

MECHANICAL SERVICES SPECIFICATION

HARBOUR CONSERVANCY
ITCHENOR

Project N°: 5453

Revision: T3

Date: 17/01/25

Client: Chichester Harbour
Conservancy

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PART 1 - GENERAL DESCRIPTION OF INSTALLATIONS

1.1 GENERAL DESCRIPTION OF DEVELOPMENT

The Harbour conservancy building Itchenor, is the main office and workshop for Chichester harbour conservancy and also houses toilets and shower facilities for people using the conservancies moorings.

This project is for the refurbishment and provision of additional toilets and shower facilities.

1.2 SCOPE OF WORKS

The works described in this document include removal of existing redundant equipment, Air Source Heat Pump (ASHP) installation, underfloor heating, domestic hot and cold-water installations, mechanical ventilation, above ground soil and waste drainage and automatic controls.

The works will include liaison with the design team to ensure compliance with these requirements, systems installation, commissioning and the provision of all relevant documentation for the works. Specialist packages identified will require design input from the specialist sub-contractor. The described systems will be maintained by the installing contractor for the duration of defects liability.

All installations will employ modern technology and controls to achieve minimum energy and water consumption. Sustainable principles will be used throughout the design. All installations must be reliable, durable, and safe and easy to maintain.

The existing building is low enough to be at risk of flooding due to extreme high tides / adverse weather situations. Wherever possible all new powered / active equipment shall be installed with the underside at least +4.500 (1m clear above Reception RG-03 FFL).

1.3 QUALITY OF INSTALLATION

This project requires a robust commercial quality installation, as such, the mechanical installation will be viewed not only from a technical aspect, but also from a suitability viewpoint. To this end, if the Contractor installs items and equipment in a manner not befitting the quality of the installation, as judged by the Engineer, it will be replaced as required, at his own cost. The Contractor is required to pay heed to all the detail on the Drawings and in the Specification and ensure that his installation is of a standard appropriate to the project.

1.4 SAMPLES

The Mechanical Services Contractor is required to provide samples of all items of equipment that will be on display for approval by the Engineer/Architect/Client **prior** to ordering. All samples to be complete with the relevant finish. Where the same equipment/faceplate is specified with multiple finish types, samples of each type are required to be provided.

This is to include, but not be limited to, the following:

- Grilles
- Thermostats

1.5 STRIPPING OUT

The office and workshop are to be retained in operation throughout the project, therefore ensure any services that feed these areas are maintained during the contract.

Within the area to be refurbished / converted, make safe, isolate, cut back to incoming and remove all existing mechanicals services.

1.6 DOMESTIC WATER SERVICES

To ensure water quality and pressure the building will be fed from a mains boosted water supply.

The existing incoming water main enters the building from below ground into the proposed accessible staff WC, cut back all existing internal pipework to this location and provide new stopcock and drain valve.

From the existing incoming supply, extend a new supply to a new pressure system and horizontal storage accumulator located under the stairs within the workshop.

From the pressure booster set extend new cold water service to feed all existing and new outlets within the building and the hot water cylinder.

Provide hot water from an unvented horizontal storage calorifier located under the stairs in the workshop heated from the ASHP, with an electric immersion heater to provide back up. From the hot water cylinder extend flow and return pipework through the ground floor ceiling void and connect to all hot draw offs, provide pumped circulation to maintain temperatures at draw-offs.

Provide weekly sterilisation of the hot water system by initiating the HWS return pump and electric immersion heater to bring the temperature above 65°C whilst circulating for 2 hours.

Provide isolation and flow control at each draw-off. Provide hot water blending valves to all outlets accessible to the public to ensure safe temperature.

1.7 AIR SOURCE HEAT PUMP

Install a complete system to provide low pressure hot water for the underfloor heating and domestic hot water generation.

System to comprise of external air-cooled condensing units located at the side of the building near the external staircase on anti-vibration mounts. From the ASHP pipework to enter the ground floor office, and extend to buffer vessel in

the workshop store. From the buffer vessel extend to serve the underfloor heating manifold and hot water cylinder.

1.8 HEATING SYSTEM

Heating to the refurbished areas will be provided via underfloor heating.

Underfloor heating will comprise of a pumped heating flow and return manifold within the warehouse store distributing to a system of oxygen barriered plastic pipes buried in the floor screed. Rooms will be zoned and controlled with space sensors operating automatic valves in the manifold. The system is to be a low profile thickness system comprising pipework within a former frame with liquid screed infill.

1.9 VENTILATION SYSTEMS

Heat recovery ventilation will be provided throughout.

To rooms with direct external wall access provide individual wall mounted supply and extract heat recovery units, units to run continuously with boost via integral humidity sensor.

To rooms with no direct external access, provide a single heat recovery supply and extract ventilation system comprising of heat recovery unit mounted on the drying room roof within the workshop connected via ductwork to supply and extract grilles within each room, intake and exhaust ductwork will run through the workshop to terminate above the existing roof. System to operate on constant trickle with boost initiated via presence detection.

All external louvres to be colour matched to façade.

1.10 CONTROLS

Provide a Wi-Fi enabled control system, suitable for remote operation via internet and phone app to allow the following functions:

- 24/7 Heating time clock control via LPHW primary and secondary pumps
- 24/7 Hot water time clock control via LPHW primary and secondary pumps and HWS secondary pump
- System to have HWS priority via UFH manifold pump control. (Pump to be off when HWS temperature in cylinder is not satisfied)
- Weekly HWS Sterilisation
- Time clock override
- ASHP fault indication

ASHP is to operate under its own controls to provide optimum start, weather compensation and primary pump control.

Underfloor heating will operate under its own control system to provide independent room temperature control via wall mounted tamperproof thermostats.

1.11 ABOVE GROUND DRAINAGE

Provide above ground uPVC soil and waste drainage to meet Building Regulations requirements.

1.12 COMMISSIONING AND TESTING

Commission and test systems to the approved standards. Provide seasonal commissioning during the one year following practical completion to ensure that systems operation is optimised.

PART 2 - DESIGN STANDARDS & RESPONSIBILITIES

2.1 SCOPE OF DESIGN STANDARDS & RESPONSIBILITIES

This section of the specification defines those elements of the Mechanical Services sub-contract where specialist design input is required, the standards to be used and the presentation format required. It also includes the design parameters of the consultant designed elements of the mechanical services, to allow procurement and commissioning of the installed systems and the required contractor's information necessary for a skilful and co-ordinated installation to be achieved.

2.2 SUB-CONTRACTOR'S DESIGN ELEMENTS

The sub-contractor will be responsible for producing and presenting a suitable design solution for the specialist installations compliant with this specification. Design solutions will comprise drawings, calculations, equipment schedules, loadings and capacities, and locations of all plant and equipment.

Full design submissions are required for:

- Controls including Wi-Fi enabled control system
- Underfloor heating

The submitted design may be subject to development before final completion due to co-ordination requirements, overall budgetary restraints, or value engineering.

The sub-contractor will also be responsible for assessing the performance of the proposed design and demonstrating to the client before installation that it meets published benchmarks for performance, energy efficiency and sustainability. The Contractor will liaise and discuss fully with the client all aspects concerning the services design and installation.

2.3 REFERENCE GUIDES AND PUBLICATIONS

Ensure that all work conforms to current editions of the following standards:

- British Standards
- Building Regulations
- CIBSE Design Guides
- Clean Air Act
- The Control of Pollution Act
- COSHH Regulations
- Construction Design Management (CDM) Regulations
- Electricity at Work Regulations
- Gas Safety (Installation & Use) Regulations
- Health and Safety at Work Act
- HSE Codes of Practice including "The Control of Legionellosis"
- BESA Codes of Practice
- Institute of Plumbing Design Guide
- Water Supply (Water Fittings) Regulations
- WRAS Directory

If a conflict arises between these specifications, advise the Engineer accordingly.

2.4 INFORMATION TO BE PROVIDED

Submit the following information for approval:

- Design drawings, as described above, for sub-contractor designed elements, indicating proposed design philosophy, flow rates and configuration of all proposed systems including system schematics
- Working drawings co-ordinated with building fabric, structure and other trades and incorporating key site dimensions to provide a neat, skillful and co-ordinated installation.
- Builders work drawings showing all requirements associated with the services installations. These are to be at a scale of 1:100 with specific details at 1:20. Major structural builders work requirements have already been identified but the sub-contractor must check to ensure that these are compliant with his proposed installations.
- Schedule of all proposed plant and equipment, detailing manufacturer, reference number, duties, electrical requirements, and accessories. Indicate where alternatives to the preferred manufacturers in this specification are offered.

2.5 PROGRAMME AND DOCUMENT CHECKING

Prepare a schedule, consistent with the main contract programme, detailing when all drawings and calculations will be issued. When issuing the drawings/calculation schedule, identify the extent and purpose of the issue, and the approval status of all drawings.

2.6 DESIGN PARAMETERS

The following design parameters have been used for the Mechanical Services installation:

Description	Design Parameters
ASHP Primary System	55°C Flow / 47°C Return
Underfloor Heating System	55°C Flow / 47°C Return
Heating for domestic hot water	55°C Flow / 47°C Return
Internal (Dry Resultant) Space	18°C
Winter Outside Design	-3°C
Hot Water Generation/Storage	60°C
Min. Hot Water Distribution	55°C
Max. Hot Water Temperature	
Shower	41°C
Basin	41°C
Internal Cold-Water Pressure	2.0 Bar maximum

PART 3 - PLANT & EQUIPMENT STANDARDS

3.1 MANUFACTURERS

Where manufacturer's products are referred to in this document, they are indicative of the quality of product to be provided. Alternative products of an equivalent quality may be offered but will be subject to approval of the Employer's representatives. Provide related products from a single manufacturer, where possible, to reduce maintenance problems.

3.2 PIPEWORK AND FITTINGS

Application: Heating and Water
Material: Copper tube to BS EN 1057 R250
Fittings: Yorkshire lead-free capillary to BS EN 1254 Pt 1

Application: Condensate
Material: uPVC waste pipe to BS4514
Fittings: Solvent weld joints

Application: Waste Systems
Material: uPVC waste pipe to BS4514
Fittings: Solvent weld

3.3 VALVES & ANCILLARIES

Isolation: Lever operated ball valve as Crane D171. Provide spindle extension on insulated pipework.

Isolation & Flow Restriction: Robert Pearson & Company. Tel: 01985 850954
Basins:RP/ACC VALVE 6 LPM
Sinks:RP/ACC VALVE 10 LPM
Showers:RP/ACC VALVE 10 LPM

Drain Cocks: Broen Ballofix, ball valve DZR

Regulation & Flow Measurement: 15-50mm - Crane D931 FO double regulating

Thermostatic Shower TMV3 scheme approved

Thermostatic Basin Tap TMV2 scheme approved

3.4 PIPEWORK INSULATION

Application: Internal Water Services & Heating
Materials: Zero ODP and GWP<5
Materials: Phenolic Foam
Manufacturer: Kingspan
Thickness: Environmental thickness to BS 5422
Finish: Aluminium foil

3.5 DUCTWORK

Application: Rigid Rectangular
Type: Galvanised MS to HVCA DW 144, low pressure

Application: Rigid Circular
Type: Galvanised MS to HVCA DW 144, low pressure

3.6 DUCTWORK INSULATION

Application: Heat Recovery Supply & Extract
Materials: Zero ODP and GWP<5
Manufacturer: Rockwool
Type: Ductwrap
Facings: Alumaguard, self-adhesive foil finish.
Thickness: Environmental thickness to BS 5422 2001 edition

3.7 DUCTWORK ANCILLARIES

Application: Supply Valves
Type: Circular Wall / Ceiling Supply Valve
Manufacturer: Gilberts Grilles
Type: Series SX

Application: Extract Valves
Type: Circular Wall / Ceiling Extract Valve
Manufacturer: Gilberts Grilles
Type: Series GX

Application: External Wall Louvres
Type: Architectural wall louvres colour matched to wall
Manufacturer: Gilberts Grilles
Type: Series WG

3.1 AIR SOURCE HEAT PUMPS

Application: LPHW Heating
Quantity: 1
Manufacturer: Mitsubishi Ecodan
Type: High Temperature Commercial Heat Pump
Ref: PUZ-WM112VAA
Rated output: 11kW @ 70/60°C

3.2 BUFFER VESSEL

Application: LPHW BUFFER STORAGE
Quantity: 1
Manufacturer: Cordivari
Details: Pre-insulated Buffer Vessel
Ref: Puffer VB 500
Storage: 478 litres
Operating Pressure: 3 Bar
Physical Size: 1645 H, 750 DIA

3.3 PUMPS

Application: ASHP Primary Heating Circulation
Description: Variable speed centrifugal pump
Manufacturer: Grundfos
Type: Magna 1 25-80
Duty: 0.76 l/s v 75 kPa
Electrical: 230V 1 ph.

Application: Heating Secondary Circulation
Description: Variable speed centrifugal pump
Manufacturer: Grundfos
Type: Magna 1 25-80
Duty: 0.76 l/s v 48 kPa
Electrical: 230V 1 ph.

3.4 HEATING EXPANSION SYSTEM & VESSEL

Application: LPHW Heating System Expansion
Manufacturer: Mikrofill
Ref: Mikrofill3
Vessel Size: 100 litre
Static Head: 3m
Cold Fill: 1.0Bar
Max Pressure: 3.0Bar
Dimensions: 512mm dia. x 669mm H.
Cons: 1" BSP

3.5 UNDERFLOOR HEATING

Application:	Space Heating
Description:	Design and provide underfloor heating systems as indicated on the drawings. Systems will be designed to heat spaces to design temperatures with 50/45°C LPHW. Installations will comprise of a pumped flow and return manifold with pumps, gauges, flow meters, drain & fill points, thermostatically controlled manifold valve actuators, pipe flow control in the return manifold and pressure relief valve.
Manufacturers:	Warmafloor / Uponor
Pipework:	Polybutylene with diffusion barrier or PE-X
Controls:	Tamper resistant wall mounted thermostats within each room linked to remote controller display and underfloor manifold zone valves. Contractor to provide example of thermostat prior to installation.

3.6 COLD WATER BOOSTER SET

Application:	Cold Water Boosting
Description:	Water pressure set and accumulator
Manufacturer:	Boost-a-Main
Pressure Set:	Model 10
Accumulator:	Pro Ves Horizontal 450

3.7 HOT WATER CYLINDER

Application:	Hot Water Generation
Manufacturer	Telford Cylinders
Type:	Tempest Indirect Horizontal
Ref:	TSMI500H
Storage Capacity:	500 Litres
Electrical:	240v 1 ph.
Immersion Heater:	3 kW
Connections:	
Cold Water Inlet:	22mm
Hot Outlet:	22mm
HWS Primary F&R	22mm
HWS Secondary R	22mm
Accessories:	Unit to be complete with mains connection kit of: Expansion vessel, Expansion relief valve and non-return valve.

3.8 HEAT RECOVERY UNITS

Application: Single Room Heat Recovery Ventilation
Manufacturer: BSK
Description: Single fan heat recovery unit
Type: Zephyr
Controls: Unit to run constant trickle with boost initiated by integrated humidity sensor

Application: Multiple Room Heat Recovery Ventilation
Manufacturer: Blauberg
Description: Supply and extract heat recovery unit
Type: Komfort EC LBE 400
Controls: Unit to run constant trickle with boost initiated by humidity sensor in return ductwork and/or presence detection in the two approach room locations.

3.9 CHLORINATION

Flush carcassed domestic water systems with chlorine dioxide solution prior to connection to the mains. Chlorinate system overnight on completion with chlorine dioxide solution and provide certification.

3.10 BONDING

Ensure all pipe installations, ductwork and plant are equi-potentially bonded to the structure.

PART 4 - STANDARDS OF WORKMANSHIP

GENERAL

The following information details standards of workmanship for this project, this is a standard scheduled and may include details of items that are not specific to this project but are retained for information.

4.1 SCHEDULE OF RATES

When requested, provide a quantified schedule of rates with sub-totals, and totals consistent with the mechanical services price.

4.2 STANDARDS OF INSTALLATION

Ensure that all work conforms to current editions of the following standards:

- BS and BS EN Standards
- Building Regulations
- Water & Water Supply and Fittings Regulations 1999
- Construction Design Management (CDM) Regulations
- Clean Air Act
- Gas Safety (Installation & Use) Regulations
- Electricity at Work Regulations 1989
- BESA Codes of Practice
- Health and Safety at Work Act 1974
- HSE Codes of Practice including "The Control of Legionellosis"
- Loss Prevention Council Recommendations
- WRc Directory

4.3 STANDARDS OF WORKMANSHIP

Provide a competent supervisor, on site for the duration of the contract, to oversee the works and to ensure that all work is completed in a neat, skillful manner. Use only appropriately skilled workers. Ensure that only Gas Safe registered operatives work on gas installations. Ensure that only certified operatives work on unvented domestic hot water systems above 15 litres. Ensure that electrical work is only undertaken by an ECA or NICEIC registered contractor.

4.4 TOOLS AND KEYS

Provide all necessary tools and keys for the operation and routine maintenance of the installations. Provide and fix on the wall of the boiler or plant room, a purpose made rack to hold keys and tools.

4.5 COMMISSIONING, TESTING AND DEMONSTRATING

Before commissioning, ensure that all ductwork systems are cleaned, water systems flushed and filled, and gas systems purged. Commission systems to comply with the specified design parameters, in accordance with CIBSE Commissioning Codes and manufacturer's instructions. Include for any

temporary works, fuel or other consumables required. At completion, demonstrate the operation of the system to the Engineer. Demonstrate the operation of the system controls to the user. Allow sufficient time in the programme for commissioning, testing, and demonstrating the system.

4.6 OPERATING & MAINTENANCE INSTRUCTIONS & HEALTH & SAFETY FILE

As part of the Health and Safety File, supply three full sets of working instructions for the whole of the plant covered in this Specification prior to Practical Completion. Provide manuals compliant with Class D of the BSRIA Technical Note TN1/84 as explained in BSRIA Application Guide AAG1/87.1 and comprising the following:

- A full description of the installation, including controls.
- Schedules of all installed equipment with figure numbers, duties, electrical details and manufacturer's address and telephone number.
- Certificates of Electrical Completion, pressure testing, commissioning, chlorination etc.
- Contractor's emergency call-out numbers.
- Valve charts.
- Gas line diagram.
- Instructions for the safe operation of the systems.
- Fault finding procedures.
- A schedule of recommended daily, weekly, monthly, quarterly, and annual maintenance.
- Manufacturers maintenance instructions cross referenced to schedule of installed equipment.
- A1 'As installed' drawings including manufacturing and control panel wiring drawings folded to A4 size in transparent plastic wallets with schedule.
- Disposal instructions.

Submit draft copy for approval two weeks before Practical Completion. Within 28 days of completion of the works, supply two paper copies of the completed document and two electronic copies on CD-ROM with 'As Installed' drawings in AutoCAD 14 format.

4.7 DEFECTS LIABILITY

The whole of the work is to be guaranteed for a period of twelve months, from the date of the Certificate of Practical Completion. The Contractor shall remedy at his own expense all defects in installation, materials, and equipment due to faulty design, construction or workmanship which may develop in that period, notwithstanding the fact that the material and equipment is specified in this specification.

Defects affecting the system functionality must be repaired within two working days of them being reported.

4.8 MAINTENANCE

Provide all regular maintenance of the equipment as detailed in the Operating and Maintenance manual including emergency call out for the duration of the Defects Liability period.

PIPEWORK

4.9 GENERAL WORKMANSHIP

Install pipework to follow the building line but all vertical pipes are to be plumb. Install pipework to vent and drain naturally, where possible. Install horizontal pipes with a gradient of 1:500 in mains and 1:250 in branches. Where natural venting cannot be achieved, fit automatic air vents. Fit drain cocks at all low points to allow the system to be drained completely.

Space pipes consistently and install un-insulated pipes between 25-50mm clear of walls. Where pipes are to be insulated, ensure finished insulation is 12-25mm clear of walls and 100mm clear of trunking in plant rooms. Run pipes above, not on the skirting.

Use only proprietary pipe fittings. Ensure pipe bends and sets are free from crinkles, flattening, score marks or distortion. Use only equal tees, reducing branch and main pipes not closer than 10 diameters from the tee.

Sleeve all pipework passing through walls and floors with pipe lengths of similar material. Where the wall or floor is a fire partition, pack the annulus between pipe and sleeve with an approved fire-proof packing. Fit split wall plates over pipework at all visible sleeves. Do not joint pipework within the sleeve.

Provide unions at all pipe connections to plant and at other convenient locations to allow pipework to be dismantled.

Avoid contact between dissimilar metals in pipework, fittings, or fixings.

4.10 SUPPORTS

Support pipes at the following intervals.

Mild Steel			Copper		
Nominal Diameter mm	Vertical Spacing Meters	Horizontal Spacing Meters	Nominal Diameter mm	Vertical Spacing Meters	Horizontal Spacing Meters
15	2.4	2.0	15	2.0	1.2
20	3.0	2.4	22	2.4	2.0
25	3.0	2.4	28	2.4	2.0
32	3.0	2.7	35	3.0	2.4
40	3.6	3.0	42	3.0	2.8
50	3.6	3.0	54	3.0	2.8
65	4.5	3.6	67	3.7	3.0

Mild Steel			Copper		
Nominal Diameter mm	Vertical Spacing Meters	Horizontal Spacing Meters	Nominal Diameter mm	Vertical Spacing Meters	Horizontal Spacing Meters
80	4.5	3.6	76	3.7	3.0
100	4.5	3.9	108	3.7	3.0

Provide all necessary hangers, brackets, struts, and rings for the support of pipework. Do not drill or cut structural members without the approval of the Contract Administrator.

Unless otherwise indicated, use metal split ring, screw fastened clips.

Ensure that pipe supports or clips are adequate for the weight to be carried and that they permit free expansion of the pipework.

4.11 THERMAL EXPANSION

Make all necessary provision for the expansion of pipework due to temperature change. Ensure that pipework is free to move.

4.12 COPPER PIPEWORK

Make capillary joints by cutting pipe end square with a saw or wheel cutter. Reamer out to ensure full bore and clean plain end. Use only lead free, solder ring fittings with a suitable phosphoric acid-based flux to BS.5245, sparingly applied. Make joint in accordance with manufacturer's instructions. Clean off traces of flux when joint is completed. Do not use end fed fittings, or self-cleaning fluxes.

Prepare compression joints as above and make in accordance with the manufacturer's instructions. Use only an inorganic, non-toxic, non-setting type jointing compound, which is WRC approved, as Boss Green or equivalent.

Make screwed joints with PTFE tape or a WRC approved inorganic thread sealing fibre with an inorganic compound. Do not use hemp or Boss White.

Make flanged joints with flanges to BS.4504 part 1 & 2 of the appropriate Table and jointed with compressed non-asbestos WRC approved fibre joint rings. Pull up joint evenly on all bolts.

Provide eccentric reducers where continuous air venting is required in the direction of a reduction. Do not employ bushes to reduce bore on a pipe run.

Do not use hexagon pattern nipples or site fabricated fittings.

Make final connections to taps with a proprietary connector and inorganic fibre washer.

4.13 BURIED PIPEWORK

Ensure buried water pipework has 900mm of cover to protect against frost and traffic damage. Bed MDPE pipework on sand and cover with sand. Lay warning tape in trench above pipe. Compact trenches backfill and re-instate original surfaces. Sleeve service entries into buildings and seal gas pipes to sleeve at inside surface. Ensure buried service valves are fully accessible.

4.14 PROTECTION AND CLEANING

Protect open ends of pipework with caps or plugs to prevent the ingress of foreign matter, during the installation stage of the work. Do not use paper plugs, shavings, rag waste or the like.

On completion of each section of water pipework, flush through with clean water to remove grit or other foreign matter.

Clean pipes externally to remove cement and paint.

4.15 INSULATION

Provide and install thermal insulation to pipes, valves and fittings as follows:

- All heating and primary HWS pipework in boiler rooms, plant rooms, trenches, ducts, voids, boxing, false ceilings, wall chases, storerooms and elsewhere, except for heating pipework used for heating surface.
- All hot water service circulating pipework in any location.
- Hot water dead-leg pipework in hollow partitions, trenches, ducts, voids, boxing, false ceilings, wall chases, where pipework is hidden and in goods stores and other locations, where the hot water pipework could emit unwanted heat.
- All cold feed and open vent pipework, throughout its length.
- Cold water pipework in ducts, voids, boxing, false ceilings, wall chases, unheated storerooms, and other unheated spaces, for frost protection.
- Cold water pipework in plant rooms, boiler houses and in other locations where necessary to protect the cold water from external heat sources.
- Cold water mains pipework where conditions are likely to cause condensation on the pipework. Provide a vapour seal to this insulation.
- Where uninsulated pipework bridges the insulation between a cold void and a warm space.

Carry out thermal insulation work using a specialist firm employing craftsmen skilled in the class of work. Do not apply thermal insulation until installation has been fully tested and all joints proved sound. Ensure all materials are kept dry. Insulate pipes separately. On exposed insulation, neatly finish joints, corners, edges and overlaps to fall on blind side. Ensure overlaps are neat and even and parallel to circumferential and longitudinal joints.

4.16 PAINTING

Paint visible ironwork and un-insulated pipework forming part of the mechanical services installation, in boiler rooms, plant rooms, roof voids and tank rooms.

Clean metalwork thoroughly before painting and coat with primer, followed by undercoat and gloss paint.

Paint metalwork black and gas pipework yellow unless otherwise indicated.

4.17 IDENTIFICATION

Identify each pipe in a boiler room, plant room, tank room, void or duct for service, circuit and direction of flow using 300mm colour bands to BS.1710.

Apply bands in each room or enclosure, at intervals not greater than 15m, at each valve and junction and at each ceiling, duct, or shaft access point.

Identify each valve, cock, and air vent etc., with a securely attached disk engraved with numerical references, except where exposed in occupied areas (unless otherwise indicated).

Provide a printed valve chart for inclusion in the Manuals, identifying each valve by number, purpose, and location. Fix in boiler and plant rooms, valve schedules identifying by number each valve in the room. Print valve charts on white, non-fading paper and mount in frameless picture mount, permanently fixed to the wall.

Where valves are provided for emergency shut-off of services, provide and fix adjacent Traffolyte labels engraved red on yellow 'Emergency Shut-Off'.

4.18 TESTING

Test the whole of the heating, and water services pipework installations by hydraulic pressure.

Test gas pipework by pneumatic pressure.

Comply with procedures given in BESA Guide to Good Practice for Site pressure Testing of Pipework and ensure safety precautions detailed in HSE Guidance Note GS4 Safety in Pressure Testing are adopted.

Provide a blanked connection to accommodate a check gauge in addition to the accurate gauge fitted to the section under test.

Test concealed or buried pipework before any permanent covering is applied.

Advise Contract Administrator, in advance, of the time pressure test may be witnessed. Apply a heating test to all heating and hot water supply systems with boiler temperature in each case maintained at 85°C for a period of not less than 6 hours. Allow the system to cool down before examining for defects.

If leaks or defects are discovered during testing, re-test following rectification of the fault.

Provide all necessary testing gear, and all labour for tests. Include for testing all systems in sections at different periods of time to suit the contract programme.

Provide a test certificate witnessed by the Contract Administrator, for each test carried out.

Ensure that all items of equipment used in installations can withstand the test pressure. Isolate existing plant and pipework as necessary to ensure components are not tested to a pressure greater than their age and condition can withstand.

Apply hydraulic test of 1 hour's duration as follows:

Operating gauge pressure less than 3.5 bar, test gauge pressure 7.0 bar.

Operating gauge pressure 3.5-7.0 bar, test gauge pressure twice operating pressure.

Operating gauge pressure greater than 7.0 bar, test gauge pressure 14.0 bar or one and a half times operating pressure whichever is the greater.

Apply pneumatic tests of 1 hour's duration as follows:

Test gauge pressure twice operating pressure

4.19 INHIBITOR

Following testing, dose the whole of the heating system with an inhibitor solution, either as specified or of an approved type suitable for the system. Follow the manufacturers recommendations for solution strength. Label F & E or pressurisation tank or fill point with details of additive and solution strength.

Ensure inhibitor selected is compatible with all components in system.

REFRIGERATION PIPEWORK

4.20 PIPE WORK, FITTINGS AND SUPPORTS

The pipe work shall be of refrigerant quality copper to BS2871 Part 2, ASTM 280, DIN1754/8905 half hard tempered. Soft tempered pipe work may be used where the pipe diameter is 1/4" or 3/8". Long radius bends shall be formed using pipe bender. The use of short radius preformed bends and elbows should be avoided to minimise pressure drop and possibility of leaks.

OXYGEN FREE NITROGEN MUST BE PASSED THROUGH THE PIPE WORK DURING ALL BRAZING OF JOINTS TO PREVENT THE FORMATION OF OXIDISATION SCALE ON THE INSIDE SURFACE OF THE PIPES.

All pipe work shall be clean, de-hydrated and sealed. Pipe work shall be stored under dry conditions. Any pipe work found to be stored without the end caps should be rejected. Where sections are cut from a new coil any remaining lengths must be re-sealed. During the installation if the system must be left unattended for any purpose whatsoever, the openings in the systems must be securely sealed.

Pipe work fittings for branching off to indoor units must be 'Refnet' headers or joints. No other fittings are acceptable. The positioning of these joints shall be strictly in accordance with the manufacturer's specification.

All pipe work shall be insulated with Armaflex Class-0 type insulation; 13 mm thick. The 'Refnet' joints or headers shall be insulated with the preformed insulation supplied with these fittings. Insulation exposed to atmospheric conditions shall be protected with two coats of special Armstrong NH insulation paint. All insulation joints shall be made using Armaflex adhesive and care should be taken that every part of insulation is sealed to maintain a vapour barrier.

The pipe work must be supported through its entire length according to good refrigeration practice. However, the brackets must not be positioned directly on the 'Refnet' joints or headers. On horizontal pipe work the bracketing should be over the insulation to allow pipe movement due to contraction and expansions. The vertical pipe work shall be bracketed at no more than 1000 mm centres. The horizontal pipe work shall be bracketed at no more than 1500 mm centres.

All installed pipe work lengths are to be accurately measured and recorded on the form provided on the removable access panel with the outdoor unit. This information is required for accurate calculation of the additional refrigerant charge for the system. The weight of the additional refrigerant must also be recorded on this form for future reference.

Installation

Installation of the system shall be undertaken by a specialist, manufacturer approved installer.

Pressure Testing, Evacuation and Commissioning

After Installation of pipe work, and prior to sealing of insulation joints, pipe work should be pressure tested to 550 psi, held for 24 hours, and checked for leaks, vacuumed/dehydrated to -752 mm Hg and held at that setting for 1 to 4 hours depending on the pipe length.

Commissioning of the system is to be undertaken by the equipment manufacturer/ supplier.

PLANT & EQUIPMENT

4.21 HEATING AND HOT WATER SERVICE BOILERS

Install boilers square on bases or wall. Ensure boiler fronts are aligned, and multiple boilers consistently spaced. Allow sufficient space for boiler maintenance. Protect boiler casings until practical completion. Do not fit casings until joints have been tested. Ensure that each boiler is fitted with a safety valve suitable for the system pressure. Provide each boiler with a drain cock. Pipe safety valve and open vent discharges to within 150mm of floor level and bracket bottom of pipe securely to floor. Ensure boiler thermostat pocket is oil filled. Provide a temperature gauge on the flow connection of each boiler. Ensure boiler room is ventilated to BS 6644 or 6798 and that ventilation is unobstructed. Ensure boilers are commissioned by manufacturers.

4.22 FLUES

Provide fabrication drawings for flue systems prior to manufacturer, allowing two weeks for comment or approval. Ensure flues are adequately supported without the need for guy wires above roof level. Provide trapped drains to a convenient discharge location to remove all condensate and rainwater from the system. Terminate flues at a suitable distance from upstands/roof pitch to avoid back pressure and to allow flue gases to clear the building in all wind conditions. Unless otherwise indicated, provide a lead flashing sleeve for fixing by others and a flue cravat to ensure that the structural penetration of the flue is weatherproof. Do not locate joints in depth of floor/sleeves. Install with sockets facing upward.

For fanned flues and balanced flues terminating below 2m from ground, fit a secure wire guard over terminal.

4.23 CIRCULATING PUMPS

Provide matching flanges for flanged pumps. Ensure that pump is installed in accordance with manufacturers requirements, particularly control box attitude on variable speed pumps. Support pumps independently of pipeline. Provide vibration isolation. Provide a pressure gauge and cock on the suction and discharge connections of each pump or twin-pump.

4.24 RADIATORS & RADIATOR VALVES

Check radiator locations for fit prior to ordering. Provide radiators with a durable white finish unless otherwise specified. Fit radiators using the manufacturer's brackets and ensure that they are level. Ensure that radiator fixings are robust, and that the radiator cannot be dislodged by vandalism. Provide secure fixings for radiators on stud walls. Provide adequate clearance between the top of the radiator and worktops, sills, dado trunking etc., to allow free circulation of air. Provide adequate clearance between the bottom of the radiator and skirting boxing or trunking etc., to allow free circulation of air.

Where there are existing conduits or small obstructions on an existing wall, allow for packing out brackets to give a neat appearance.

Ensure that each radiator has a vent cock at the top and provide a thermostatic control valve on the flow and a lock-shield valve on the return at bottom opposite connections, unless otherwise specified. Ensure that the direction of flow through the thermostatic valve is compliant with the manufacturer's instructions.

4.25 UNDERFLOOR HEATING

Adjust pipe spacing to meet heating requirements. Provide increased pipe density adjacent to glazed screens and full height windows. Lay insulation, grid, and pipework immediately before screeding operation. Pressure test pipework and maintain and monitor pressure during screed laying. Allow screed to dry fully before applying heat. Obtain confirmation from all manufacturers of proposed floor finishes that their product is suitable for underfloor heating. Ensure that the flooring manufacturer's instructions for under heated floors are complied with.

4.26 SYSTEM PRESSURISATION

Provide boiler safety valves suitable for the maximum operating pressure of the commissioned system. Wire low pressure contacts to boiler controls to isolate boilers in the event of pressure failure.

VENTILATION

4.27 GENERAL

Ensure that the installation complies with BS 5720.

4.28 IDENTIFICATION OF DUCTWORK

Mark each range of ductwork with an identification code illustrating the direction of air flow, what the range of ductwork is serving, and the type of air being conveyed.

Provide Identification coding accordance with BESA Code of Practice DW/144 Identification of Ductwork.

4.29 CLEANING OF DUCTWORK

Clean out each range of ductwork during the progress of the Contract and demonstrate by removal of access openings for inspection of the systems.

4.30 FLEXIBLE CONNECTIONS

Use flexible ductwork for connecting to various terminal units and equipment subject to vibration, and for final connections to air diffusers and registers, installed in straight lengths only.

Keep the flexible ductwork to a minimum length not exceeding 900mm. Ensure that fire resistance is in accordance with the Fire Regulations and that flexible meets the requirements of air tightness of DW/144 and the temperature and pressure of the system with the minimum frictional resistance.

Ensure that circular flexible ductwork is of the lined type with cuffed ends or equal suitable for connecting to the metal ductwork or equipment with metal clips and if required, suitable jointing compound.

Where the adjoining ductwork or equipment is insulated, wrap the flexible ductwork with 50mm water repellent Rocksil secured with metal bands.

4.31 AIR DIFFUSERS, GRILLES & REGISTERS

Provide air diffusers or grilles with all necessary suspension brackets, screws, suitable attachments, bolts, nuts, and washers to support the grilles to the recommendation of the manufacturer. Support grilles attached to ductwork independently of the ceiling. Provide non-vision grilles with horizontal inverted 'V' section blades. Provide square and rectangular diffusers and grilles with welded mitred corners.

4.32 SELECTION OF FANS

Select each fan to ensure that the specified duty is not on or close to a maximum performance curve.

Ensure each installed fan and fan motor can handle a 15% increase above the specified total pressure at the design volume.

4.33 INSTALLATION OF FANS

Provide flexible connections and resilient mounts to fans. Where fans are installed in ceiling voids, ensure fans are accessible from below.

4.34 WINDOW MOUNTED FANS

Provide window fans, complete with the following:

- a) Automatic draught proof shutter and exterior grille.
- b) Electric socket and speed control unit.
- c) Window gaskets.

4.35 WALL-MOUNTED FANS

Provide wall mounted fans complete with the following:

- a) Finished to prevent rusting.
- b) Fixing frame of flanges and wall sleeve.
- c) Protection guards.
- d) Fans shall be capable of the specified performance when tested in accordance with BS 848, Part 1 and, where applicable, shall comply with the requirement of BS 5285.
- e) External and internal grilles and draught proof shutter.

4.36 TRANSFER GRILLES

Provide transfer grilles as follows:

- a) Of satin finished aluminium or PPC paint finish to Architects requirements.
- b) Provided with a foam plastic gasket to prevent staining of the wall and ceilings.
- c) Fixed into wood frames with aluminium screws or suitable plated wood screws.
- d) The grilles shall be of the non-vision type.
- e) Double grilles shall be of the quick release type.

4.37 AIR TRANSFER

Where transfer grilles are not specified or shown, arrange for room doors to be undercut by 10mm to assist with air ingress.

AUTOMATIC CONTROLS & WIRING

4.38 COMPONENT INSTALLER

Use a specialist installer to provide controls systems, components, and wiring.

4.39 WIRING DIAGRAMS

Submit panel wiring diagrams for comment or approval prior to manufacture. Give full details of internal panel connections, external panel features, external cable sizes and proposed external wiring routes. Allow two weeks for comment or approval.

4.40 INSTALLATION WIRING

Provide power and control wiring to all items of mechanical plant and control components, unless otherwise indicated. Chase walls and provide conduit and boxes for sensors and switches in occupied areas. Co-ordinate chasing and other installation works with other trades.

Carry out wiring strictly in accordance with manufacturers recommendations and the current edition of the IET regulations. Connect the panel from a supply left by others in the plant room. Segregate extra low voltage wiring from 240v mains wiring.

Provide galvanised mild steel trunking with removable lids and galvanised conduit in plant rooms. Ensure that trunking lid is fully removable and is not obstructed by plant, pipework, or insulation.

Wire to remote plant in MICC cable or PVC/SWA/PVC. Wire to sensors in screened cable. Maintain screening continuity to controller with a single earth at the controller only. Mount sensors in plastic boxes only. Run cables on

galvanised cable tray and maintain separation between power and screened sensor cables. Check the rotation of all three phase motors.

4.41 CONTROLS/COMPONENTS

Provide all necessary isolators, starters, sensors, relays, protection devices, panels, distribution equipment, controllers, motorised valves, motorised dampers, and linkages etc to complete the installation. Make final connections to pumps with a switch operated plug and socket with flexible connection. Ensure twin pump plugs cannot be cross connected. Provide local double pole isolators to all other items of plant with short flexible conduit connections.

Site control sensors as indicated on the drawing or as agreed with the Contract Administrator. Provide suitable pockets for immersion sensors and fill with oil.

Mark valve and damper motors to indicate the open and closed positions. Provide only plug and seat type control valves.

Provide panels with a door interlocked isolator. Where panel doors incorporate a liquid crystal display, install display and mount panel to leave display at eye level. Label each panel door mounted item with engraved plastic labels securely fixed. Provide a 13A switched socket outlet on the side of each panel. Provide a spare fuse of each size within the panel and two spare indicator lamps.

4.42 ELECTRICAL BONDING

Fully earth bond boiler and plant room pipe and metal work installations to meet current electrical regulations. Bond hinged panel doors to panel.

4.43 COMMISSIONING AND DEMONSTRATION

Fully commission the system in accordance with the control manufacturers instruction and the CIBSE commissioning code C, section 2. Allow one day's attendance to fully demonstrate the controls to the satisfaction of the Contract Administrator and to instruct staff on the system operation. Demonstrate optimum start operation, boiler boost, weather compensation, frost protection and other system features by simulated starts, loads, and conditions.

ABOVE GROUND DRAINAGE

4.44 GENERAL

Ensure all sanitary appliances are provided with new systems of above ground drainage comprising soil and vent stacks, small waste pipes, traps, and all fittings etc. Install all wastes in full compliance with all relevant codes and standards. Ensure the drainage system is fully ventilated to atmosphere at critical points and connects to the below ground drainage system as detailed elsewhere.

Co-ordinate all new drainage runs with the structure and other services, taking account of depths of available service voids etc. Conceal pipes, wherever

possible, within service boxings, or where this is not possible, neatly run at low level.

Ensure that all horizontal drain runs are adequately ventilated to prevent noise and the loss of trap seals during multiple discharge conditions.

4.45 PERFORMANCE CRITERIA

Install pipework, fittings, and accessories to ensure that:

Appliances drain quickly, quietly, and completely always without nuisance or risk to health.

Discharge is conveyed without crossflow, backfall, leakage, or blockage.

Air from the drainage system does not enter the building.

Pressure fluctuations in pipework do not vary by more than +/-38 mm water gauge and traps retain a water seal of not less than 25mm at all times.

The system can be adequately tested, cleaned, and maintained without undue disturbance to finishes.

4.46 INSTALLATION GENERALLY

Before commencing work, ensure that any specified painting of surfaces which will be concealed or inaccessible is completed.

Install pipes, fittings, and accessories in accordance with BS EN 12056.

Obtain all components for each type of pipework from the same manufacturer unless specified otherwise.

Provide access fittings and rodding eyes as necessary in convenient locations to permit adequate cleaning and testing of pipework.

Do not bend plastics pipes.

Adequately protect pipework from damage and distortion during construction.

Fit purpose made temporary caps to prevent ingress of debris.

Fit all access covers, cleaning eyes and blanking plates as the work proceeds.

Where not specified otherwise, use plated, sheradised, galvanized or non-ferrous fastenings, suitable for the purpose and background, and compatible with the material being fixed.

4.47 CO-ORDINATION WITH FINISHES

Ensure any access doors and rodding eyes etc. are positioned so that access panels can be sympathetically accommodated within building finishes i.e., tiled removable panels/secret fixed access doors etc.

Ensure other trade contractors are aware of access panel locations to ensure panels are not concealed behind finishes.

4.48 PIPE ROUTES

Install pipes to the shortest practical route, with as few bends as possible and no bends in wet portion of soil stacks, unless agreed with Engineer. Agree pipe routes not adequately shown on drawings with the Services Engineer before commencing work.

4.49 FIXING PIPEWORK

Fix wastes securely at specified centres plumb and/or true to line.
Fix branches and low gradient sections with uniform and adequate falls to drain efficiently.
Fix externally socketed pipes/fittings with sockets facing upstream.
Provide additional supports as necessary to support junctions and changes in direction.
Fix every length of pipe at or close below the socket collar or coupling.
Provide a load bearing support for vertical pipes at not less than every storey level. Tighten fixings as the work proceeds so that all pipework is self-supporting and undue weight is not imposed on fixings at the base of the pipe. Isolate from structure where passing through walls or floors and sleeve pipes using sleeves one size larger than pipe.
Provide for thermal and building movement when fixing and jointing and ensure that clearances are not reduced as fixing proceeds.
Fix expansion joint pipe sockets rigidly to the building; elsewhere use fixings that allow the pipe to slide.

4.50 FIRE STOPPING

Provide intumescent collars or suitably rated seals, correctly sized and appropriately rated for the location chosen, to all pipes penetrating fire barriers.

4.51 TERMINATIONS

Ensure all vent pipes from stacks terminate above the roof of the buildings, well away from any openings into the building.

Provide terminations with soaker sheet, sealing system, weathering cravat and bird cowl etc. to interface directly with the building's roofing system.

4.52 ACCESS FOR TESTING AND MAINTENANCE

Install pipework with adequate clearance to permit testing, cleaning, and maintenance.

Position access fittings and rodding eyes so that they are not obstructed by other pipework, framing, etc.

4.53 TESTING GENERALLY

Inform Engineer sufficiently in advance to give him a reasonable opportunity to observe tests.

Check that all sections of installation are securely fixed and free from obstruction and debris.

Ensure that all traps are filled with clean water.

Carry out tests as specified in section 2. After testing, locate and remedy all defects without delay and retest as instructed. Do not use smoke to trace leaks. Keep a record of all tests and provide a copy of each to Engineer.

Ensure all tests are witnessed, either by the Engineer or Building Control Officer.

Ensure that temporary caps have been removed and that permanent blanking caps, access covers, rodding eyes, floor gratings and the like are secured complete with all fixings.