine maintenance in order to remain so for its projected life."

Organisation	Name	Signature	Date
NHSL - Commissioning Manager - Hard FM	[illegible]	[redacted]	6/5/20
NHSL - Infection Control Lead			
NHSL - Infection Control Consultant Microbiologist			
Technical Advisor - Mott MacDonald			
AE NHSL - Turner PES	[illegible]		6 May 20
AE Independant Validation - IOM	[illegible]		6/5/20
HFS			

SCOTTISH HOSPITALS INQUIRY

Hearing Commencing 26 February 2024

Bundle 1 – Documents referred to in the expert report of Mr. Stephen Maddocks

A46676816