

SETU NetLabs – Chiller Replacement

Mechanical Specification

Volume Two

Descriptive and Technical Specification

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SPECIFICATION LAYOUT

VOLUME ONE

Preliminaries

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Descriptive and Technical Specification

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Equipment Schedules

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SECTION A: DESCRIPTIVE SCOPE OF WORKS

1. SPECIFIC REMINDERS

The contractor's attention is drawn to a number of specific items that are detailed within the specification that are occasionally missed when developing tender prices. These items are detailed fully within the specification but are noted here for convenience.

- Velcro fixed valve covers are required for **all** valves in the plant areas, on the roof.
- All pumps shall be fitted with Velcro fixed insulation jackets
- Thin wall alternative piping systems for the heating system will not be accepted.
- The insulation levels for pipework are higher than called for on many projects historically. Ridged, pre-insulated pipework is specified.

2. GENERAL REQUIREMENTS

2.1 Definitions

Where the term “Mechanical specialist” or “Electrical specialist” is used, the term refers to the Nominated Mechanical and Electrical Contractor’s.

2.2 Introduction

While the detailed project requirements are described within the technical specification and drawings, section A of this specification provides a description of the services installation and draws attention to particular elements of importance.

Use latest edition of each standard referenced, containing all revisions available at the time that the project was issued for tender. Where a European or international standard has been modified or appended for use in Ireland, the modified or appended version shall apply.

2.3 Labelling of plant and systems

General Requirements

Labelling shall be provided on all plant, equipment, pipe work, valves, ductwork, and sensors.

All labels must be neat, lined up with other labels (in the case of pipework and ductwork), orientated for easy view, and securely fixed. Any labelling installed which does not fit this description shall be removed and replaced as required.

Pipe and ductwork labels shall be provided at least once within every building compartment and every 5m on long runs within a single compartment such as a corridor.

All labelling shall be robust and securely fixed, designed to have a lifespan of at least 15 years.

BMS labelling, switch, and lamp layouts must be provided to the Employer’s Representative for approval prior to manufacture. Failure to provide this information may result in rejection of the panel on arrival to site.

Plant labels shall include the area of the building served by the unit in addition to the unit reference numbers.

All labelling shall be installed a minimum of one week prior to substantial completion

Plant and equipment labels

All plant and equipment labels shall be securely fixed engraved labelling systems with clear text.

BDP.

Plant labels shall have a height of no less than 50mm. Plant text shall identify the plant reference number and a simple English description for the purpose of the plant. An example of a typical engraved label of the standard required is shown below:



Prior to manufacturing plant labels the contractor shall issue the consultant engineer with a list of proposed labels for each item of plant with the proposed labelling identified for comment in an editable document the following form:

Plant Reference	Intuitive Description
CH-02	Chiller
PU-01	Pressurising Unit
Etc.	

Valve Tags

Valve tags shall include a system identifier and valve number.



Prior to manufacturing valve tags the contractor shall issue the consultant engineer with a list of proposed tag references in an editable document in the following form:

System	Referenced	From	To
Chilled water	CHW	01	XX
Etc.			

Valve Charts

Perspex covered, wood framed charts shall be provided within each plant and tank room, mounted securely on the wall of the plant room.

Valve charts shall clearly indicate all valves within that plant room with the full valve descriptions and references such as the following:

Valve Number	Purpose
CWS 01	Isolation of cold water to the chilled water pressurisation unit
Etc.	

Pump Labels

Provide a clear and permanent label at each pump that includes the area or system served. Where a variable speed pump is used that contains integrated controls and associated local set point, the required set point shall be clearly included on the label. The set points shall be the set points measured through commissioning and not just the design set points.

Equipment labels

Equipment that will be visible within, or from the building shall be provided without bright labels, stickers or branding. Any equipment delivered with such branding or bright labelling shall have the labels removed or painted over on arrival by the mechanical contractor. The exception shall be warning labels that shall be discreetly located on plant.

Adjust the labelling as required to suit the actual flush mechanism used.

2.4 Access to services

Identify all access doors that will be required within building elements to adequately access and maintain the systems, prior to the installation of any systems.

Co-ordinate the installation of valves, access doors and other components that require access to ensure that access doors within building elements are minimised and can be shared with electrical services that require access where possible.

Orient systems to allow clear access to components and place all plant such as pumps and meters within normal reach without requiring access tools.

2.5 Site Dimensions

Check dimensions on site prior to ordering any equipment and confirm equipment will fit within the space available and can be delivered to the spaces required. Any equipment delivered to site which does not fit, cannot be moved to the required location, or does not have adequate maintenance provision shall be replaced without cost to the project.

Wherever possible plant shall be selected that can easily be removed at a future date. Where this is not possible, and plant must be installed prior to the completion of an element of construction ensure that the contractor is informed of the required delivery sequence prior to construction.

Ensure that all equipment fits and can be installed within the building elements that it is attached to. Where grilles and diffusers are smaller than the building ceiling grid system, provide appropriate blanking plates that meet the recommendations of the equipment suppliers.

2.6 Chemical Consumables

Allow for the provision and application of all chemicals required to complete the mechanical services works including but not limited to the following:

- Flushing and sterilisation chemicals.
- Cross contamination dyes.
- Corrosion treatment chemicals.
- Glycol

2.7 Metric System

All pipes and fittings and other components used in the installation shall be metric sizes.

3. COMMISSIONING

3.1 Commissioning Certs

Commissioning certificates shall be provided for the following prior to substantial completion. This is not necessarily a comprehensive list and all certs referred to within the specification shall be provided:

Cert	Notes
Pipe network pressure certs	

Metering

Cert	Notes
Load test results	Refer to the controls spec for details. Each meter must be load tested and the results proved.

Heating and Cooling

Cert	Notes
System flushing cert	Confirm all systems flushed
System dosing cert	Confirm all systems are dosed. Ensure chemicals are compatible with materials used in the system.
Heating and cooling system flow rates at each valve	Provide a record of the flow rates at each valve in heating and cooling mode.
Sensor control test report	Test the temperature reading at each sensor against a calibrated instrument. Confirm the user adjustment works correctly at each sensor.

4. PRE-COMMISSIONING

4.1 Pre commissioning actions

Pre-commissioning actions shall include but not be limited to:

Water Systems

Flush all systems prior to commissioning. Bypass all dirt sensitive components prior to flushing. Post commissioning, spot check filters and strainers and clean all if any are found to contain dirt.

Preparation of temporary flushing and balancing loop details where necessary to ensure the proper cleaning, flushing, and balancing of all the hydraulic systems. Ensure the latest current good practice and the latest BSRIA guides are followed with respect to cleaning and the design detailing of piping systems (e.g., dead legs, drain cocks, air vent lines, valve arrangements etc) to avoid bacteriological contamination, particularly pseudomonas. After the systems are filled, a comprehensive testing and certification process shall be carried out to confirm the systems are free from pseudomonas and any other bacteria.

Pressure tests all systems

Dose systems with biocide and corrosion inhibitors.

5. HANDOVER

Provide 4 No. keys for drain valves or any other valves that have not been fitted with levers or hand wheels.

Provide 2No. Panel keys to the client for MCC panels etc.

Hand these keys to the client at handover stage and obtain a signature of receipt.

6. TRAINING

Provide the client with full training and record the training provided. Refer to the project preliminaries for further details of the training requirements.

7. PLANT SUPPORTS

Existing supports required for the roof system including a “big foot” system for lifting pipework off the roof to allow drainage.

The contractor shall use existing supports to install the new chiller. This is subject to a Structural Assessment undertaken by the contractor.

Plant supports shall be regular and adequate to distribute load to the requirements of the structural engineer.

Provide all secondary steel to support plant and pipework to the requirements of the plant and equipment manufacturers.

The contractor shall use a crane to remove redundant plant and lift new plant to the roof. This is to be out of hours and agreed prior with SETU.

The contractor shall be responsible for the crane lifting plan and will issue plan to SETU prior to undertaking crane lift.

8. CHILLED WATER SYSTEM

8.1 Cooling Generation

One of the existing chillers shall be replaced with a new free cooling chiller.

Air-Cooled Free Cooling Chiller Specification

The chiller shall be a factory-assembled, air-cooled, free-cooling water chiller suitable for outdoor installation and designed to provide chilled water for commercial, and industrial applications. The unit shall incorporate an integrated free-cooling system to maximise seasonal efficiency by utilising low ambient air temperatures to provide partial or full cooling without compressor operation. The chiller shall be selected to meet the cooling duties indicated in the project schedules and shall comply with current Ecodesign requirements and recognised European performance standards.

The unit shall utilise low Global Warming Potential (GWP) R32 or alternative refrigerant and high-efficiency hermetic scroll compressors arranged in multiple independent refrigeration circuits to provide staged capacity control, improved part-load efficiency and operational resilience. Compressors shall be complete with crankcase heaters, motor over-temperature protection, over-current protection, anti-vibration mounts and factory oil charge. Refrigeration circuits shall incorporate electronic expansion valves, filter driers, sight glasses, pressure transducers and all necessary safety devices.

Heat rejection shall be provided by high-efficiency, full-aluminium microchannel condenser coils with electronically commutated (EC) axial condenser fans. The condenser assembly shall be designed to minimise the refrigerant charge while providing excellent heat-transfer performance and corrosion resistance. Fan speed shall be automatically modulated to optimise energy efficiency, reduce noise levels and extend the operating envelope during low ambient conditions.

The unit shall incorporate a fully integrated free-cooling section comprising microchannel free-cooling coils installed within the chiller casing. The free-cooling system shall automatically transfer heat from the return-water circuit directly to the outdoor air whenever ambient conditions permit, thereby reducing compressor operating hours and significantly improving seasonal energy efficiency. All free-cooling pipework, valves, and controls shall be factory-assembled within the unit footprint, without requiring additional plant space.

The evaporator shall comprise a direct expansion brazed stainless-steel plate heat exchanger optimised for R32 refrigerant. The evaporator shall be factory-insulated with closed-cell insulation and shall incorporate integral frost-protection heaters. Water connections shall be provided with grooved mechanical couplings or equivalent to facilitate installation and maintenance. The hydraulic circuit shall be selected to suit the scheduled water flow rates and pressure losses.

The chiller shall achieve high seasonal cooling efficiencies through the combination of EC fan technology, staged compressor control, and integrated free-cooling operation. Performance shall be independently certified in accordance with EN 14511 and EN 14825. The unit shall be Eurovent-certified, with cooling capacities, energy efficiency ratios, and seasonal performance values provided by the manufacturer.

The electrical installation shall comprise a factory-wired IP54-rated electrical panel complete with interlocked main isolator, compressor and fan motor protection, control transformers and all necessary electrical safety devices. The unit shall be suitable for operation from a 400 V, three-phase, 50 Hz electrical supply and shall include all necessary protection against abnormal operating conditions.

The unit shall be provided with a fully integrated microprocessor control system capable of automatic operation, alarm management, operating history and energy optimisation. The controller shall provide automatic free-cooling changeover, compressor sequencing, fan-speed control, and fault diagnostics. The control system shall support integration with the Building Management System (BMS) via BACnet, Modbus RTU and Ethernet TCP/IP communication protocols and shall permit master/slave operation of multiple chillers where required.

The unit shall be designed for low-sound operation through the use of EC condenser fans, acoustic compressor treatment, and a reduced-sound configuration. Manufacturer-certified sound power and sound pressure data shall be provided for design verification and compliance with the project acoustic requirements.

The chiller shall be supplied complete with all standard accessories including flow switch, evaporator frost protection heater, main isolator, pressure relief devices, refrigerant safety controls and remote alarm contacts. Optional accessories such as anti-vibration mounts, water filters, local HMI displays and remote communications shall be provided where indicated on the drawings and schedules.

The complete air-cooled free-cooling chiller shall be factory-assembled, pressure-tested, refrigerant-charged, and performance-tested prior to delivery. The manufacturer shall provide certified performance data, electrical schematics, commissioning procedures, operation and maintenance manuals and declarations of conformity as part of the project handover documentation. The unit shall comply with the Pressure Equipment Directive, Low Voltage Directive, Machinery Directive, F-Gas Regulations, Ecodesign requirements and all other applicable European standards.

Pipework and Fittings

BDP.

ALL heating distribution pipework MUST be provided with one coat of zinc chromate primer prior to fitting insulation. Failure to provide this paintwork prior to insulation will result in the removal of insulation for painting. All exposed (visible) pipework shall be painted with one undercoat and an overcoat to the colour agreed with the Employer's Representative. All fittings and welds shall be wire brushed prior to painting.

All Pipework within the plantroom or concealed within the building shall be insulated with foil backed insulation. Valve jackets provided with Velcro fixings shall be provided on all valves within the plant room.

All exposed Pipework within rooms shall be painted with a finishing paint coat to a colour selected by the Employer's Representative.

All components within the plant room that require access, including but not limited to, pumps, meters, and regulating valves, must be located to allow ease of access and shall not be mounted more than 1.5m from floor level.

8.2 Use of Alternative Pipe Systems

Alternative thin wall pipe systems shall not be used in this project either for high- or low-level pipework. All heating pipework shall be installed in medium grade mild steel.

8.3 Pressurisation unit

Install a new pressurisation unit complete with feed and expansion vessel.

8.4 Glycol

Include for glycol protection in any water added to the system. Assume protection to -12°C.

The contractor is to allow for a full system refill before the handover of the project.

8.5 Trace heating

Trace heat the new pipes installed at roof level.

8.6 Dirt- air Separator

Install a new dirt-air separator for the new chiller.

8.7 Wiring

Include for all wiring required for the system including power and control wiring and associated containment.

8.8 Builders work

Include all required supports including chiller supports, openings, fire sealing etc.

Include for lifting plant to the roof.

9. CONTROLS

The controls shall be adjusted to adopt the new chiller.

The controls system is described within the controls specification. The contractor shall ensure that the controls specialist receives all tender documents for the project including the controls specification and controls points list.

SECTION B: TECHNICAL SPECIFICATION

10. PIPE WORK GENERAL REQUIREMENTS

10.1 General Requirements

Neatness of installation

Arrange all pipe runs neatly, parallel with other pipe or service runs and building structure, subject to gradients for draining or venting. Ensure all vertical pipes are plumb or follow building line.

Parallel shall be defined as the distance between pipes or pipes and building elements not varying by more than 5mm over any 1m distance and 10mm over any 5m distance.

Ensure that valves are aligned in groups and are perfectly in line, (or staggered with equal spaces when locating valves inline will prevent ease of use). Align all valves with handles or adjusters facing the normal user position

Valve handles shall not face downwards unless explicitly approved by the valve manufacturer. Where valves are placed externally, their handles shall point down to ensure that water doesn't drain beneath insulation and appropriate valve types shall be used.

Spacing of pipework

Space pipe runs in relation to one another, other service runs and building structure, allow for specified thickness of thermal insulation and ensure adequate space for access to pipe joints, etc.

Use the following minimum clearances in spacing of pipe runs: -

Between	And	Clearance (mm)
Pipeline	Wall Finish	25
Pipeline	Ceiling or Soffit	50
Pipeline	Floor finish	150
Insulated Pipe	Adjacent service	25
Un-Insulated Pipe	Adjacent service	50
Adjacent pipes	Both Insulated	25
Adjacent pipes	One insulated	75
Adjacent pipes	Both un-insulated	150

Pipes through fire walls		30mm clear minimum between insulation.
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Drain requirements

Grade pipework to allow system to be drained. Provide a means of draining the system at all low points. Use eccentric reducers, and tees to allow full system draining.

Test Plugs

Provide test plugs on pipelines either side of all valves and in any other location required to fully commission the system.

Plugs to be of type Binder, Mechseal or approved equivalent and shall include water tight caps.

Expansion and contraction

Arrange supports and fixings to accommodate pipe movement caused by the thermal changes. Generally, allow the flexure at changes in direction. Allow for movement at branch connections. Select pipe rings and clips appropriately to allow axial movement due to expansion.

Provide expansion loops in all straight heating pipework runs with a length of greater than 25m. Use expansion bellows where the installation of loops is not possible due to space constraints.

Provide expansion loops in all straight plastic pipework used in compliance with the pipe suppliers' recommendations.

Pipe supports

Supply and install all pipework supports required to carry out the installation.

Arrange supports and accessories for equipment, appliances or ancillary fitments in pipe runs, so that no undue strain is imposed upon pipes.

Ensure that materials used for supports are compatible with pipeline materials.

All pipe supports shall be robust metal supports. Plastic pipe supports shall only be used for plastic pipework.

All supports shall be provided with corrosion protection by forming from galvanised steel with cut ends painted.

Provide additional supports directly adjacent to fire stopping, with spacing's complying with the fire stopping product manufacturers requirements.

Pipe fittings, bends/swept tees

BDP.

All pipe fittings shall be manufacturer fittings, on site constructed welded or burn in fittings shall not be used.

Use eccentric type reductions and enlargements on horizontal pipe runs to allow draining and venting, concentric on vertical pipes, with easy transition and an included angle not exceeding 30 degrees. Do not use bushes, except at radiators and at fittings where required size is not of standard manufacture. Where required, use eccentric bushes to allow draining or venting; maximum aspect ratio not to exceed two pipe sizes; above this ratio use reducing fittings. Use square tees at venting and draining points. Square elbows are not acceptable. Use bends and swept tees where practical.

Fabricated junctions

Do not use any fabricated junctions or fittings, except with the receipt of written approval from the Employer's Representative.

Pipes through walls and floors

Enclose pipes passing through building elements, (walls, floors, partitions, etc.) concentrically within purpose made sleeves. Fit masking plates where visible pipes pass through building elements.

Pipework through external walls

Seal all services where they exit through an external wall with an air tight sealer. Expandable foam must not be used in isolation to seal any pipework through external walls as it does not provide an airtight seal.

Pipe sleeves

Where pipe insulation is not carried through pipe sleeve, cut sleeves from material same as pipe one or two sizes larger than pipe to allow clearance. Do not use sleeves as pipe supports.

Install sleeves flush with building finish. In areas where floors are washed down, install with a 100mm protrusion above floor finish.

Pipe sleeves through fire barriers

Pack annular space between pipe and sleeve or insulation and sleeve with non-flammable and fire-resistant material to form a fire/smoke stop of required rating. Apply 12mm deep cold mastic seal at both ends within sleeve.

Capping of distribution headers

Terminate headers in removable flanged connections with bolt fixings.

Temporary plugs, caps and flanges

BDP.

Seal all open ends as installation proceeds by plugs, caps or blank flanges, to prevent ingress of foreign matter.

Use plugs of metal, plastic, or wood to suit pipework material.

In the event of such precautions not being taken, strip out pipework adjacent to open ends to demonstrate that fouling of bores has not occurred.

Storage of pipework on site

All pipework stored on site must be raised a minimum of 300 mm above floor level. Any pipework stored outside a sealed compartment must also be capped at both ends. All pipework shall be stored in a weatherproof area free from potential rain ingress.

Removal of Pipework from Site

On completion of the project, remove all unused services and fixings from the site.

Drilling

Drill holes squarely. Use drills of requisite size and depth, and appropriate to fabric. Do not flame-cut holes in metal work.

General

Inspect components carefully before fixing and reject any which are defective.

Ensure cut ends of pipes to be clean and square with burrs removed.

Allow for thermal and building movement when jointing and fixing.

Form junctions using fittings intended for the purpose, ensuring that jointing material does not project into bore of pipes, fittings and appliances.

Avoid contact between dissimilar metals and other materials which would result in electrolytic corrosion. Take appropriate means to prevent galvanic action where dissimilar metals are connected.

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

Prevent entry of foreign matter into any part of system by sealing openings during construction. Fit all access covers and cleaning eyes as work proceeds.

Connections between pipes of different materials

Plastic

BDP.

Connect plastics pipework to pipework of other materials using approved connectors and methods in accordance with plastics pipework manufacturer's recommendations, to form a watertight joint.

Copper

Connect copper pipework to clay/concrete sockets using a caulking bush (brazed on), bituminized yarn and 1:3 cement: sand mortar, neatly finished, to form a watertight joint.

Connect copper pipework to cast iron sockets using a caulking bush (brazed on), bituminised yarn and an approved caulking compound, neatly finished, to form a watertight joint.

Connect copper pipework to cast iron using purpose made copper to iron connectors.

10.2 Fixing To the Building

Take the following precautions when fixing to the elements shown below:

Reinforced concrete

Take precautions to avoid fixing through reinforcement.

Brickwork

Do not fix to unsound material or mortar between brickwork courses.

Timber rails

Fix equipment, brackets and supports by drilling hole through timber rail and fixing with bolt, back plate, washer and loose nut.

Hollow stud/tile/block walls

Fix equipment, brackets and supports where there is access at rear of wall, by drilling hole through wall and fixing with bolt, back-plate, washer and loose nut.

Fix equipment, brackets and supports where there is no access at rear of wall, drill hole and use screw anchor type fixing or gravity type toggle fixing.

Concrete, brickwork, or blockwork

Fix equipment, brackets and supports using wood screws in plugs.

Drill holes and fix using steel bolts of grouted bolt type or expanding bolt type fixing.

Metalwork

Fix equipment, brackets and supports by drilling holes and fixing using set screws or bolts complete with washers, shake proof washers and loose nuts.

Steelwork and concrete structures

Provide manufacturer's information on recommended fixing. Obtain approval for any fixing to structure steel work and concrete structures.

Generally, use proprietary fixings to structural steelwork and concrete structures.

Obtain approval to cut holes in structural steelwork or concrete structures or weld to structural steelwork.

10.3 Painting

Use the following pipework and fitting coatings:

All coatings to be applied by (or purchased pre-applied by) the mechanical service specialist.

Where pipework is delivered to site with a primer coat, all fittings and welds or screwed connections shall still be primed, and any damaged or corroded areas of pipe shall be wire brushed and re-primed within two weeks of welding.

Where fittings have not been painted as they have been installed and rusting has occurred, the fittings shall be replaced.

Steel fittings shall be painted irrespective of the jointing method used.

Water service location	Coating of Pipes and Fittings
Exposed within shower areas	Pre-coated chrome plated
Exposed, un-insulated pipework	Paint with undercoat (Zinc phosphate primer) and overcoat to match surrounding surfaces. All paint to be neat, drip and ripple free and to be suitable for the temperature of the pipe to which it is applied.
Insulated pipework	Paint with undercoat (Zinc phosphate primer)
Concealed pipework	Paint with undercoat (Zinc phosphate primer)

Gas Pipework Location	Coating of Pipes and Fittings
All areas	Paint with undercoat (Zinc phosphate primer) and overcoat in yellow (Ochre – Ral 1024) paint. Ochre yellow paint. All paint to be neat, drip and ripple free and to be suitable for the temperature of the pipe to which it is applied.

Heating Pipework Location	Coating of Pipes and Fittings
Un-insulated Pipework - Visible	Paint with undercoat (Zinc phosphate primer) and overcoat in paint. All paint to be neat, drip and ripple free and to be suitable for the temperature of the pipe to which it is applied.
Insulated Pipework	Paint with undercoat (Zinc phosphate primer). Recoat fittings and welds within four weeks of their installation. Wire brush welds before painting.

Preparation for Painting

Ensure metal surfaces are thoroughly cleaned, all mill and weld scale removed and finally degreased. Clean steel surfaces in accordance with IS EN ISO 8503 and prepare surfaces for painting in accordance with IS EN ISO 4618-3

Materials

Use the following materials as appropriate

Solvent borne priming paint to BS 7956 for bare woodwork.

Red Oxide priming paint for bare iron and steelwork.

Zinc Phosphate priming paint for bare ferrous and non-ferrous metals.

Calcium Plumbate priming paint to BS 3698 for galvanized steel or composite wood/metal components.

Undercoating paint for previously primed or painted surfaces before the application of finishing coats.

Gloss finishing paint for previously primed or painted/undercoated surfaces.

Epoxy resin paint for Specialist coatings requiring resistance to acids, alkalis, oils, solvents, abrasion or high humidity.

Aluminium paint to BS 388 for structural steelwork, storage vessels, heated metallic surfaces and similar applications where moisture and heat resistant properties are required.

BDP.

Cold galvanizing paint for making good damage to previously galvanized surfaces and protection to galvanized materials modified during installation.

Zinc-rich metallic to BS 4652 for bare iron and steelwork where electrical conductivity has to be assured.

Black tar-based paint to BS 1070 for moisture resistant protection to metal surfaces where decorating appearance is not important.

Bitumen based coatings for cold application to BS 3416 protection to iron and steel, particularly pipelines and fittings for use in contact with potable water.

Bitumen based coatings for cold application to BS 6949 not to be used in contact with potable water.

Paint Quality

Ensure paints used are of quality and type to suit application and that:-

- Primers have good adhesion, covering power, rust-inhibiting and grain filling properties.
- Gloss finishing paints are of machine finish grade having high adhesion and high resistance to solvents, mineral oils, cutting oils, detergents, chipping and impact damage.

Heat Resistant Paint

Use heat resistant paints for applications to surfaces over 70°C.

Workmanship

Ensure paints are applied in accordance with manufacturer's instructions and to BS 6150.

Weather Conditions

Do not apply paints where weather, temperature, humidity or other conditions may have a damaging effect upon finish or paint.

Cleaning and preparing for painting

Steel surfaces

Ensure metal surfaces are thoroughly cleaned, all mill and weld scale removed and finally degreased. Clean steel surfaces in accordance with IS EN ISO 8503 and prepare surfaces for painting in accordance with IS EN ISO 4618-3.

Surfaces

Ensure metal surfaces are thoroughly cleaned, all mill and weld scale removed and finally degreased.

Prepare surfaces for painting in accordance with IS EN ISO 4618-3.

For steel pipework, remove scale, rust or temporary protective coating by chipping, wire brushing or use of approved solvents and paint with one coat of red oxide primer, as work proceeds.

Application Off Site

Wherever possible ensure paint finishes applied by component manufacturers are spray applied.

Apply paint evenly and ensure finish shows no excessive brush marks, grinning, runs, sagging, ropiness or other application defects.

Cold Galvanizing

Repair damage to galvanized components due to installation process, i.e. following cutting, drilling or welding, by applying 2 no. substantial coats of cold galvanizing paint.

10.4 Identification

Clearly label all pipework using colour bands to BS 1710

Apply colour bands, 300mm wide, to each pipe at least

- Once in every room or enclosed area.
- At intervals not exceeding fifteen metres.
- At every junction.
- At every valve.
- At every inspection and access position into service shafts, false ceilings, bulkheads etc.

Secondary Identification

Apply colour bands, 50 mm wide, and superimpose a legend identifying circuit, direction of fluid or gas flow, and nominal pipe bore.

Apply to colour bands by transfers of an approved type.

BDP.

Ensure that all labels are securely fixed in a manner that will not allow them to peel off over time.

Orient all labels so that they can be clearly viewed from a normal position of observation.

Valves

Identify each valve, cock, stop valve, air vent, drain cock etc. with disc engraved with numerical reference except where the valve is within 2m of the final outlet or termination.

Use primary and secondary identification colours of associated system for painted or self-colour discs.

Securely attach metal or laminated plastic discs, minimum diameter 35mm, to each item.

Legends

Engrave discs with permanent characters, minimum height 6mm.

Incorporate in operating instructions relating to regulating valves and flow measuring equipment, details of flow rate, pressure differential and setting, as appropriate.

10.5 Pipework Supports

Space supports as shown in the following table:

Copper Pipework

Pipe bore (mm)	Horizontal (m)	Vertical (m)
Up to 15	1.2	1.8
22	1.4	2.1
28	1.8	2.4
32	2.4	3.0
35	2.4	3.0
42	2.4	3.0
54	2.7	3.0
67	3.0	3.0
76.1	3.0	3.0

BDP.

108	3.0	3.0
133	3.0	3.0

Mild Steel Pipework (medium grade or higher)

Pipe bore (mm)	Horizontal (m)	Vertical (m)
Up to 15	1.8	2.4
20	2.4	3.0
25	2.4	3.0
32	2.7	3.0
40	3.0	3.6
50	3.0	3.6
65	2.7	3.0
80	3.7	4.6
100	3.7	4.6
125	3.7	5.4
150	4.5	5.4
200	4.5	5.4
250	4.5	5.4

Where multiple pipe runs of differing bores are supported from a common point, use support spacing of pipe requiring closest spacing.

Plastic pipework shall be supported in full accordance with the manufacturer's requirements.

If alternative piping systems are used, ensure pipes are installed and supported to manufacturer's guidelines.

BDP.

Provide additional supports directly adjacent to fire stopping, with spacing's complying with the fire stopping product manufacturers requirements.

10.6 Electrical Bonding

Ensure an electrical bonding terminal suitable for connection of 6 sq mm maximum conductor is provided where required to allow earth bonding of pipework, valves, fittings, equipment, and cladding.

10.7 Air Venting

Provide a means of venting the pipework systems at all high points. Provide automatic air vent valves at all high points except at locations agreed with the Employer's Representative. Provide drain points at all low points in the system except at locations agreed with the Employer's Representative. Ensure that access is provided to all drains and vents.

10.8 Insulation

General

All pipework, joints, and valves shall be insulated except for final pipework drops to fittings that are exposed to potential damage by occupants within working areas.

Pipe work insulation materials shall be supplied by a manufacturer registered in accordance with ISO 9000-2 and ISO 9001.

Insulation shall be finished with a neat and undamaged appearance. All insulation damage shall be repaired prior to handover, irrespective of the cause of damage.

Insulation with a manufacturer fitted vapour layer shall be used.

Where areas are designated for services to be painted black by the architect, pipework shall be delivered with pre-finished black insulation.

Insulation properties

The insulation used shall have the following properties:

- A thermal conductivity of 0.025 W/m²K or better
- Zero ODP and GWP
- ZERO CFC and HFC in its manufacture
- Fire performance to BS, s1, D0
- A BRE Green Guide Rating of A+
- Manufactured to BS EN ISO 14001
- 90% closed cell structure

BDP.

- All insulation shall comply with Euroclass A1
- When completed, ensure surface-finish complies with BS 476-7 Class 1 spread of flame.
- Supply materials classified as less than 5% smoke obscuration rating when tested in accordance with EN ISO 5659-2.

The following materials must not be used.

- Urethane foams.
- Extruded polystyrene
- Polyisocyanurate foam
- Polyethylene foam

Ensure the insulation will maintain its thermal performance for a minimum of twenty five years

Insulation Thickness

The following insulation thicknesses shall be used:

Pipe Diameter	Insulation Thickness	Insulation Thickness for external or car park pipework
Up to 20mm	25mm	50
Up to 40mm	30mm	50
Up to 65mm	35mm	65
Up to 100mm	40mm	65
Up to 150mm	45mm	80
Up to 250mm	50mm	80

External Pipework Insulation

External insulation shall remain undamaged by submersion in water.

Jointing

Insulation to be glued in full accordance with the manufacturer's instructions. Joints shall be formed in full compliance with the manufacturer's recommendations. Tape shall not be used for fixing insulation unless supplied and recommended by the insulation manufacturer.

Insulation shall be neat with no peeling or rough insulation or taping. Insulation shall be contiguous.

Pipe Supports

Use manufacturer supplied inserts for pipe supports.

Vapour barriers shall be carried through supports.

Use spreader plates over insulation where recommended by the insulation manufacturer.

Fire Sleeves

Where pipes pass through fire walls, provide a fire sleeve system that is rated for 2 hour fire protection under IS EN 1366. Fire sleeves shall take the form of phenolic foam, intumescent protector and stainless-steel outer lining and plate.

The outer sleeve shall be 0.5mm thick stainless steel that is clasp fastened and 205mm in length.

Fire sleeves shall be installed in accordance with the manufacturer's instructions

Fittings

All fittings, including elbows and tees shall be fitted with manufacturer formed insulation sections.

Integrity of Vapour Barriers

Vapour barriers shall be provided as an integrated component of the pipe insulation.

Repair immediately any damage to vapour barriers, repair to manufacturer's instructions.

Workmanship

Insulate each pipe separately. Do not enclose adjacent units together.

Ensure all pipework surfaces are dry before the installation of thermal insulation.

Neatly finish joints, corners, edges and overlaps and, where possible, arrange overlaps to fall on blind side. Ensure overlaps are neat and even and parallel to circumferential and longitudinal joints.

Ensure joints are close butted together. Secure overlaps with adhesive or matching class 'O' tape, a minimum of 50mm wide, on both longitudinal and circumferential butt joints.

BDP.

Insulate fittings to same standard as adjacent pipework and use mitred segments where necessary, taped as above.

Where insulation abuts pipe support inserts that have integral vapour barriers seal using class 'O' foil tape to continue vapour barrier or containment.

Valve, Flange, Heat Exchanger Insulation

Insulate all valves, flanges, plant items and other fittings placed in insulated pipework, machining equivalent insulation and vapour barrier performance.

Valve jackets provided with Velcro fixings shall be provided **on all valves**, flanges, pumps and heat exchangers within the plant rooms and externally. All valve jackets used on external pipework shall be weatherproof.

Valve jackets shall **also be provided on all valves of 65 Dia. and larger, throughout the installation.**

Smaller valves, outside the plant room can be provided with insulation carried through but with access to valve levers maintained.

Buried heating pipework

Buried heating pipework shall be a proprietary, pre-insulated district heating pipework, suitable for below ground usage.

A cross-linked polyethylene pipe insulation shall be used with a conductivity of 0.0199 W/m*K and an insulation thickness of 50mm

The system shall be capable of operating with a working pressure of at least 6 bar.

10.9 Insulation Protection

The following Insulation protection systems shall be used:

Building Area	Protection Type	Alternative Option
Insulated pipework within the building	None	
Insulated pipework within plant areas above 1.8m	None	
Insulated pipework within plant areas below 1.8m	None	

Insulated pipework exposed externally	Polyisobutylene	
Insulated pipework within enclosed, external areas.	Polyisobutylene	

Provide polyisobutylene (PIB) protection as follows:

Wrap pipework and fittings, and vessels with PIB sheeting lapped at every joint by at least 50 mm. Solvent weld joints and support with banding in accordance with manufacturer's instructions.

Arrange joints to shed water and prevent the ingress of water.

Where valves are provided externally, they shall be oriented horizontally or downward to ease with sealing. Valve jackets shall be used on all exposed external pipework.

Minimum thickness of polyisobutylene shall be 0.8mm.

Aluminium Pipe Cladding

Profiled aluminium cladding shall have a thickness of 0.56mm. It shall be fitted with reinforcement bands at 300mm centres and shall be left in an undented condition at practical completion. All damaged protection shall be replaced before practical completion irrespective of the source of damage.

10.10 Valve Quarter Turn Operation

All isolation valves shall be quarter turn level operated except where it is not possible to obtain a valve of the size or type with a quarter turn isolation function.

11. 56) HEATING SYSTEM PIPEWORK

11.1 General Requirements

Supply and install all heating system pipework and fittings within the building.

Connect all pipework to heat emitters and plant.

Supply and install all heat emitters.

Ensure that adequate access is provided for maintaining the system and ensure that builders work access hatches are provided as required to maintain the systems.

All water pipework and fittings shall be suitable for the distribution of low-pressure hot water, containing the various water treatment chemicals used in the system and at the various temperatures found within the system.

Isolation and Regulation

Supply and install isolation valves in the following locations:

- At all branches from main risers
- Before connections to equipment
- At all sub-branches
- At any other location indicated on the drawings

All valves shall be placed in locations where they are unlikely to be tampered with.

Co-ordinate the location of access hatches required, prior to the system installation

Cleaning

Thoroughly clean and degrease all pipework, joints, and fittings. Remove all dirt, plaster and other construction materials before concealment or handover.

Manufacturer's Instructions

Follow manufacturer's instructions for the storage, preparation, and installation of all equipment, fittings, and materials.

11.2 Pipework

Supply and install all heating services pipework in medium grade black mild steel pipework, except where other materials are specifically referred to on the drawings.

11.3 Insulation

Refer to the general pipe section for details.

11.4 Pipework Joints

All pipework joints shall be welded. All connections to valves or equipment shall be screwed for ease of maintenance.

Use skilled craftsman in possession of a current certificate of competence appropriate to type and class of work, issued by an approved authority. Provide certificates for all welders on request.

Preparation, making and sealing

Oxy-acetylene welding, conforming to BS 2971.

Arc welding, conforming to BS 2633 or BS 2971 appropriate to system temperature and pressure. Use arc welding process on piping greater than 100mm.

Screwed joints

Ensure that plain ends are cut square. Reamer out bore at plain ends.

Screw plain ends, taper thread.

Coat male pipe threads with jointing compound and hemp, or PTFE tape on small sizes. Immediately after applying coating, connect with female end of socket or fitting, and tighten ensuring that coating does not intrude into pipe. Leave joint clean.

Expansion devices

Fit expansion devices in the form of expansion loops or bellows in any straight runs with a total length of greater than 25m. Preference should be given to the use of expansion loops over bellows where space allows.

Provide insulated, Velcro fixed insulation jackets over all expansion bellows.

Expansion loop

Provide expansion loop in material and finish of associated pipeline. Size to limit stress set up in material of pipe wall to 69 MPa.

Forge bend from a single length of pipe or join by welding fittings if expansion loops are too large to manufacture in one piece.

Expansion compensators

Axial bellows

BDP.

Ends: Flanged

Bellows - Stainless steel, multi-ply or single-ply construction fitted with stainless steel inner sleeves.

Operation - Supply expansion joints capable of not less than 2000 complete reversals of movement at the given working conditions; and of withstanding a pressure test of 1.5 times the design pressure without deformation (and at least a minimum of 2 bar).

Anchors

Construct to resist axial stress transmitted by flexure of horizontal and vertical pipe runs or loading on vertical pipes assuming that unbalanced forces exist at all anchor points, even when these are situated in intermediate positions between two expansion loops or bellows. Use similar or compatible materials to the attached pipe.

Provide and fix all associated backing plates, nuts, washers and bolts for attachment to or building into building structure; ensure structure is suitable for transmitted stress. Set out and line up anchors accurately in position. Inspect final grouting into building structure.

Provide anchors constructed using mild steel over straps or heavy U-bolts. Secure to channel section, adequately attached to or grouted into building structure, weld longitudinal edges of strap to pipe.

Flexible Connection Installation

Fit rubber bellows as close to source of vibration as practicable. Ensure the pipe at other end of bellows is a fixed point. Install flexible connections strictly in accordance with manufacturer's instructions.

Ensure flexible connections are tied when the plant is on vibration isolation mountings.

Terminal Unit Connections

Do not use hose connections unless explicitly approved by the consultant engineer.

Install hose connections strictly in accordance with manufacturer's instructions.

Headers

Terminate ends with blank, bolted flanges.

Screwed flanges

Apply jointing materials. Screw on flange and expand tube into flange with roller expander where necessary.

Preparation

BDP.

Ensure that flange mating faces are parallel; flange peripheries are flush with each other; and bolt holes are correctly aligned.

Making and Sealing

Insert jointing between flange mating faces. Pull up joint equally all round.

Flexible couplings and flange adapters

Preparation - Ensure that cut ends are square and free of bumps, dents and score marks and are within manufacturer's tolerances.

Making and sealing - Ensure gasket is suitable for service. Thoroughly lubricate gasket using manufacturer's recommended lubricant. Assemble coupling in accordance with manufacturer's instructions.

For non-end load capable couplings, ensure that adequate pipe anchorage is provided to prevent pipe disengagement.

11.5 Valves

All valves are to be pressure tested at the manufacturer's works.

All valves shall be kitemark certified.

All valves shall be CE marked

All valves shall be attached to pipework with screwed fittings.

All valves shall be manufactured from a copper alloy.

Stop valves

For isolation of pipework up to 65 Dia.

- Type: Lever operated
- Brass full bore ball valve, WRC approved
- Materials: to suit steel tube: Bronze or DZRR copper alloy body.
- Chrome or nickel plated DZR sphere with full bore flow aperture. PTFE seals and stem seals. Anti-blowout stem.
- Ends: Threaded

For isolation of pipework over 65 Dia.

BDP.

- Type: Lever operated
- Construction - Provide controlled elastomer compression on flange faces; semi-lugged wafer type design, for installation between flanged pipework connections, body to suit IS EN 1092-2.
- Provide lever and gear operated valves with long body neck for lagging clearance.
- Seat - Bonded.
- Materials - Cast iron body; stainless steel shaft; aluminium bronze disc; EPDM seat.
- Operation - Lever and graduated notch plate.

Regulating valves

- Type: Screwed regulating valves up to 65Dia. Flanged for 65 Dia and above.
- WRAS approved
- Materials: To suit steel tube

Double regulating valves

- Type: Screwed double regulating valves up to 65Dia. Flanged for 65 Dia and above.
- WRAS approved
- Material: To suit steel tube.
- Material - Cast iron to IS EN 13789.
- Oblique or Y pattern; copper alloy, nickel alloy or resilient valve face; rising stem outside screw or non-rising stem inside screw; manufacturer's standard materials.
- Provide drain plug facility; independent means for positive isolation on pressure tapping or adapter.

Test plugs

Measurement of temperature and pressure, to be provided as required allowing the system to be fully commissioned.

Self-sealing test points

Provide DZR copper alloy self-sealing test plugs for measurement of temperature and pressure, complete with captive cap for sealing when not in use. Ensure test plugs are suitable for system operating temperature and pressure.

Radiator valves

Material - Bronze or brass copper alloy body.

Pattern - Angle or straight to suit application.

Straight - Threaded to EN 10226 or compression to IS EN 1254-2 (EN 1254-2) to suit pipework as indicated.

Angle - Threaded to EN 10226 with one end internal and other end external with union nut and tail pipe; or compression joint to IS EN 1254-2 (EN 1254-2) one end and other end externally threaded to EN 10226 with union nut and tail pipe to suit pipework as indicated.

Fit wheel valves on flow connections to radiators, and other heat emitters, without thermostatic radiator valves. Fit Lockshield valves on return connections.

Motorized valves

Motorized valves shall have a maximum power requirement of 1W.

Valves shall be designed to have a zero-power requirement when not providing heat.

Motorized valves and their associated heads shall be provided with five year warranties.

Motorized valves shall be suitable for a static pressure of 10 bar and a differential pressure of 250 kPa.

All valves shall be specifically designed for commercial and industrial use and valves marked as intended for domestic use shall not be used.

Pipe strainers

- Type: Screwed up to 50mm, flanged for 65mm and above.
- PN16
- Material - Bronze to IS EN 1982. up to 50mm Cast iron 65mm and above
- Ends - Threaded to EN 10226 up to 50mm or flanged if over 65 Dia.
- Pattern - Y pattern body.
- Screen free area - Not less than 250% of pipe bore.
- Screen perforations
- 15 to 50mm nominal size, within range 0.7 - 0.9 mm diameter.

BDP.

- 65mm and over nominal size, within range 1.5 - 1.8mm diameter.
- Internal to external flow through screen. Provide plugged connections for drain, air vent and differential pressure monitoring, threaded to EN 10226.

Gauges

- Provide gauges in the following locations:
- On common flow and return header to boilers.
- On main variable temperature flow and return connections.
- In additional locations as indicated on the drawings.

Use dial type gauges of robust construction, enclosed in dust tight metal cases. Retain dial glass with bezels screwed to case. Finish with chromium plating.

Use white dial scales indelibly and clearly marked with black lettering to indicate measured values. Select scale ranges which indicate 'Normal' when pointer is vertical or central on scale.

Dial case - 100mm diameter for flush mounting to steel panel.

Mount gauges with dial face in vertical plane flush to panel and conceal casing within a steel metal cubicle

Control valves

Ball valves:

- Material - Nickel-plated brass; stainless steel ball; PTFE seal; stainless steel spindle; EPDM spindle seal.
- Connections - Threaded to EN 10226.
- Ancillaries - Lever for manual operation.

Three way:

- Material - Nickel-plated brass; stainless steel ball; PTFE seal; stainless steel spindle; EPDM spindle seal.
- Connections - Threaded to EN 10226.
- Ancillaries - Lever for manual operation.

Check valves:

- WRAS approved.
- Pipe material - to suit steel tube.
- Screwed Connection

Drain cocks

Fit at all low points in the system that cannot be drained through outlets.

- Operation: Lockshield connection to accept key
- Materials: Bronze body
- Ends: Threaded
- Outlet: Fit outlet with hosepipe connector

Automatic air vents

- Type : Ball float
- Combined air and dirt separators
- Microbubble air and dirt separator

Construction: Vertical steel housing with internal large surface area mechanism to remove microbubbles via coalescence effect. Fitted with dirt drain at its lowest point for removing dirt that sinks, and fitted with a dirt drain valve on the side of the housing for removing dirt that floats on the water.

Air vents to automatically seal on leak through the use of expanding washer

Provide automatic air release mechanism.

Ends : Line size with flange

Maximum temperature, 110°C.

Maximum pressure 10 bar.

Direct acting safety valves

Confirm all safety valves are set to appropriate pressures

BDP.

Provide test Certificates for all safety valves prior to substantial completion

PN rating 10

- Type: Double spring loaded, high lift type.
- Up to and including 65 Dia.:
- Copper alloy - Bronze or DZR copper alloy body.

Over 65 Dia.:

- Material - Cast iron body.
- Ends - Flanged.
- Spring type - Double spring loaded, high lift type.

Pumps

Select pumps at or near the most efficient part of the performance curve for the duty required. Pumps delivered to site that do not meet this requirement must be replaced.

Pump type and materials supplied shall be appropriate for their application and the conditions of the fluid served.

Position and orientate pump in accordance with manufactures guidance.

Support pumps independently of pipework, except by agreement with the Employer's Representative.

Pump supports shall be painted and shall not contain any sharp finishes.

Locate pumps with adequate access for maintenance without the need to stand on other plant or pipework.

Fit flanged or screwed connections to all pumps over 65 Dia.

Fit condensate drains from pump bodies where recommended by the manufacturer

Pump electrics

Supply surge suppressors to star connected motors and to all motors subject to star-delta starting to limit peak voltage to 1200 volts. Fitted by manufacturer.

Supply transient suppressors in the form of resistor and capacitor networks across the starter contactor coils. Fitted by manufacturer

BDP.

Ensure motors, starters and ancillary equipment are suitable for operation at full capacity at heights above sea level not exceeding 1000m, with air cooling at an average temperature over 24 hours not exceeding 35°C dry bulb with maximum conditions of 40°C dry bulb and 50 per cent RH.

Use motors which conform to DD CLC/TS 60034-20-1-1, DD CLC/TS 60034-20-1: EN 50347 and EN 60034, as applicable, which operate at lowest possible speed, compatible with performance requirements.

Select maximum continuous rating (MCR) such that

- Driven machine operates at correct speed or speeds at design duty.
- When running continuously at design rated duty, the temperature of the motor parts is within limits defined in IS EN 60034-1.
- When provided with excess motor current (over-load) protection of thermal overcurrent release type, ensure operation is within tolerances of tripping as defined in IS EN 60947-4

Use motors with Class 130 or 155 insulation, with temperature rise as defined in IS EN 60085.

Fit motor bodies with conduit entry terminal box or cable gland as required, and to suit type and size of cable being terminated.

Motors - over temperature protection use thermistors as follows:
Fit positive temperature coefficient thermistors. Provide a minimum of 3 PTC thermistors in each motor with 2 ends terminated in motor terminal box clearly and permanently marked.

Motor starters - motors of 0.37kw and above:

Provide starters incorporating overcurrent protection for motors of 0.37kW and above.

Provide starter with manual reset, adjustable, inverse time delay, and ambient temperature compensated thermal overcurrent release to IS EN 60947-4-1. Ensure overcurrent release is compatible with starting, accelerating and running characteristics of motor, starter and driven machine combination. Use phase unbalance protection on three phase equipment.

Current limiting motor starters:

- Use static type thyristor voltage control starter to provide reduced current starting.
- Provide adjustable ramp times.
- Provide contactor for switching and disconnect for isolation.

- Provide details of harmonic distortion content prior to ordering.

Direct-on-line motor starters:

- Use direct-on-line starter to IS EN 60947-4-1, with single phase motors and three phase motors.

Star delta motor starters:

- Use star delta starter to IS EN 60947-4-1 with three phase motors.

Incorporate adjustable time delay contactor relays, to control star delta changeover, ensuring electrical endurance compatible with starter contactors. Ensure starting sequence activated on voltage restoration.

Auto-transformer motor starters:

- Use auto-transformer starter to IS EN 60947-4-1 with three phase motors.
- Provide 2 step closed transition auto transformers suitable for 3 operating cycles per hour.
- Provide auto transformers with three tapplings for selection of motor starting voltage. Arrange tapplings to limit motor starting current to 80 per cent, 65 per cent and 50 per cent of full voltage starting current.
- Incorporate adjustable time delay contactor relays, to control automatic changeover from selected reduced voltage to full voltage, having an electrical endurance compatible with starter contactors. Ensure starting sequence activated on voltage restoration.

Stator rotor motor starters:

- Use stator rotor starter to IS EN 60947-4-1 with three phase motors.
- Provide starter resistors suitable for indicated operating cycles per hour.

BDP.

- Incorporate adjustable time delay contactor relays, to control starter resistor short circuiting contactors, having electrical endurance compatible with starter contactors. Ensure starting sequence activated on voltage restoration.

Access to pumps

Locate pumps with adequate access for maintenance. Comply with manufacturer's maintenance guidance.

Location of valves

Install and locate valves to manufacturer's instructions

Install double regulating variable orifice valve to ensure equivalent of 10 diameters of straight pipe upstream and 5 diameters downstream of double regulating valve.

Supports - Arrange supports for control components to ensure no strain is imposed on components.

Access - Arrange control components to ensure adequate access for operation and maintenance.

Provide outlets of vent cocks with discharge pipes.

Vibration isolation mountings

Provide vibration isolation and mountings as recommended by equipment manufacturers and as required to prevent excessive noise or vibrations.

Pressure equipment directive/pressure equipment regulations:

All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 97/23/EC, implemented in the UK through the Pressure Equipment Regulations 1999, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

Only relevant equipment and assemblies certified as compliant will be permitted under this specification, and any substitution put forward must also be compliant with the Directive.

Installation of heat emitters

Install in accordance with manufacturer's instructions. Ensure that all radiators are mounted at equal heights and are fully level. Radiators must be securely fixed. Where floor mounted or nonstandard fixings are proposed, a sample must be constructed on site and commented on by the Employer's Representative prior to ordering supports.

11.6 Testing, Cleaning and Commissioning

Method statement

Provide a method statement covering the sequence of events, chemicals to be used etc. Statement to be provided at least two months prior to the start of any flushing and/or chemical cleaning works.

Cleaning and chemical treatment Specialist

Use a Specialist for analysis and for design, supply, installation and operation of any system cleaning and chemical treatment process.

Notify manufacturers and suppliers of equipment of proposed system cleaning and chemical treatment processes. Establish if any manufacturer or supplier of equipment requires any particular cleaning and chemical treatment process due to size of waterways or materials used.

All chemicals used are to be compatible with the metallurgy of the systems and equipment used.

Where any equipment installed can be damaged by common treatments, install a laminated notice in the boiler house indicating the treatments that can damage the system or reduce the system life.

Preliminary checks

Prior to carrying out cleaning or chemical treatment process, ensure that:

All foreign matter is removed.

Certified pressure tests have been carried out in the parts of the system to be cleaned. Carry out further pressure tests on the isolated sections of the system independently.

All water used for pressure testing is inhibited. Leave remaining pipework sections full after testing.

Where there is a risk of freezing inhibited mono-ethylene glycol is used.

Circulation has been demonstrated and approval obtained on all parts of the system. Manipulate and leave fully open all valves other than those used to isolate sections. Carry out balancing and certification after the flushing, cleaning and passivation operations.

No damage can occur to any item of plant or equipment due to cleaning and chemical processes.

Chemicals used are compatible with system materials.

BDP.

All items of plant and equipment subject to damage or blockage due to cleaning and chemical treatment processes are isolated or removed.

Dirt pockets are installed at low points to facilitate solids removal. Supply dirt pockets with drain valves sized to pipework size.

All drains provided have been tested and approved and that any pumping equipment associated with the drainage system is fully commissioned.

Dead legs that are more than 3 pipe diameters in length are looped to allow effective cleaning.

Strainer baskets and filter media, incorporated within systems, are removed; and where necessary spool or stool pieces are installed.

Temporary strainers and filters are installed as required for removal of solids during cleaning and chemical treatment processes.

Strainers are clean prior to the start of the cleaning process, throughout the cleaning and on completion.

Suitable supply and drainage points are provided with 50mm minimum connections, properly sited and installed, either valved or plugged.

All automatic/manual air vents are fully commissioned.

All requirements of COSHH regulations are complied with during the chemical cleaning and chemical treatment of the system.

Where required by local water authority, provide effluent tanks for storage of all waste products of cleaning and chemical treatment processes.

Following local water authority approval, either neutralize or dispose to drain of all waste products; or ensure authorised disposal at registered sites.

Comply with Waste Management Duty of Care: A Code of Practice and Control of Pollution (Special Waste) Regulations 1980 where appropriate.

Testing

Pressure test all water services pipework

Operating gauge pressure less than 3.5 bar, test gauge one and a half times operating pressure. (and a minimum of 2 Bar)

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

For below ground pipework test to 7 bar or twice the working pressure (whichever is the greater) for 4 hours.

BDP.

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

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

Advise appropriate personnel, in advance, of the time pressure tests may be witnessed.

Carry out Hydraulic Pressure Testing as described in HVCA Guide to good Practice for Site Pressure Testing of Pipework. Test section by section for one hour, as the work proceeds and prior to application of thermal insulation.

Keep record of pressure tests and issue them to the Employer's Representative, and include them within the handover documentation.

Commissioning

Carry out commissioning of installations in accordance with the procedures, checks and tolerances given in the BSRIA Application Guides for water systems and air systems to achieve the standards set in the CIBSE Commissioning Codes.

Preliminary checks

Carry out checks and procedures as detailed in CIBSE Commissioning Code W, Section W1. Ensure system is statically complete as defined in section B4 of BSRIA Application Guide 2/89 Commissioning of water systems in buildings.

Use pre-commissioning checklist from BSRIA Application guide 2/89.

Setting to work and regulation

Set to work and regulate water distribution systems in accordance with CIBSE Commissioning Code W, Sections W2 and W3, and sections C3 and C4 in BSRIA Application Guide 2/89.

Measurement

Use instruments for measurement detailed in BSRIA Application Guide 2/89.

Test all outlets in groups to determine that appropriate flow rates and temperatures are achieved.

Performance test records

Keep a systematic record of tests. Include the test record with the O & M's.

Flushing

Carry out flushing of water systems in accordance with BSRIA Application Guide BAG BG 29/2012 Pre-commission cleaning of pipework systems.

All water used for pressure testing, flushing and system filling is of good quality. Leave remaining pipework sections full and treated after pressure testing.

Install all necessary pipework ancillaries to enable a Specialist to carry out flushing, inspection and witnessing of water systems in accordance with BSRIA Application Guide BAG BG 29/2012 . Pre-commission cleaning of water systems.

Temporary connection from the mains must be in compliance with the Water Supply Regulations, or by installation of a temporary tank and pump arrangement.

Domestic water systems are to be flushed and disinfected in accordance with the requirements of EN 806, and to the satisfaction of the local water supply authority. Flush systems using mains water until the water is clear.

Witnessing

When the system has been cleaned, obtain written confirmation from the Employer's Representative that the system, including water storage tanks has been inspected. If the system is found to be dirty at any stage after the cleaning has taken place, then the mechanical services specialist shall re-clean and sterilise the system unless a signed witnessing certificate is produced.

Chemical cleaning and solids removal

Carry out chemical cleaning procedure in accordance with BSRIA Application Guide BAG BG 29/2012 Pre-commission cleaning of pipework systems.

Sterilization – General

After flushing process, carry out sterilization in accordance with EN 806.

Prior to sterilization ensure each system is flushed, cleaned and drained.

Provide temporary connections to system terminal points suitable for introduction of sterilization chemicals and fluids and 22mm minimum valved drain connection on incoming main immediately downstream of mains isolating valve.

Fill system with clean, fresh water.

Chemical dosing – LPHW systems

Provide biocides effective against Legionella Pneumophila, algae, fungi, moulds and slime forming bacteria including pseudomonas and sulphate reducing bacteria.

Supply biocides as recommended by water treatment Specialist.

BDP.

Incorporate a bio dispersant in the programme to break up and disperse any slime masses, where required.

The water treatment Specialist shall select the appropriate corrosion inhibitors, to minimise corrosion, and biocides to prevent any proliferation to mild steel, copper and copper alloys.

Provide a specific inhibitor to protect aluminium when it is present in the system.

The cleaning agent is to be specified by the water treatment Specialist.

Documentation:

Within handover documentation include the following:

Certificate confirming that the water systems have been cleaned, sterilised and tested

Details of routine cleaning and sterilisation required that will be required by the end user

Provide number of copies as indicated of hard cover binders containing details of

- Programme outlines.
- Purpose of chemical treatment.
- Chemicals used and quantity.
- On site testing procedures.
- Control limits of tests.
- Equipment data and drawings.
- Product notes and material safety data sheets for all chemicals used.

Chemical provision:

Provide consumables for a period of 12 months.

Fully balance all systems. Make a full record of all commissioning point flow rates and provide a comparison of flow rates achieved with design flow rates. Send results to the Employer's Representative for comment.

Instrument and gauges

Ensure instruments are correctly calibrated. Record details of instruments on record sheets.

Submit evidence of correct calibration of instruments to be used in connection with commissioning and testing.

Thermostats and temperature sensors

Test all thermostat and temperature sensor readings against calibration equipment that is provided with a calibration cert that is dated within six months of the test period.

Performance testing

Test the full system, under various conditions. Check the operation of run and standby plant, and check all controls settings, and the operation of every function of the controls system before requesting that the Employer's Representative to witness the correct operation of the system.

Venting of heat emitters

Vent all air from heat emitters prior to testing, and again at substantial completion.

11.7 Standards and Regulations

Comply with all of the requirements within following standards:

Standard	Use For
EN 10255	Steel pipework
EN 10226-1	Steel fittings - Screwed
EN 10255-1, PN 16	Pipe flanges
EN 1092-1	Pipe flanges
BS 7786	PTFE tape
EN 751-2	Pipe jointing materials
EN 10226	Screwed joints with PTFE tape
EN 12536	Welding rods gas welding
BS 2633	Electric arc welding
BS 2971	
BS 2971	Welding of steel pipework
EN 12266	Testing of valves at manufacturers works
EN 61800-5-1	Variable speed drives on pumps

EN 13828	Ball valves
EN 593	Butterfly valves
BS 7350	Globe valves
BS 2767	Radiator valves
EN 215	Thermostatic radiator valves
BS 5154 EN 12288	Check Valves
EN 442-1	Radiator manufacture