



THE PRIORY, WARE

Mechanical Installation – particular specification Parts 2 & 3

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ISSUE & REVISION RECORD PART 2

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INDEX – Mechanical Installation – particular specification Part 2

1.	Preamble	Page 4
2.	Tendering	Page 4
3.	Working & Builders work drawings	Page 4
4.	Drawings	Page 5
5.	Record drawings	Page 5
6.	Scope of work	Page 5
7.	One-pipe towel rail circuits	Page 6
8.	LTHW installation generally	Page 7
9.	Gas fired boiler	Page 7
10.	Flues	Page 7
11.	Pumps	Page 8
12.	LTHW pipe-work & emitters	Page 8
13.	LTHW pressurisation & make-up unit	Page 9
14.	Valves & cocks	Page 9
15.	Mains water installation	Page 9
16.	<i>Stored water – hot & cold</i>	Page 9
17.	Hot water cylinders	Page 10
18.	Hot water service pipe-work	Page 10
19.	Cold water services	Page 10
20.	Thermal insulation	Page 11
21.	Description of control systems	Page 11
22.	Soil waste & vent installation	Page 12
23.	THE PRIORY, WARE – specific calculations	Page 14
24.	Testing & commissioning	Page 15
25.	BMS	Page 16

Part 2 Mechanical Installation – particular specification

1. Preamble

This section is to be read in conjunction with all other parts of this specification. Where the detailed requirements given in this section are at variance with the general requirements of Part 3, the method described in this section shall apply.

All works described in this document will be carried out by the Mechanical Sub-Contractor.

2. Tendering

The Tenderer shall complete the schedule of the names of the manufacturers used in this Tender.

On request the Tenderer's shall submit technical details, description of the materials, manufacturing details and the finishes for the above within 10 working days.

The Tenderer may submit proposals for alternative or additional equipment but they must specify these totally independently of equipment required within this document.

The Contractor shall include for liaison with others integrating their works with the overall project programme and site working and particularly, but not exclusively, include the following:

- a. Successful demonstration of the complete installation after completion of the work to the satisfaction of the Clients representative, the Architect and the Services Consultant. The demonstration shall be carried out at a later date when the building and load is available and undertaken outside of normal working days to a programme agreed with the Client, the Contractor and the Services Consultant.
- b. Witness testing as works to the Specification of the Clients representative, the Architect and the Service Consultant. The testing shall include an un-witnessed test with results forwarded to the Service Consultant followed by a full witness test.

3. Working & Builders work drawings

As detailed within Part 1 of this document the Sub-Contractor will be required to produce working or co-ordination drawings and shall produce detailed drawings when necessary to ensure that the works are fully co-ordinated with all other disciplines and the building structure.

The Sub-Contractor shall produce Builders work drawings in accordance with Part 1 of this specification unless otherwise stated.

During the initial procurement and mobilisation, the Sub-Contractor shall evaluate the accuracy of the consultants' drawings and **fully accept** the responsibility for co-ordination within the building fabric and other services.

4. Drawings

The drawings accompanying this Specification are up-to-date at the time of issue and are intended to indicate the general requirements for the installation. These drawings may not be to scale.

The Contractor is required to keep close liaison with the Main Contractor and other associated Contractors to prepare all working drawings as necessary in accordance with the detailed plans, which will be supplied to the Contractor via the Main Contractor as issued by the Architect/Clients Representative or Design team.

The Contractors shall check all dimensions, prior to the preparation of drawings for pipe-work, pump sets etc.

The Contractor shall be held responsible for the accuracy of these services in relation to the building structure and the Architects requirements. The Contractor shall be deemed to have visited the site and to be fully aware of the conditions applicable.

"The design drawings will not be updated after the construction drawings have been issued. The Contractor will be required to update the drawings throughout the period of the Contract to accommodate all design development and variations. These can then be agreed with the Design Team prior to approval."

5. Record drawings

The record drawings package will include a copy of each of the working and design drawings, updated to reflect the final installation arrangements. All drawings shall be prepared on CAD and issued in paper and software format.

The Contractor shall supply and fix a Perspex fronted metal framed copy of the 1:20 as installed main plant layout and valve chart in the area where plant is situated.

Two copies of the preliminary drawings and draft manuals will be submitted to the Consultant for comment, two weeks before the completion of each phase.

For exact details of how the O&M manuals shall be set out please refer to part 1.

The final documentation shall be issued in four copies as follows:

The Priory, Ware - c/o Mr Terry Philpott, (2 paper and 1 electronic copy)

6. Scope of work

The mechanical services and electrical installation shall comprise the supply of materials and products, delivery to site, offloading, storing and transporting about the works, installing, setting to work, testing and commissioning, providing installation drawings including builders work drawings, 'As installed' drawings and operating manuals, training employers personnel and carrying out obligations during the defects liability period.

The Sub-Contract works shall comprise the following services:

- Initial firing up of heating system to ascertain each emitters flow and return entry points.
- Full drain down of all heating circuits.
- Full removal of all heating plant within the plant room, including BMS. All downstream circuits to be carefully marked and cut back to plant room exit points and valved for re-connection.
- Removal of existing cold feed and expansion pipework from the plant room and top floor tank room. Cap as necessary but all dead legs must be negated.
- Full clean of all walls and floors. Decorate throughout plant room only to clients requirements including safety paint to all floor areas with safety markings.
- Installation of new gas fired boiler plant. (See drawings and attached specification/quote. Please note, all prices given are list prices and are subject to contractors discounts.
- Installation of new gas pipe-work from existing entry into plant room. Check meter position and suitability.
- Installation of all new distribution pipework within the plant room as shown on tender drawing.
- Installation of 2 pressurisation units and expansion vessels for heating circuits.
- Installation of 120kW plate heat exchanger as shown on tender drawing.
- All discharges of condense to adjacent soil stack within plant room.
- Installation of all associated controls and wiring. One ambient, programmable room thermostat to control the heating from the common office corridor.
- Installation of Flamefast Boilerguard, plant room management safety system as shown on tender drawing.
- Full flushing of all the heating circuits throughout with mains water until clean.
- Installation of approximately 54 sets of IMI-Hydraulics, 'eclipse' thermostatic radiator valves to every radiator throughout.
- Installation of Smiths Environmental, mechanical heat recovery fan, to be installed within the rear canteen area to extract heat and discharge into the main office corridor. This must include all making good, electrical work and any required decoration.
- Full commissioning of all installed plant by manufacturer and witnessed by RBHDC.

NOTE – Tender drawings show pipe-work routes, plant positions etc., based on architects general arrangement drawings. The Contractor shall make due allowance in his price for any minor alterations to pipe-work routes, positions of plant or emitters and to avoid any local obstructions such as structural beams. Where a deviation from tendered pipe-work routes is deemed of a sufficient variation to be chargeable, the schedule of rates detailed in section ?????? shall apply. If no costs are given in this schedule the Contract administrator will assume that all costs are included in the main tender price.

7. One-pipe towel rail circuits

When running a one-pipe circuit, it is imperative that each radiator or towel rails bypass runs directly below. **Radiated heat will not be efficient if this principle is ignored!** It is also important that high lift valves are fitted to both ends. Only full bore valves of any kind (including TRV's, although these are not recommended for this circuit), are permitted. The basic idea of a one-pipe circuit, in modern systems, is that it works as a permanent heat dump (bypass) even if all valves are closed. Any doubts whatsoever regarding this type of installation must be brought to the attention of the Services Engineer – Rob Berridge Heating Design Consultants.

IMPORTANT: *Only screwed maintainable gland type valves are to be used.
No circlip sealed gland type valves will be permitted.*

8. LTHW installation generally

The primary heating system shall be pressurised LPHW serving radiators.

Two wall mounted 48KW gas fired condensing boilers in cascade, located within the plant room provides the space heating and hot water via a single pumped circuit with individual pump sets at design flow and return temperatures of 70/50°C will supply all areas.

The individual heating zones/circuits shall be served via three number of pumped heating manifolds and sets, located in the plant room.

The pumped manifolds shall enable the flow and return temperatures to mix down to 70°C at the manifold.

All floors are heated via existing LPHW panel radiators.

All heat emitters shall be provided with IMI-Hydronic, 'eclipse' Thermostatic Radiator Valves (TRV's) on the flow inlet to each emitter.

An existing 500 litre hot water cylinder will continue to supply all the hot water requirements for the project.

9. Gas fired boiler

There is to be a Vaillant wall mounted 96KW gas fired condensing boiler cascade located within the plant room to provide the space heating and domestic hot water via a single pumped circuit at design flow and return temperatures of 70/50°C.

The boiler shall contain the necessary temperature and pressure relief discharge and general valve arrangement as necessary for a working system.

The boiler shall be installed in full accordance with manufacturers recommendations with regards service space etc.

The Contractor shall allow in his tender price for all gas pipe-work within the garage including isolation and solenoid valves.

The boiler shall be provided by Vaillant UK, Quotation ref. PSP 14049. See attached.

For details and layouts for the heating plant and equipment, please refer to manufacturers information and the tender drawing. See attached.

10. Flues

The two wall mounted 48KW gas fired condensing boilers located within the plant room shall be fitted with individual 80/125mm concentric flues which shall run from the rear of the plant room, through the rear wall into the ladies WC area at high level within existing boxing. They will run with continuous ascending direction as per the manufacturers instructions and terminate via the brick/block at the rear of the estate to atmosphere. Total flue length is approximately 10 metres

including change of direction. Three fire rated inspection hatches of minimum 300mm x 300mm must be installed to facilitate full flue inspection and maintenance should it ever be required.

The flue supports shall be as recommended and supplied by the flue manufacturer. The flue adaptor has been included as part of the Vaillant quotation listed above.

11. Pumps

Each pump shall be installed as shown on the tender drawings.

Each pump shall be fitted complete with pump valves and temperature/pressure gauges and shall be installed to manufacturers recommendations.

Pumps shall all be of canned rotor type.

Pumps shall be installed for the use with the following services:

- LPHW primary circulator pump for hot water.
- Three heating circuit pump sets.

12. LTHW pipe-work & emitters

A copper flow and return distribution system shall be installed from the boilers and within the plant room to serve all existing heating circuits and the domestic hot water Calorifier within the adjacent large cupboard.

The Contractor shall install pipe-work generally as indicated on the Tender drawings and in-line with each individual item of plants manufacturers' installation notes.

The pipe-work shall be installed in copper with copper fittings as indicated within Part 3 of this Specification, MLCP pipe, manufactured to EN ISO:21303-1 or black steel (heavy weight quality) also indicated in this section under, 'pipework general'.

Where pipe-work passes through walls, floors or ceilings, the pipe-work shall be sleeved with an oversized pipe-work section of the same material. The sleeve shall be of sufficient diameter to permit free movement of the enclosed pipe-work and shall project beyond the finished surface. When installed within a fire resisting structure the space between the sleeve and pipe-work shall be sealed with intumescent mastic.

Each floor branch shall be fitted with variable orifice double regulating valves to enable hydraulic balancing of the system throughout.

All pipe-work shall be run generally as indicated in section **23. THE PRIORY, WARE - specific calculations.**

Any valve positions shall be clearly conveyed by the mechanical Sub-Contractor to the Main Contractor so that future access can be accommodated.

All pipe-work shall be insulated in foil-faced mineral wool as per Part 3 of this Specification.

13. LTHW pressurisation & make-up unit

There is to be two pressurisation units within the plant room as indicated later in the specification to serve the heating system.

The pressurisation unit shall be capable of filling with a minimum of 3 BAR pressure.

The unit shall provide a fully automatic sealed system and come with all necessary valves and shall have the ability to incorporate a high/low pressure alarm.

The Contractor shall supply and install an expansion vessel. This shall be provided using a flexible rubber diaphragm within a steel shell, complete with factory preset nitrogen gas charge. The expansion vessel shall be installed in series with the pressurisation unit.

Expansion vessel to be calculated on site once main pipe-work has been established, with the aid of the Services Consultant.

14. Valves & cocks

All isolation valves shall be either IMI-Hydronic or equivalent spec full-bore lever type in accordance with Part 3 of this Specification.

Valves and cocks shall be positioned generally as indicated on the Tender drawings. TRV's and Lockshield to be IMI-Hydronic, 'Eclipse' packs or equivalent to EN215.

Variable Orifice Double Regulating Valves shall be used on the return branches as stated in Part 3 for ease and flexibility of balancing.

15. Mains water installation

Any pipe-work, which shall run externally of the property, shall be run within a purpose made ground trench in MDPE pipe-work to a depth avoiding exposure to frost. Typically a minimum depth of 750mm.

All mains water pipe-work within the plant room or service voids shall be insulated in foil faced mineral wool as per Part 3 of this Specification.

16. *Stored water – hot & cold*

It is the responsibility of the site manager or developer to engage the services of a water hygiene specialist to ascertain the necessity of regular cleansing to any stored water incorporated within the design. This typically refers to the prevention and control of Legionellosis, in accordance with ACoP L8, the control of legionella bacteria in water systems. (Approved Code of Practice & Guidance).

17. Hot water cylinders

An existing 500 litre hot water cylinder is located in the adjacent, large cupboard, directly outside the plant room. This cylinder will stay in operation, with the existing controls assessed for soundness and reliability for continued use and their ability to be incorporated into the new control system.

A further, existing 36 x 18 indirect cylinder within the main plant room will be completely removed and all hot water service pipework joined into the outlet manifold of the 500 litre cylinder in the adjacent cupboard.

18. Hot water service pipe-work

An existing copper distribution system serves all hot water outlets. Only plant room pipework is to be renewed within this tender.

The pipe-work shall be installed in copper with copper fittings as indicated within Part 3 of this Specification.

Where pipe-work passes through walls, floors or ceilings the pipe-work shall be sleeved with an oversized pipe-work section of the same material. The sleeve shall be of sufficient diameter to permit free movement of the enclosed pipe-work and shall project beyond the finished surface. When installed within a fire resisting structure, the space between the sleeve and pipe-work shall be sealed with intumescent mastic.

The pipe-work shall be adequately supported and enclosed so as to permit free movement for expansion and contraction.

The spacing of the support shall not exceed the centres tabulated within Part 3 of this Specification. Wherever run together, hot and cold pipe-work shall be insulated and spaced according to Part 3 of this Specification.

19. Cold water services

The Contractor shall install pipe-work generally as indicated on the Tender drawings. The pipe-work shall be installed in copper with non-dezincifiable capillary or compression fittings as indicated within Part 3 of this Specification.

Where pipe-work passes through walls, floors or ceilings the pipe-work shall be sleeved with an oversized pipe-work section of the same material. The sleeve shall be of sufficient diameter to permit free movement of the enclosed pipe-work and shall project beyond the finished surface. When installed within a fire resisting structure, the space between the sleeve and pipe-work shall be sealed with an intumescent mastic.

20. Thermal insulation

All pipe-work within external trench ducts and ceiling voids shall be installed with pre-formed rigid sectional mineral wool insulation with aluminium foil finish. Thickness of insulation shall be as listed in Part 3 of this Specification.

All heating pipe-work within the plant room or service voids shall be installed with pre-formed rigid sectional mineral wool insulation with a foil faced finish. Thickness of insulation shall be as listed in Part 3 of this Specification. All pipework must be clearly marked as to its purpose and direction.

21. Description of control systems

The Contractor shall employ the use of a competent controls specialist for the complete controls design and installation on the project. One can be supplied if requested.

The Contractor shall ensure continuity between the installation of all services and integration between them where necessary.

General

The heating installation is of the sealed pressurised type via a pressurisation unit/expansion vessel.

Boilers, pumps & water heaters

H.W.S. shall operate on opening of sanitary outlet with pressure provided by the existing, high level water storage on the top floor.

Boiler primary pump shall be arranged for 'run-on' on timed boiler shut down which shall be variable between 15 and 30 minutes or as per the manufacturers instructions.

Frost protection

Frost protection shall be provided to all service areas.

Hot water service control

The hot water flow temperature shall be controlled by individual cylinder thermostats.

Instruction of Employers staff

On handover to the Employer of the completed installation, the controls specialist Commissioning Engineer, or similarly qualified Engineer, shall attend the Employers staff and shall make this staff fully conversant with the operation and maintenance of the complete installation.

Checking & adjustment of control installation

During the Defects Liability Period the controls specialists shall make visits to the site and shall carry out thorough checks on the controls installation under actual working conditions. Such adjustments that are necessary to the controls installation shall be made and reported to the Design Engineer and shall take due account of variation in the operation of the mechanical plant under control.

Until the final check and adjustment has been carried out, the contract shall not be considered for final acceptance and the balance of retention sums may not be released.

22. Soil, waste & vent installation

Pipe-work shall be un-plasticised polyvinyl chloride (UPVC) pipelines up to 50mm for internal soil, waste and ventilation installations and shall conform to BS 4514. Pipe fittings shall be fully compatible with the adjoining tubes.

Tubes and pipe fittings shall be straight and correctly shaped, cleanly finished, round in cross-section and shall be free from cracks, surface flaws, lamination and other defects.

UPVC fittings shall be used which shall have characteristics similar to the adjoining pipe-work. Sockets of fittings shall be correctly formed and the wall thickness, composition and performance shall conform to BS 4514. Fittings of one manufacturer shall be used throughout.

Spigot and socket joints shall be jointing rings located within a groove or housing located near the mouth of each socket. Jointing rings may be either 'o' rings, 'd' rings or ribbed - dependent on pipe-work and fitting manufacturer.

The correct expansion tolerances shall be provided within ring and seal joints by following the manufacturers' instructions. Any marks on fittings or pipe barrels indicating maximum depth of insertion shall not be exceeded. Cut ends of pipes or fitting shall be re-marked for the correct depth of spigot insertion.

Jointing by solvent welding shall be carried out strictly to the manufacturers instructions. The correct solvent cement shall be used for each manufacturers pipe-work system. Ring seal joints shall be included at the manufacturers recommended intervals to take up pipe-work expansion.

In addition the installation shall be in accordance with the following clauses:

- a. The pipe-work in branch connection shall be arranged to allow free drainage of the system. Connections to mains and branch pipes shall be arranged to prevent cross flow from one appliance to another and shall be made with an easy sweep in the direction of the flow except where otherwise directed. All bends shall be of the long radius type.
- b. The jointing between lengths of pipe-work and fittings shall be carried out in such a manner that a continuous smooth bore is maintained within the joint. No lipping or protrusion of the jointing material within the bore of the joint shall take place.
- c. In pipe systems of 75mm and over, where junctions and changes of direction take place in the horizontal plane, the junction or change of direction shall be achieved using angled fittings or groups of fittings having obtuse angles of not less than 112° unless large radius bends are used in which case the minimum obtuse angle shall be 92°.

Double junctions shall not be used in the horizontal plane.

- d. Where connections are to be made between UPVC stacks and cast iron or salt glazed earthenware drains, cast iron or UPVC adaptor fittings shall be used as supplied by the manufacturer for this purpose.

- e. Where connections are to be made between UPVC pipe-work and sanitaryware the following methods shall be used:
- I. Pipe or fitting with an integral enlarged socket, 133mm internal diameter to accommodate the sanitaryware outlet with the final joint being made by a neoprene or synthetic W.C. mechanical seal connector suitable in size to ensure a tight fit between the connector, the sanitaryware outlet and the UPVC pipe.
 - II. Pipe spigot end with male and female neoprene or synthetic W.C. mechanical seal connector suitable in size to ensure a tight fit between the connector, the sanitaryware outlet and the UPVC pipe.
- f. All waste pipe-work shall be installed entirely to the satisfaction of the Design Consultant and in accordance with the requirements of the local Water Authority and the local authority's Building Control Inspector. Where excessive lengths of waste pipe-work are required, increases in pipe size may be necessary but only in accordance with the relevant British Standard.

A percentage of the SVP's shall be fitted with air remittance valves in the stub stack and shall be fixed in strict accordance with the agreed drainage drawings and the manufacturers highest connected appliance. The remaining SVP's shall be run directly through the roof terminating with a suitable weather cowl, i.e. ridge or tile vent provided by the Main Contractor. The Main Contractor shall be responsible for running pipes up to and connecting into these tile vents.

All vent pipes in the roof space must be run as vertically as possible in rigid plastic. Flexible tubing must not be used except for changes in direction and final connections to the tile vents. Furthermore the length of these vent pipes shall be limited to 200mm. All pipes shall be properly bracketed to the satisfaction of the Design Consultant.

All appliances shall be fitted with a 76mm deep seal trap and anti-siphonage trays shall be provided where a 50mm diameter common waste pipe is used for one or more appliances.

Waste pipes shall be fitted with a 76mm deep seal trap and anti-siphonage trays shall be provided where a 50mm diameter common waste pipe issued for one or more appliances.

Waste pipes shall be sized generally according to the appliance as per the following:

- WC	100 mm dia.	UPVC	Waste
- Bath	40 mm dia.	UPVC	Waste
- Shower	40 mm dia.	UPVC	Waste
- Sinks	40 mm dia.	UPVC	Waste
- W.H. basin	32 mm dia.	UPVC	Waste

The horizontal soil and vent pipes shall generally be installed to the gradients recommended in BS 5572 or as indicated on the drawings. The soil and waste pipes shall be installed with the gradient falling towards the main vertical soil vent pipes.

The horizontal vent pipes shall be installed with the gradient rising towards the main vertical vent pipes. The gradient specified shall be achieved in continuous falls from high to low points by the use of fittings or groups of fittings of the correct angle.

The support system used for suspending a horizontal pipe system shall incorporate an adjustable drop rod capable of correcting small errors in alignment should these become apparent during the testing and commissioning of the system.

Access points shall be provided as indicated on the drawings and shall be faced to form a true completion of the bore of the pipeline and made gas and water tight with good quality rubber gaskets firmly secured with copper alloy bolts and washers. No part of a cover shall project into the pipeline bore.

Any waste or vent pipe-work in excess of 40mm outside diameter passing horizontally or vertically through internal block walls or ceilings must be provided with an approved fire collar to achieve the required fire compartmentation. Anything less than 40mm diameter must be mastic sealed to eliminate smoke spread only. The Mechanical Services Sub-Contractor is responsible for all the above.

The underground drainage system will terminate in a socket to which the above ground drainage shall be connected by means of a caulked lead joint, if cast iron or a cement joint, if salt glazed clayware.

Pipeline below 100mm shall be fitted with a suitable reducing piece of flange to fit the drain socket.

The soil, waste and vent installations shall be tested in one operation. However, it may be necessary to soundness test in sections as the work proceeds. Tests should be carried out in accordance with BS 5572. Each installation shall be finally air tested with all the appliances connected at 38mm water gauge for 3 minutes.

23. THE PRIORY, WARE - specific calculations

Hot water

Existing hot water cylinder and domestic distribution pipework will not be affected within this scope of works and only primary pipework supplies will be affected. Rob Berridge Heating Design Consultants bear no responsibility for downstream services beyond the 42mm 'extended manifold' but these will be tested.

Cylinders

Existing 500 litre unit.

Cold water

Existing.

Boilers

2 X 48kW Vaillant Eco TEC plus wall mounted gas condensing boilers, to run in cascade format.

Boilers to run at flow and return temperatures of 70/50°C respectively to maximise the condensing mode of the set up. Boilers to be delivered in kit form including: flue header, low loss header and rigid triple frame. On commissioning, if it is deemed that the system can run at 65/45°C as the primary set temperatures, this will be acceptable.

Expansion vessels - heating

1 x 25 litre and 1 x 150 litre IMI-Hydronic, 'Statico' nitrogen filled vessels with full bore EN331 service valves to each.

Pressurisation unit

1 x Reflex, Servitec Mini, vacuum degassing unit with additional water make up unit to serve the secondary side of the new plated heat exchanger with in the plant room.

1 x Stuart Turner SPU Mini to serve the primary side of the new plated heat exchanger.

Both units to be set to 1.5bar and maintain this pressure throughout.

Chemicals

The use of chemicals are generally strictly forbidden with contracts designed by RBHDC. All system water must be fully demineralised, have low conductivity and a pH of 8.5 unless otherwise agreed with the Design Team. The principles of VDI2035 should be fully adopted. Please contact www.elysator.co.uk

However, the primary side of the new plated heat exchanger service the new boilers must be dosed with Sentinel X100 to achieve a maintained passivity of 8.5pH. RBHDC to witness final dosing and testing. This **MUST** be annually checked as part of the agreed service contract on the plant and system.

24. Testing & commissioning

The Contractor shall engage a Services Commissioning Engineer (Rob Berridge Heating Design Consultants), whose function shall be to monitor and oversee the testing and commissioning of all mechanical services.

The independent Commissioning Engineer shall ensure by question and suggestion, methods and practices that the best interest of the Client are achieved resulting in precise, accurate and professionally documented commissioning data.

The scope of the involvement of the Services Commissioning Engineer shall encompass the following:

- I. Study the consulting engineering original 'Contract Issue' specifications and design drawings comparing anomalies to the Contractors most recently revised 'working drawings'.
- II. Provide method statements for testing and commissioning all the electrical systems related to mechanical works.
- III. Liaise with manufacturers and suppliers to produce a commissioning procedure document.
- IV. Produce a commissioning procedures document for approval inclusive of commissioning programme.
- V. To propose any alterations or additional test exercises which are considered necessary to comprehensively confirm the performance of the system and compliance with the design criteria.
- VI. To be satisfied to the satisfactory physical application of the tests in terms of standard, location, duration, quantity and frequency etc., and to query same as appropriate.

- VII. Obtain and review copies of test records relating to pressure testing of ductwork and pipe-work.
- VIII. Examine and co-ordinate, subsequent to the setting out of the Engineering Services by the Contractor the results of pre-commissioning and documentary records thereof plus random checking on completion.
- IX. Carry out regular site inspections with regard to commissioning items, or as agreed.
- X. To attend and witness, all testing and commissioning procedures as undertaken by the Contractor and Consulting Engineer.
- XI. Witness demonstration of system performance.
- XII. Confirm that the test and commissioning records represent a true and accurate record of the tests carried out and the results actioned.
- XIII. Prepare a brief technical report of the results of the testing and commissioning exercises and to certify that the installation is operational and performing in accordance with the design criteria.
- XIV. Prepare operating and maintenance manuals
- XV. as indicated elsewhere in this Specification.

The Contractor shall provide the necessary labour, material and instruments for carrying out these tests and shall give the Engineer 10 working days notice of the date it is proposed to carry out any tests.

The Contractor shall then commence testing the installation and shall notify the Engineer that the systems are operating according to the intent of the Contract Specification/design parameters.

The Contractor shall submit the results of the test to the Engineer on an Inspection Certificate of the type described in the Regulations within 7 days of the date of testing.

The Contractor shall also allow for testing the installation whilst work is in progress or as instructed by the Clients representative if necessary.

In cases where the installations are tested and commissioned in sections, the Contractor shall repeat final demonstration to the satisfaction of the Engineer that all the sections of the works already demonstrated separately are capable of simultaneous operation in accordance with the requirements of the Contract.

25. BMS

All BMS options to be fully discussed with RBHDC prior to tender but the following control priorities must be adhered to :

1. All hot water systems must be priority hot water circuits. PDHW.
2. Flow temperatures must be set and limited to 70 degrees Centigrade. This temperature must be achieved in all scenarios where condensing technology is installed.
3. Return temperatures must not exceed 50 degrees Centigrade (Condensing Boilers Only). This can be controlled via the BMS or STAD valves installed on the return pipework of each circuit. RBHDC to advise settings.
4. Weather compensation must be incorporated into any new systems for heating efficiency.
5. AcoP L8 (legionella protection) cycles must be engaged to meet current regulations.
6. All BMS connections to spill and fill, expansion, vacuum degassing and water make up units must be incorporated.

- 7. Indication is always given on the tender drawings but these will get amended and sent to all concerned subsequent to feasibility meetings and discussions prior to the start of the contract works.
- 8. End users (site staff and responsible persons) should only have access to minor controls; they should not have access to primary flow or return settings or anything that could alter the efficiency of new plant subsequent to commissioning.

I hereby confirm that I have read, understand and will adhere to the contents of this specification
(PART 2)

Signed: Date:

Please print name:

Company:

ISSUE & REVISION RECORD PART 3

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No.o	26/08/20	R Berridge				Specification

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INDEX – Mechanical Installation – general Part 3

1.	Preamble	Page 21
2.	Workmanship	Page 21
3.	Materials	Page 21
4.	Regulations	Page 21
5.	Pipe-work – General	Page 22
6.	Valves, cocks, strainers & gauges – General	Page 35
7.	Heating Appliances	Page 46
8.	Testing & commissioning	Page 46
9.	Acoustic & vibration isolation	Page 50
10.	Thermal insulation, painting & identification – General	Page 50
11.	Direct expansion refrigeration pipe-work	Page 54
12.	Soil, waste pipe-work installation – General	Page 55

Part 3 Mechanical Installation – General

STANDARDS OF MATERIAL & WORKMANSHIP

1. Preamble

This section of the Specification generally indicates the minimum acceptable standards of workmanship and materials to be applied in providing the Engineering Services installation(s) described in the Specification and drawings and shall be read in conjunction with other sections of this specification.

2. Workmanship

The installation(s) shall comply with the standards of good practice and workmanship generally acknowledged in the relevant industry, and only labour qualified by trade test (where applicable) or of accepted grade for the particular works shall be employed.

3. Materials

All materials shall be new, of good quality and manufactured or fabricated to comply with the current requirements of the relevant British Standard Specification as a minimum, but in any case, to approval of the Services Consultant, **Rob Berridge Heating Design Consultants (RBHDC)**. Any doubts must be brought to the attention of the design team.

4. Regulations

The Contractor is to comply with Standards Acts and Regulations as follows:

- a. Health and safety at work.
- b. All relevant British Standards.
- c. The Gas Safety Regulations.
- d. All Local Water Board requirements.
- e. The Bye-Laws of the Water Act. (WRAS Approval).
- f. Control of Substances Hazardous to Health Regulations.
- g. Noise at Work Regulations.
- h. Control of Pollution Act.
- i. Regulations under the Factories Act.
- j. Regulations under the Electricity Act.
- k. The Clean Air Act.
- l. The Building Regulations.
- m. Technical Memorandum No.13 of CIBSE
- n. Any special requirements of the local Electricity, Gas Board, Fire Fighting Authority, Water Board or Local Authority Bye-Laws.
- o. For ALL gas installation pipe-work on industrial and commercial premises, IGEM/UP/2 (edition 3 communication 1771) must be strictly adhered to.
- p. Clean Air Strategy (HETAS) 2019.

- q. Control of Asbestos Regulation 2012. <https://www.hse.gov.uk/asbestos/regulations.htm>
See Attached PDF.
- r. AcoP (Approved Code Of Practice) L8 for legionella protection.

5. Pipe-work - General

Generally all pipe-work, ducting, etc., shall be concealed, except in plant rooms, tank rooms, etc., where all services shall be exposed. It is the Contractors responsibility to ensure that adequate access is provided to all concealed services.

Tubing general

Tube materials for the various services shall comply with the following tables:

SERVICE	MATERIAL
a) Heating Systems Circulation Pipe-work	Black Steel, heavy weight quality. Copper. Table X BS 2871 Light gauge press fit stainless steel to: DIN2394. MLCP to: EN ISO:21303-1
b) Chilled Water Systems Circulation Pipe-work	Copper. Table X BS 2871 Light gauge press fit stainless steel to: DIN2394. MLCP to: EN ISO:21303-1 HEP 20 Barrier Pipe to BS 7291 (Permission needs to be sought from RBHDC).
c) All Systems Safety valves discharges, cold feeds, open vents Automatic Air Vent discharges Drains from pumps Other drains from plant	Black Steel, heavy weight quality. Light gauge press fit stainless steel to: DIN2394. Light Gauge Copper Light Gauge Copper Light Gauge Copper or UPVC to BS 4514 Light Gauge Copper or UPVC to BS 4514
d) HWS, CWS, MWS Overflow/ Condense Wastes Distribution Pipe-work	Condense must comply with BS 6798 Light Gauge Copper (not for condense)

	<p>Light gauge press fit stainless steel to: DIN2394.</p> <p>MLCP to: EN ISO:21303-1</p> <p>UPVC to BS 4514</p>
<p>e) <u>Soil & Waste Systems</u></p> <p>Main soil, Waste & Ventilation Pipe-work</p> <p>Small dia branch wastes & vent pipe-work</p>	<p>UPVC to BS 4514</p> <p>UPVC to BS 4514</p>
<p>f) <u>Gas & Oil Services</u></p> <p>Gas & oil pipes in building or above ground</p> <p>Gas & oil pipes below ground</p>	<p>Black Steel, heavy weight quality - Copper or 'Tracpipe' (CSST).</p> <p><i>All tubes shall be black steel or heavyweight quality, which shall be PVC machine wrapped to give corrosion protection. An unbroken barrier shall be provided by double wrapping the joints and fittings with an approved tape after installation. The bore of the gas pipes only shall be coated with red lead paint.</i></p>

NOTE: *The open trenches will be cut and backfilled by the Main Contractor but the Sub-Contractor shall be responsible for ensuring that the bottom of the trenches have a true gradient as required and are adequately rammed before pipe laying is commenced. Joint positions are to be adequately supported.*

Steel pipe-work if required

Steel pipe, black and galvanised or sizes up to and including 150mm - N.B. shall comply with BS 1387 and be of heavy weight grade.

Steel pipe-work shall be manufactured by Messrs Stewarts & Lloyds, Wellington Tube Company or equal to.

All tubes shall be of even bore, clean and smooth throughout, commercially straight and free from grooving, blistering and rust. Tube shall be colour banded.

All steel tubing shall receive one coat of primer protecting paint before despatch from works. If the tubing is delivered oiled but not painted then the Contractor shall take the necessary precautions to protect them from inclement weather and paint them on site with an approved oxide paint.

Light gauge copper pipe-work

Pipe-work shall be to BS 2871 Part 1, Table X, manufactured by Yorkshire Imperial Metals Ltd or equal to EN 1057 (2006).

All copper tubing shall be produced free of all harmful films or scales as recommended by the British Non-Ferrous Metals Research Association.

All tubes shall be scoured to remove all oxides formed during manufacture and shall bear the British Standard 'Kite Mark'.

Fitting general

Pipe fitting such as bends, tees, etc., shall be provided as specified thereunder for the various services and tube materials.

Throughout the pipe runs long sweep bends are to be used in preference to elbow wherever practical. All made or set bends shall have as large a radius as is possible and shall be free from buckling.

Tees shall be of the easy sweep or twin elbow pattern except where square tees will facilitate venting and draining.

Where a gradual reduction or increase in pipe diameter is required, i.e. pump connections, taper pieces at least 150mm long shall be used.

Bushes shall not be used and where a reduction in size of the pipes is required, reducing sockets or tees shall be used. Eccentric reducing sockets shall be used wherever necessary to ensure proper drainage or elimination of air pockets.

Concentric reducing sockets shall be used in vertical pipe-work.

Pulled bends should be used where practical for offsets and expansion loops.

Tees shall be sweep pattern, except in the following circumstances:

- a. Where the use of a sweep tee would result in the formation of an airlock.
- b. Where vent pipes are taken off the ends of tees and the circulation is directed through the tee branches.
- c. At low points where drainage would be impeded.
- d. At any other position where, in the opinion of the Services Consultant, the use of a square tee would simplify or improve the pipe-work assembly.

All pipe-work in false ceilings up to 50mm bore shall have welded joints and connections if steel or soldered capillary joints if copper, for pipe-work over 50mm bore connections shall be as specified below. No compression type joints will be accepted in these areas unless otherwise agreed with the services designer.

Fittings for steel pipe-work

Fittings for steel pipe-work shall comply with the following:

BLACK STEEL TUBES

50mm N.B. & below	Screwed malleable iron beaded fittings to BS 143 up to 5.2 BAR & BS 1256 with threads conforming to ISO/R7 & BS 21.
Over 5.2 BAR or	Purpose made heavy welding fittings within false ceilings to BS 1965/1963 to match pipe-work to which they are attached.
65mm N.B. & above	Purpose made heavy weight welding fittings to BS 1965/1963 to match pipe-work to which they are attached.

GALVANISED STEEL TUBE

50mm N.B. & below	Screwed galvanised malleable iron beaded fittings to BS 1256 & BS 143 with threads conforming to ISO/R7 & BS 21.
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65mm N.B. & above Flanged heavy weight steel galvanised after manufacturer.

NOTE: Wrought iron fittings for expansion bends shall be heavy quality and comply with BS 1387 : 1967

Fittings for copper pipe-work

Fittings for copper pipe-work shall comply with the following:

COPPER TUBE

50mm N.B. & below Capillary fittings or compression joint to BS 864 Type A.

65mm N.B. & above Bronze weldable fittings or flanged copper/gunmetal fittings bronze welded to tube.

NOTE: All copper tube fittings must be of a non-dezincifiable quality.

Flanges

Mating flanges shall be provided on all services to items of Plant and Equipment and valves 65mm bore and over. Pairs of flanges shall also be provided on all services pipe lines of **65mm bore and over**, in intervals approximately 15m and wherever necessary to facilitate dismantling.

Flanges shall be machined full face, to BS 10 or BS 4504 to the pressure table compatible with the item to which the joint shall be made and suitable for the working pressures to which they will be subjected and shall conform to the appropriate BSS table. On copper pipe-work, they shall be of naval brass bronze, gunmetal or brazing metal, on steel pipe-work, they shall be of carbon steel and shall be galvanised when used on galvanised pipe-work.

Flanges on black steel tube shall be back and base welded to the tube according to BS 806 Type 6 or 7. Flanges on galvanised tube shall be screwed in accordance with BS. Flanges on copper tubes shall be of copper alloy not subject to dezincification. Flanges on light gauge copper tube shall be back and base bronze welded onto the tube.

Unions

Unions shall be installed on all services (except where specified otherwise) in pipe-work up to and including 50mm bore at intervals of approximately 15m and wherever necessary to facilitate dismantling and adjacent to each valve.

All unions shall be of malleable iron with two conical bronze seats and with hexagon nuts on both parts. Unions on galvanised pipe-work shall be galvanised. Unions on copper pipe-work shall be of bronze or gunmetal not subject to dezincification. Long screw connections will not be permitted.

Pipe-work installation

All pipe-work shall be installed in a first-class workmanlike manner throughout, with full provision for venting, expansions and contraction, maintenance and renewals.

Open ends left during the progress of the work shall be protected with purpose made metal, plastic or wood plugs, caps and blank flanges to prevent dirt or rubbish entering. Before setting to work all sections of pipe-work shall be thoroughly flushed out. Should any stoppage in the circulation occur after the various systems have been put into operation, owing to non-compliance with this requirement, the Sub-Contractor shall attend and rectify the matter at his own expense.

All pipe-work shall be fixed mutually parallel where adjacent and all vertical pipes shall be parallel to adjacent vertical walls.

Pipes laid into timber cuts or notches in joists must be fully insulated to prevent expansion noise.

All service pipe-work, whether copper or HEP 20 type barrier pipe will be pressure tested to 7 BAR for a period no less than 20 minutes and should be left full, at pressure through to 2nd fix to prevent accidental damage.

Pipe-work shall follow the lines of walls and shall be graded to ensure venting and draining. The clearance between pipe-work or its covering (if insulated) and the wall or any other fixture shall be not less than 25mm.

Where pipe-works is to be insulated, it shall be fitted in such a manner as to allow each pipe to be insulated the full circumference and also to allow the prescribed clearances, after insulation, on other pipes and any other surface.

Joints shall not be made in the thickness of any wall, floor or ceiling and pipe-work shall not be solidly embedded in brickwork or floors unless specially ordered. Where tubes pass through walls, floors or ceilings, sleeves shall be fitted, providing a 13mm gap between the pipe or lagging with this space packed with Rockwool or similar.

Locate and arrange horizontal pipes and ducts, unless otherwise noted, above the ceilings or floors on which they are shown, arranged so that under considerations of all other work in the area, the maximum ceiling height and/or useable space is maintained.

All pipes passing through floors or walls where visible to be provide with pipe escutcheon plates.

Pipe-work shall be reamed after cutting and shall be free from flattening or distortion. If hot bending is used on galvanised tubing, the tubing must be re-galvanised throughout after the bend has been manufactured.

Where pipe-work is buried underground it shall be double wrapped with Denso tape. All such wrapping shall be only completed after successfully witnessed pressure tests and shall be approved by the Services Consultant before the trench is filled in.

Where this Specification calls for welding on galvanised services, all special sections of pipe-work must be pre-fabricated and welded and these shall be galvanised after manufacture

The Contractor shall be deemed to have included in his Tender for work in setting up piers, wastes, drains, beams etc.

Any pipe-work, which, in the opinion of the Services Consultant or his representative, is not fixed in accordance with the foregoing, shall be removed and re-fixed at the expense of the Sub-Contractor.

Pipe-work shall be installed with due allowance for expansion and contraction, complete with guides, anchors, etc., to ensure correct, quiet operation, with no undue stress applied to pipe-work or joints.

All water service pipe-work up to and including 28mm, that is run within ceiling voids or particularly over and cut into joists, will be insulated in "Celafelt" slip over pipe lagging (or similar) to ensure free movement over the joists.

Gas pipes should be run at least 150mm away from power cables and conduit. If this is not possible, contact between the two must be prevented by means of insulating distance pieces and sleeves.

Jointing

Screwed joints shall be made to BS 21 and ISO/R7 with approved jointing materials.

Flanged joints shall be bolt made with Taylors Rings or 'Klingerite' lying within the bolts and approved jointing paste. Bolts, nuts and washers to be bright and/or plated mild steel and be suitable for the system/service being installed. Bolts shall only project between 5 and 10mm past the nuts. For brass or gunmetal flanges, 'Klingerite' gasket joints may be used. Bolts and nuts shall be selected with sufficient tensile strength/performance applicable to the particular system/service in which they are being installed. Welded joints shall be made as specified in Part 3.

The following methods shall be used for jointing straight lengths of tube subject to the terms of Part 3, concerning flanges and unions unless otherwise specified in reference to particular sections of the work.

Joints on straight runs are not to be closer than 3 metres except where tees are necessary.

a) **Black Steel Tubes**

50mm N.B. & below Screwed sockets

65mm N.B. & above Welded & flanged

b) **Galvanised Steel Tubes**

50mm N.B. & below Screwed sockets

65mm & above Screwed flanged or welded flanged
(Galvanised after manufacture)

c) **Light Gauge Copper Tube**

50mm & below Capillary fittings

65mm N.B. & above Bronze or Autogenous welding

Steel sockets shall comply with BS 1387, copper capillary joints shall comply with BS 864 and copper compression joints shall be of the non manipulative type to BS 864 type 'A'.

Flanges of up to 65mm bore shall be screwed or welded to pipe-work and before expanding to seal welded around the hub. Flanges of 65mm bore and over shall be back and bore welded to the pipe-work.

The Contractor shall ensure that all soldered joints on copper capillary fittings are carried out to the manufacturers recommendations. Both copper tube end and inside of fitting shall be thoroughly cleaned, with wire wool or similar, prior to jointing to provide complete capillary action. All soldered joints shall be made using manufacturers recommended cleaning and jointing fluxes and solder type. All fluxes and solder used shall be applicable to the type and pressure rating of system/service on which they are used.

The Contractor shall ensure that the following soldering, all jointing flux is thoroughly cleaned and removed from pipe-work and fitting to prevent any corrosion or discolouring.

The Contractor must take care to provide copper joints which are suitable for the maximum working pressure and temperature of the service for which they are to be used. All fittings for copper tube must be proof against dezincification.

All surplus-jointing materials shall be cleaned off at the time of making the joint. The Services Consultant shall require the remaking of any joint not considered correctly made and/or cleaned in accordance with this specification.

The Contractor must ensure that any jointing compound used is suitable for the material being conveyed. This is of particular importance with regard to the gas and oil services.

N.B. Solder must be lead free on all potable water joints.

Welding

Before commencing welding on the site, evidence shall be produced proving the competence of the welder to execute the work required. Such evidence shall be by way of a Certificate of Competency issued by the Association of Heating, Ventilating and Domestic Engineering Employers.

The Contractor shall ensure that all welders used on the contract hold a current Grade 'A' Certificate issued by the Heating and Ventilating Contractors Association/National Joint Industrial Council and shall produce such a certificate on demand.

Oxy-acetylene welding shall be carried out in accordance with the standard recommended by the Association of Heating, Ventilating and Domestic Engineering Employers.

Arc welding shall be carried out in accordance with the standard recommended by the Welding Research Council and/or British Standard Institution.

All welding shall be carried out to no less than the standard laid down in 'Welding of Mild Steel Pipe-work 1970'. The manual relates to welding of low carbon steel pipe-work and provides for standards for water and steam pressures up to and including 17.2 BAR and/or temperatures up to and including 220°C.

Welding rods shall be good quality and for copper pipe-work welded joints are to be made by the oxy-acetylene bronze welding process, using 'Phosphor Bronze' rods and fluxes as recommended by the rod manufacturers.

Pipes shall be properly aligned and spaced before the weld is commenced and to be held in position whilst welding by jig or tack welds. The distance between the centres of any two adjacent branch welds shall not be less than twice the diameter of the larger branch.

The hole in the main pipe shall be equal to the bore of the branch. All loose scale and oxide shall be removed from the inside of the main pipe before the branch boss is welded into position. Generally sweep branches shall be made except for tees on headers and as excepted for sweep tees in the foregoing clause.

Pipe-work shall generally be machine cut but where pipes are cut by flame, all oxide shall be cleaned off with a file, grinder or hammer and chisel and all irregularities on outer edges shall be removed by filing to satisfaction of the Services Consultant.

All joints other than those specified shall be butt-welded and pipe ends shall be correctly prepared for same as recommended in previously noted regulations. Such butt welds shall completely fuse the walls of the pipe without leaving notches at the edges or undercutting at the sides of the welds on the external surfaces. The finished surface shall be slightly convex and where one weld joins another there shall be no bump. Internally there shall be complete penetration and root fusion with a bead more than one half of the thickness of the end tube.

Where branches are to be welded in, the ends of the branch pipes shall be correctly shaped to the main pipe and the hole for the branch pipe cut in the main pipe shall be to the full diameter of the branch pipe and be executed with the aid of a template.

Pipes out of alignment shall, where possible, be produced by fire-made sets and under no circumstances shall pipes be joined by welding when more than 5° out of alignment. Sleeve type welded joints will not be permitted.

Branches welded in shall not be less than an angle of 60° to the main pipe or shall be made using manufactured branch swept shoe fittings accurately profiled to fit the main pipe. The opening in the main pipe shall be correctly shaped to coincide with the branch and both pieces shall have bevelled edges. All burrs shall be removed before welding is commenced and the branch piece shall not project into the bore of the main pipe. Bends shall be factory made or produced by fire-sets; cut and shut and lobster back methods shall not be acceptable. Factory made reducers are to be used and no improvisation in producing a reduction in the diameter of pipes will be permitted.

The Services Consultant shall be at liberty to order the cutting out of up to $2\frac{1}{2}\%$ of the welded joints for inspection and testing, without cost to the employer, or not less than two welds from each of the welders used on the project.

Specimens shall be cut from the work at the Services Consultants direction and subjected to visual examination and bending tests. Work which in the opinion of the Services Consultant, is defective, shall be re-welded at the Sub Contractors expense.

Defective work shall be considered to include work which in the opinion of the Services Consultant, has not been satisfactorily prepared, nor achieved complete penetration, or is found to be unsatisfactory under bending tests, or unsatisfactory in any other way. The Services Consultant shall nevertheless reserve the right to order further tests at no cost to the Employer, if it is found that any sample/inspected weld fails to comply with the full requirements of the Specification. Non-destructive weld testing may also be considered by the Services Consultant instead of cutting-out on certain welds. Such tests may be required by the Services Consultant, at no additional cost to the Employer, should in the opinion of the Services Consultant, an unreasonably high percentage of weld tests fail.

The Services Consultant may call upon the Sub-Contractor to:

- a. Demonstrate the quality of the Welders work according to BS 2645 Part 2.
- b. Submit samples for further examination.

No welding shall be carried out under the following conditions:

- a. When surfaces of materials are wet.
- b. In rain or high wind.
- c. When the temperature of the parent metal is 5°C or below.

Pipe brackets, supports etc.

All necessary hangers, brackets, rollers, guides, anchors and supports for the piping are to be provided of approved purpose made types and manufacture. The spacing, details and types are to be agreed with the Services Consultant and as specified in Part 3. Supports are generally to be of black steel or malleable iron for steel piping, galvanised for galvanised piping and brass, copper or gunmetal for copper tubing. Support shall allow adequate movement for expansion and contraction and shall be forged. Special brackets and supports shall be permitted where necessary, subject to their approval by the Services Consultant.

Vertical rising pipe-work shall be supported at the base or as indicated to carry the total weight of the riser. Branches from risers shall not be used as a means of support.

All heavy valves and similar fittings shall be provided with suitable brackets or hangers.

The method of securing the bracket, hangers or clips to the structure shall be as agreed with the Structural Engineer.

Where fixing to solid concrete structure set anchor fixing shall be used, the hole in the structure being drilled by the correct size of bit of the anchor used.

Where brackets are to support insulated pipe close to the structure sufficient clearance is to be provided between the pipe and the structure to allow insulation and vapour sealing to be applied.

Pipe-work mounted horizontally above false ceilings and similar positions shall be supported on R.S. angle or channel supports hung from drop rods at either end. Pipe-work shall be supported to allow for expansion and contraction, without stress being applied to other equipment (i.e. boilers, valves, fan coils etc.). Heating pipe-work shall be suitably anchored and guided to meet manufacturers requirements and the Services Consultants satisfaction.

Where pipe-work expansion is provided by expansion loops, the brackets, supports and installation shall be such as to allow full lateral and longitudinal movement, without placing excess strain or stress on pipe-work, fittings, connections, brackets etc.

The 'U' bolts around heating, chilled water and H.W.S. pipe-work shall have a minimum clearance of 1/16". Brass or sheet lead bearers shall be provided where copper pipe-work rests on steel supports, with brass 'U' bolts or copper flat iron straps around the pipe-work.

The diameter of the rods from which 'U' bolts shall be made is as follows:

32mm bore pipe-work and under 3/8"	10mm
40mm and 50mm pipe-work 1/2"	12mm
80mm to 125mm pipe-work 5/8"	15mm
150mm bore pipe-work and above 3/4"	18mm

Where horizontal support brackets are impracticable or inexpedient, steel pipes shall be supported by malleable pipe rings or fabricated steel made in halves and secured by bolts or screws. Calliper hooks shall be permitted. The support rods for the pipe rings shall be bolted to cleats fixed to the under-side of the floor slab, as previously described. Copper pipe-work may also be supported in a similar manner but the ring clips shall be made from brass.

Where pipe-work up to 50mm bore is fixed to solid walls, brackets may be of the screw-on or long shank built in type, except where the walls are plastered when only the long shank built in type shall be used. For fixing to woodwork and lightweight partitions or walls they shall be screw-on pattern and may be adjustable two-piece type.

Brackets for mild steel pipe-work shall be mild steel or malleable iron and brackets for copper pipe-work shall be brass or gunmetal. The upper half of the pipe clip shall be detachable without disturbing the fixing.

Chilled water brackets shall be complete with hard wood blocks, the same thickness as insulation and galvanised steel sleeve to maintain a continuous vapour barrier.

Individual suspended pipes or group support pipes on steel channel or angle or unistrut etc., shall be supported by drop rods/studding. All drop rods/studding shall be mild steel either galvanised or plated and shall be complete with securing and locking nuts and washers. The drop rods/studding shall be of sufficient size and strength to cater for the particular service/system in which they are installed.

The diameter of drop rods/studding for supports shall be not less than the following:

Individually supported piped up to 20mm	6mm studding
Individually supported piped up to 100mm	10mm studding
Individually supported piped up to 200mm	12mm studding
Group supported pipes up to 4 No.	10mm studding
Group supported pipes up to 8 No.	12mm studding

For pipe-work running below block & beam flooring, the use of rubber-lined supports will be used on 10mm stud.

The spacing of support shall not exceed the centres given in the following:

A) SUPPORTS FOR STEEL PIPE-WORK

TUBE SIZE mm	INTERVALS FOR HORIZONTAL RUNS		VERTICAL RUNS m
	BARE m	LAGGED m	
15	1.8	1.8	2.4

20	2.4	2.4	3.0
25	2.4	2.4	3.0
32	2.7	2.4	3.0
40	3.0	2.4	3.6
50	3.0	2.4	3.6
65	3.7	3.0	4.5
80	3.7	3.0	4.5
100	4.0	3.0	4.5
125	4.5	3.7	5.5
150	5.5	4.5	5.5

B) SUPPORTS FOR COPPER PIPE-WORK

TUBE SIZE mm	INTERVALS FOR HORIZONTAL RUNS		VERTICAL RUNS m
	BARE m	LAGGED m	
15	1.2	1.2	2.4
22	1.2	1.2	3.0
28	1.5	1.5	3.0
35	1.8	1.8	3.0
42	2.0	1.8	3.6
54	2.4	1.8	3.6
65	2.7	2.4	4.5
76	3.0	2.4	4.5
108	3.0	3.0	4.5

Brackets screwed to walls shall be secured by expanding plugs or other purpose designed fixing devices. Softwood plugs shall not be permitted.

Pipe clips on two or more vertical pipes shall be fixed side by side in line horizontally and all supports so arranged that each pipe could be removed separately without affecting the adjoining pipe-work.

No structural steelwork or reinforced concrete shall be drilled for fixing and brackets or supports without the Services Consultants agreement.

'Redhead' or other equal and approved type bolts may be used for fixing pipe supports to underside of floor slabs subject to the Structural Engineers approval. The bolts shall be adequately sized to take the load to be supported. Special brackets/supports shall be included by the Contractor to suit detailed structural requirements and requirements of the Tender documents.

Pump suction and discharge lines shall be adequately supported and so arranged that no weight or stress is imposed on the pump connections under any working conditions and shall be such as to not bypass any ant-vibration or flexible connection provisions installed.

A minimum clearance of 25mm shall be allowed between pipes and where pipes are insulated this clearance shall be maintained between the finished surface of the insulation to each pipe. Insulation binding pipes together shall not be permitted.

Provision for expansion

Due allowance and adequate provision shall be made for the expansion and contraction of the pipe-work, whether indicated on the Tender/Contract drawings or not. Branches from the main pipe runs shall be installed so that expansion can take place without unduly stressing the welds or pipe-fittings and supports shall be designed to allow the correct expansion for the pipe-work.

This particularly applies to branches from main pipes in the vertical pipe ducts. Provision for expansion by means of bends, extended run, etc., shall be made before connecting to the vertical pipes.

Where expansion cannot be taken up by changes in direction of pipe-work, bellows or articulated expansion joints shall be provided. These shall be selected and installed in accordance with the manufacturers instructions.

To ensure correct expansion of pipe-work, special mild steel anchor brackets shall be provided where necessary. These anchors shall be rigidly fixed to the building structure and to the pipe-work. Distortion of the pipe runs shall be avoided. Anchor brackets shall be of similar materials to that of the pipe-work.

All anchor brackets; special fixing details and fixing to structure shall be agreed and approved by the Structural Consultant and Services Consultant prior to manufacture. All bolts, washers, fixings etc., shall be of sufficient strength and of correct type for the type of installation in which they are in installed.

Pipe guides shall be fitted both side and adjacent to each bellows expansion joint to meet manufacturers requirements and also at intervals along the pipe runs to avoid buckling and distortion.

Details of all expansion and anchorage arrangements including guides shall be submitted to the Services Consultant for approval.

Pipe sleeves

Each pipe passing through a wall, or floor, shall pass through a sleeve cut from a length of mild steel or copper pipe to suit the material of pipe-work to which it is fitted, and built into the wall or floor. The sleeves shall finish not less than 2mm proud of the finished face of the plaster or finished surface. Sleeves fitted to pipe-work passing through plant room floors (or similar), shall finish not less than 80mm proud of the finished floor level. The annular space between the pipes and sleeves shall be adequately caulked with fireproof material to meet Fire Officers/Local Authority requirements and to reduce noise penetration to maintain same sound reduction as main structure.

Sleeves shall be of sufficient size to allow free movement of pipes and furthermore where pipes are insulated the sleeves are to be oversized to allow the insulation (*and vapour barrier where applicable*) to be carried through the sleeves in accordance with the requirements for such insulation detailed elsewhere in this specification.

The Sub-Contractor shall provide puddle flanged sleeves for building into retaining walls for incoming gas and water mains and all other utilities or services forming part of his works.

All pipe sleeves where exposed shall be fitted with approved chromium plated floor and/or ceiling escutcheon plate to Architects and Services Consultants approval. These cover plates must not be affixed to the pipes but only to the sleeves or to the building fabric. These must be submitted for approval before fixing.

Air venting

On all circulating water services at points where air is liable to collect, automatic air vents with isolating cock shall be fitted, unless the use of air bottles and manual air cocks is approved by the Services Consultant. Discharges shall be run to suitable non-hazardous positions. Pipe-work shall be arranged to avoid the need for such air vents as far as practicable. All vents must have full bore servicing valves immediately upstream and auto vents must only be left open for commissioning.

Drain piping

Drip piping from pump glands or other machinery shall discharge to a copper tundish and a drain pipe of suitable size shall be run from there to the nearest gully.

All changes of direction shall be made with square plugged tees or crosses to permit rodding and unions shall be provided to each 3m of length.

Drip and drain piping shall be in copper tube.

Boilers, cylinders and other vessels shall be provided with emptying gland cocks with loose keys delivering to common drainpipes not less than 25mm diameter, which shall have a visible discharge to sump or gully.

Alternatively, if approved by the Services Consultant, a hose union may be provided to the drain cock.

Valved dirt pockets shall be provided at the base of each flow and return riser positions and as indicated on Tender/Contract drawings. These shall be not less than line size up to 32mm bore and line size with 32mm drain valve 40mm and above. Dirt pockets shall not be less than 300mm long, with isolating gate type valve with capped or flanged end suite pipe size. Dirt pockets shall also be formed in the connecting flow pipe-work to all A.H.U. coils and H.W.S. cylinders.

Painting & polishing

Painting and polishing shall be as specified elsewhere in this specification.

Use of dissimilar metals

The Sub-Contractor shall ensure that dissimilar metals that will promote chemical or electro-chemical action, causing a weakening or failure are not included within any system, either in contact or at a distance.

Pipe-work & electrical services

The Sub-Contractor shall ensure that pipe-work is not located above or directly adjacent to any electrical switch or control panel and any pipe-work so erected will be removed and re-routed at the Sub-Contractors expense.

6. Valves, cocks, strainers & gauges - General

All valves, cocks etc., installed for the work specified herein shall be of the best quality and made by approved manufacturers and be suitable for the type and pressure rating of the service/system installed.

It is important that the Sub-Contractor includes for all necessary valves for the proper completion, working, isolation and regulation of all services and equipment and elsewhere where necessary, whether detailed on Tender drawings or not, and they are to be suitable for the duty in question. Generally, isolating valves shall be fitted to all items of plant including heaters, coolers, air handling units, chillers, pumps etc.

Regulating valves shall be fitted on branch lines, bypasses etc., where regulation of flow is required for balancing the system.

Unless agreed and approved by the Services Consultant, valves shall not be bolted together, spacer sections shall be installed to allow correct installation of valves and securing bolts, nuts etc.

Valves provided shall, wherever practical, be provided by one common manufacturer subject to design and installation conditions to the approval of the Services Consultant. Valves shall be installed in such a manner as to ensure no undue force or stresses are placed on the valves. Recommended, IMI Hydronic Engineering full bore lever type.

All isolating valves are to be fitted with hand wheels, which shall have directional arrows 'open' and 'shut' cast into the wheel and all regulating valves to have Lockshields with dust caps.

All radiator, gate, high lift, towel rail valves will be of the serviceable gland type with screwed sealing nut. NO circlip type gland seal valves will be accepted. This is to ensure that any required servicing of these valves does not require a full draining of the system.

Any "Ballofix" type valves used on outlets must be full bore only.

Valves & strainers

All valves and strainers installed for the work specified herein shall be manufactured under the control of a Quality System complying with BS 5750/ISO 9000.

All valves must be **full bore** and must be positioned no further than 150mm from both sides of any serviceable valve or control.

Valves and stopcocks shall be installed generally as indicated on the drawings and wherever necessary for the efficient and easy control, balancing and isolation of each and every part of the system.

All valves and strainers shall be fitted in such a manner that they are readily accessible for operation and maintenance.

Valves installed on a particular project shall have a common manufacturer wherever possible.

Valves and pipe-work shall be provided with adequate support to ensure that no undue force or stresses are induced into the valves.

Pipe connections to valves up to and including 50mm shall have taper threads to BS 21, whilst 65mm and larger shall be flanged to BS EN 1092-1:2002 (*previously: BS 4504*).

All valves on HTHW service above 120°C shall have flanged connections.

Unless agreed and approved by the Services Consultant, valves shall not be bolted together. Spacer sections shall be installed to allow for the correct installation of valves and securing bolts etc.

All valves and fittings for domestic hot and cold water systems shall be listed in the Water Research Centres 'Water Fittings and Materials Directory' and comply with the Water Supply Bye-laws.

Valves for copper pipe systems shall be selected to ensure that they will not suffer from electrolytic or galvanic corrosion.

Commissioning sets shall be fitted on the return and double regulating valves in the bypass on all systems to heaters, air handling units, chillers etc., to enable the system to be balanced.

The manufacturers recommendations for the minimum lengths of straight pipe shall be maintained before and after the commissioning sets and other flow measurement devices.

Pipe-work valves

Chilled LTHW and MTHW Services

The maximum temperature for MTHW is 120°C

a) ISOLATING VALVES

Gate valves with non-rising stem blue & red lever full bore valves to BS 6675.

Up to 50mm to BS 5154

Hattersley	Fig. 33X
Crane	D151
Pegler	PB300
IMI-HE	TA60

65mm & larger to BS 5150

Hattersley	Fig. M511PN10 or M541PN16
Crane	FM57 or FM63
Pegler	K416GM
IMI-HE	TA-GAV

b) COMMISSION SETS

Oblique double regulating valve close coupled to a metering station complying with BS 7350.

15mm Size – Flows 0.01 to 0.025 l/s

Hattersley	Fig. 2473L
Crane	D942
IMI-HE	STAV ULF (0.01-0,018 l/s)

or PEGLER EQUIVALENT

15mm Size – Flows 0.025 to 0.05 l/s

Hattersley	Fig. 2473M
Crane	D942
IMI-HE	STAV LF (0.028-0.047 l/s)

or PEGLER EQUIVALENT

Up to 50mm

Hattersley	Fig. 2432
Crane	D941
IMI-HE	STAV

or PEGLER EQUIVALENT

65mm & larger

Hattersley	Fig. M2733PN16
Crane	DM940
IMI-HE	STAF

or PEGLER EQUIVALENT

c) DOUBLE REGULATING VALVES

Oblique globe valve with characterised disk and double regulating feature.

15mm for Low & Medium Flows

Hattersley	Fig. 1473
Crane	D922

or PEGLER EQUIVALENT

Up to 50mm to BS 5154

Hattersley	Fig. 1432
Crane	D941
IMI-HE	STA

or PEGLER EQUIVALENT

65mm & larger to BS 5152

Hattersley	Fig. 733DRPN16
Crane	DM920
IMI-HE	MDF2

or PEGLER EQUIVALENT

d) NON RETURN VALVES

Swing pattern check valves.

Up to 50mm to BS 5154

Hattersley Fig. 47
 Crane D138
 IMI-HE TA-NRV
or PEGLER EQUIVALENT

65mm & larger to BS 5153

Hattersley Fig. M651PN16
 Crane FM492
 IMI-HE TA-NRV F
or PEGLER EQUIVALENT

e) AUTOMATIC AIR VALVES

Automatic air vents

C. Winn & Co., Type B/SS with isolating cock/Caleffi with isolating cock.

IMI-HE: ZUT15

All automatic air vents are to be left open for filling and commissioning purposes only.

f) STRAINERS

Strainers shall be of the 'Y' pattern with stainless steel perforated screens. Must be installed with service valves.

Up to 50mm

Size of perforations 0.8mm diameter

Hattersley Fig. 807
 Crane D297
 IMI-HE TA-STR
or PEGLER EQUIVALENT

65mm & larger

Size of perforations 1.6mm diameter

Hattersley Fig. 810PN16
 Crane FM276
 IMI-HE TA-STR F
or PEGLER EQUIVALENT

g) DRAIN VALVES**0.5" Size**

Drains taps to BS 2879 with hose connections

Hattersley Fig. 370
 Crane D341
 IMI-HE SAV
or PEGLER EQUIVALENT

0.75" & larger

Gland cock or ball-valve with hose union outlet

Hattersley	Fig. 81HU	-	Gland Cock
	Fig. 100HU	-	Ball-Valve
Crane	D344 1/2	-	Gland Cock
	D171HU	-	Ball-Valve
IMI-HE	TA86HU	-	Ball-Valve

or PEGLER EQUIVALENT

h) RADIATOR VALVES

Manual radiator valves must be constructed to BS 2767 and be suitable for service conditions of 10 BAR and 120°C.

Thermostatic radiator valves (TRV's) must be constructed to BS 7556, be suitable for service conditions of 10 BAR and 120°C and **MUST** be installed on the flow (inlet to the radiator) to prevent noise.

The finish of the body and the colour of the dome of Lockshield valves shall match that of the TRV's.

Wheelhead

Hattersley	Fig. 3150
Crane	D880CP or D890CP
IMI-HE	MIKROTHERM

or PEGLER EQUIVALENT

Lockshield

Hattersley	Fig. 3150
Crane	D881CP or D891CP
IMI-HE	REGULUX

or PEGLER EQUIVALENT

Thermostatic

Hattersley	Fig. 3180 angle pattern
	Fig. 3280 straight pattern
IMI-HE	CALYPSO TRV

or PEGLER EQUIVALENT or HONEYWELL VT117E

i) SAFETY VALVES

Hot water

For low and medium temperature, hot water heating safety valves shall be spring loaded with bronze bodies. Safety valves shall be sized individually to ensure that the design discharge capacities are achieved at the required rate.

Open vented systems

Hattersley	Fig. D0320 or D0321
Nabic	542

or PEGLER EQUIVALENT

Closed unvented systems

Hattersley Fig. D0320 or D0321
 Nabuc 500
 or *PEGLER EQUIVALENT*

From each LPHW system safety valve, a full-bore drip pipe shall be fitted, terminating in a non-hazardous location 300mm from the floor and fitted with a supporting bracket.

j) COPPER ALLOY 3 – WAY EVENT VALVES

Copper alloy ball-valves or gland cocks shall be of the 3-way 'T' port pattern arranged to provide alternative outlets from a vessel either to a permanently piped vent or to the plant room atmosphere.

Stops shall be provided to limit rotation to 90° and misalignment of the ports.

Pipe connections shall be threaded female to BS 21 and the body ends shall be permanently marked with the direction of flow through the valve and drain port.

Up to 50mm

Hattersley Fig. 85T gland cock
 Fig. 110 ball-valve
 or *PEGLER EQUIVALENT*

k) CONDENSATE

Gate valves with non-rising stems or rubber lined butterfly valves.

Up to 50mm to BS 5154

Hattersley Fig. 33X
 Crane D151
 IMI-HE TA60
 or *PEGLER EQUIVALENT*

65mm & larger

Hattersley Fig. 940 or 950 - butterfly valves
 Fig. 35PN16 - gate valve
 Crane F620 or F621 - butterfly valves
 DM160 - gate valve
 IMI-HE TA-BTV - butterfly valves
 TA-GAV - gate valve
 or *PEGLER EQUIVALENT*

l) NON RETURN VALVES

Check valves shall be of the swing or wafer pattern. Spring returns will not be accepted unless otherwise agreed with the design team.

Up to 50mm to BS 5154

Hattersley Fig. 47
 Crane D138
 IMI-HE TA-NRV
 or *PEGLER EQUIVALENT*

65mm & larger

Hattersley	Fig. 850 wafer check valve Fig. M651 PN16 swing check valve
Crane	Fig FM450 wafer check valve Fig FM492 swing check valve
IMI-HE	TA-NRV (both swing and wafer available) <i>or PEGLER EQUIVALENT</i>

m) DRAIN VALVES**0.5" Size**

Drain taps to BS 2879 with hose connections.

Hattersley	Fig. 370
Crane	D341
IMI-HE	SAV <i>or PEGLER EQUIVALENT</i>

0.75" & larger

Gland cock or ball-valve with hose union outlet.

Hattersley	Fig. 81HU	- gland cock
	Fig. 100HU	- ball-valve
Crane	D344 1/2	- gland cock
	D171HU	- ball-valve
IMI-HE	TA86HU	- ball-valve <i>or PEGLER EQUIVALENT</i>

n) HOT & COLD WATER SERVICES

All valves shall be listed in the Water Research Centre's 'Water Fittings and Materials Directory' and comply with the Water Supply Bye-Laws. They must also be WRAS approved.

Valves for copper pipe systems shall be selected to ensure that they will not suffer from electrolytic or galvanic corrosion.

o) ISOLATING VALVES

Gate valves with non-rising stems, rubber lined butterfly valves or stopcocks to BS 1010.

Up to 50mm to BS 5154

Hattersley	Fig. 33X	- threaded ends
	Fig. 30C	- compression ends
Crane	D151	- threaded ends
	D155C	- compression ends
Yorkshire	YP508GM	- compression ends
IMI-HE	TA-BAV	- (both threaded and compression ends available) <i>or PEGLER EQUIVALENT</i>

65mm & larger to BS 5154 or BS 5155

Hattersley	Fig. 941 or 951	- butterfly valves
	Fig. 35PN16	- gate valve

Crane	F611 or F614	- butterfly valves
	DM160	- gate valve
IMI-HE	TA-BTV	- butterfly valves
	TA-GAV	- gate valve

or PEGLER EQUIVALENT

p) DOUBLE REGULATING VALVES

Globe or butterfly valves with characterised disk and double regulating feature.

15mm for low & medium flows

Hattersley	Fig. 1473 or 147C
Crane	D922
IMI-HE	STA

or PEGLER EQUIVALENT

Up to 50mm to BS 5154

Hattersley	Fig. 1432 or 143C
Crane	D920
IMI-HE	STA

or PEGLER EQUIVALENT

65mm & larger to BS 5155

Hattersley	Fig. 953
Crane	Fig DM920
IMI-HE	STA

or PEGLER EQUIVALENT

q) NON RETURN VALVES

Swing pattern or wafer check valves. Not spring loaded.

Up to 65mm to BS 5154

Hattersley	Fig. 47
Crane	D138
IMI-HE	TA-NRV

or PEGLER EQUIVALENT

65mm & larger to BS 5153

Hattersley	Fig. 5870
Crane	Fig FM450 wafer check valve Fig FM492 swing check valve
IMI-HE	TA-NRV F (both swing and wafer available)

or PEGLER EQUIVALENT

r) STRAINERS

Strainers shall be of the 'Y' pattern with stainless steel perforated screens.

Up to 50mm

Size of perforations 0.8mm diameter.

Hattersley	Fig. 807 or 807C
Crane	D297
IMI-HE	TA-STR

or PEGLER EQUIVALENT

s) **DRAIN VALVES**

15mm size

Drain taps to BS 2879-2 with hose connections.

Hattersley Fig. 370

Crane D341

IMI-HE SAV

or PEGLER EQUIVALENT

0.75" & larger

Gland cock or ball-valve with hose union outlet.

Hattersley Fig. 81HU - gland cock

Fig. 100HU - ball-valve

Crane D344 1/2 - gland cock

D171HU - ball-valve

IMI-HE TA86HU - ball-valve

or PEGLER EQUIVALENT

t) **DOUBLE CHECK VALVES**

Double check valves must be listed in the 'Water Fittings and Material Directory'.

For sizes 15 to 28mm they shall be made from DZ|R copper alloy with compression ends to BS 864 Part 2.

For sizes 1.25" to 2" they shall be made from gunmetal with female threaded ends to BS 21.

u) **GAS SERVICES**

Valves shall have been type approval tested by the Gas Council to EN331.

Up to 50mm

Hattersley Fig. 200M lubricated plug valve

Fig. 100 ball-valve

Crane Fig. D191 ball-valve

IMI-HE TA84

or PEGLER EQUIVALENT

65mm & larger

Hattersley Fig. 201MPN16

Fig. M519PN16 gate valve for gas service

IMI-HE TA33

or PEGLER EQUIVALENT

Preferred supplier for all IMI Hydronics plant is:

Smith Brothers Stores Ltd - <https://sbs.co.uk/contact-us/>

Auto filling units

Auto filling units that incorporate an RPZ (reduced pressure zone) valve must be commissioned by an approved WRAS RPZ valve tester and must be carried out in accordance with the, 'water suppliers approved installation method' (AIM-08-01).

These units must also be registered with the local water supplier and have a service contract in place.

THIS IS A LEGAL REQUIREMENT

Flexible connections

Flexible couplings shall be fitted to all pump suction and discharge connections, water chillers, dry coolers and general centrifugal or reciprocating equipment.

Couplings shall be line sized, made from a multi-ply nylon fabric carcass with wire reinforced collars and liners designed to suit the fluid conveyed and the working of shock temperatures/pressures that will be experienced in the various systems.

Up to 50mm - Engineering appliances screwed to BSP to suit working pressure and temperature, or equal and approved.

65mm & over - Engineering appliances flanged to appropriate BSS type and over 'S', or equal and approved.

***Note:** On flanged connections, face of flange should be ground flush and nuts, bolts and washer installed in accordance with manufacturers requirements, with spacer pieces either side of flexible connection.*

During testing the Contractor shall ensure that flexible connections are removed to avoid damage to the unit.

Pressure gauges & thermometers

a) Pressure gauges

These shall be provided and installed on pump sets (suction and discharge) and on all other items of plant (boilers, chillers etc.) and equipment (flow and return) and shall be dial pattern of the bourdon tube type calibrated in kilo Pascal's and pounds per square inch. The working pressure shall be indicated on the dials by red lines. The casing of the gauges shall be finished in matt black and shall be complete this isolating cocks and siphons.

Pressure gauges shall be Fig. No. E220 with 150mm (6") diameter and graduations for pressures shall be agreed with the Services Consultant before these are ordered. A bronze gauge cock Fig. No. E.95 shall be provided for isolating pressure gauges and for the L.T.H.W. pumps, gauge cocks shall be Fig. No. D.315, 3 way type.

Pressure gauges and isolating cocks shall be of Crane Limited manufacturer or the equal and approved.

b) Thermometers

Thermometers shall be provided and installed on flow and return connections on all plant and equipment (boiler, chillers, pump circuits etc.) and on all return branches of circulation systems.

They shall be the mercury in steel type and bulb or where required of the rigid stem pattern. The thermometers shall be finished in matt black and shall be suitably calibrated in degrees centigrade 150mm (6") diameter dial type as manufactured by Crane Limited or other equal and approved.

c) Capillary tubes

Capillary tubes shall be of copper and shall where possible be collected together and in all cases be neatly fixed and run in cable trays supported by the building structure.

Radiator valves

All radiator connections shall be fitted with angle wheelhead or Lockshield valves. Radiator flow connections shall be fitted with thermostatic control valves, where called for in the Contract drawings. Recommended, IMI Hydronic Engineering TRV sets.

Valve labels

All valves shall be provided with Traffolyte labels with the valve number and service engraved thereon, securely fixed in an approved manner. Permanent fixed labels to pipes adjacent to valves is acceptable.

Completion

On completion of the various systems and prior to handing them over, all valve glands shall be systematically tightened as necessary and re-packed if required. After this has been completed the Contractor shall hand over to the building owner, two complete sets of all necessary Lockshield, air vent, drain and plug cock keys and wrenches. A fully numbered valve chart will be required after demonstration and given to the services design engineer.

Water authority

All valves, stopcocks etc., used on the various water services shall where necessary, conform to Local Water Authority's requirements and shall be tested and stamped by them, as detailed in the Water Bye-Laws. The Contractor shall allow for all such costs.

Test point tappings

Test point tappings shall be provided on the flow and return connections at the following locations:

- Main plant items (boilers, pumps, water chillers, dry coolers, computer room A.C. units etc.)
- Water coils
- Control valves (including by-pass)
- Strainers
- Orifice valves (inlet and outlet)
- Test points shall be of the type as manufactured by 'Binder Engineering Co. Ltd', IMI Hydraulics Ltd or equal and approved. They shall be fully suitable for the pressures, temperatures and water systems encountered.

When these test plugs are installed in insulated pipe-work, the pipe-work system shall be extended beyond the thickness of the insulation.

These test points should not be installed on the underside of the pipe-work or any other location in which sludge or debris could interfere with the pressure readings being obtained.

One set of 100mm dia., dial thermometer and pressure gauges, suitable for use with the test points, shall be provided in each plant room.

7. Heating appliances

Fan convectors

Ratings stated shall be actual outputs as obtained from tests carried out in accordance with the Standard Codes for Testing and under the design conditions stated.

Heater coils shall be on non-ferrous metal or if of ferrous metal, this fact must be stated in the Tender and suitable protection against corrosion must be approved.

Convectors shall be provided with air cocks accessible without dismantling any part of the casing.

Fan assisted convectors shall have casings lined with sound absorbent material.

Motors shall be of two-speed or multi-speed type with a maximum speed not exceeding 720 rpm and mount on sound insulating material.

They shall be single or three phase as necessary for their duty.

Equipment shall be inaudible under normal working conditions.

Radiators

The position and heights of radiators shall be confirmed on site before ordering. A minimum clearance of 75mm (3") above floor shall be provided for cleaning under horizontal pipes serving them.

Each radiator shall be fitted with an air cock or air vent plug.

Radiators shall be supported on suitable brackets. Where fed from a straight pipe exceeding 9m (30ft) in length, brackets shall be of suspended pattern to allow movement. Due allowance shall be made for floor finish and covering in determining the height and fixing of stands.

8. Testing & commissioning

Procedure

Testing and commissioning shall be as specified under the relevant clauses of all sections of this Specification and the following detailed clauses.

Subject to any additional requirements stated in the Specification the following procedure shall be followed:

Note: *In sub-clause a) to f) inclusive of this clause the term 'the installations' shall be read to include the complete installation or any part of them which it may be required to commission, test, operate etc., as separate entities.*

- a) As soon as practicable after the completion of the installation, the Contractor shall give notice to the Main Contractor that it is required to operate them and shall request the Main Contractor to clean out all plant spaces, builders work ducts, sumps, sub-ways and the like, remove all rubbish and generally leave them and the access ways to them in a tidy and finished state.

- b) The Contractor shall thoroughly clean and blow out all airways, casings, switchboard, panels, cabinets and other items of plant and equipment, flush all pipe-work systems and vessels and generally prepare the installations for operation.
- c) The Contractor shall check the availability of water, fuel, electricity etc., as appropriate and where necessary shall arrange with other parties concerned for testing to be carried out jointly.
- d) The Contractor shall then flush, clean, test, balance and commission the installations and shall generally satisfy himself that they are operating according to the intent and meaning of the Contract.
- e) The installations having been in use for a reasonable time to allow for the observation of results and subsequent adjustment if required. The Contractor shall then, by a repetition of the relevant parts of the procedure of sub-clause d) above, demonstrate to the satisfaction of the Services Consultant that the installations which have been set to work comply in all respects with the requirements of the Contract.
- f) If it is not possible at the time of the demonstration as e) above, to operate the installations under full load conditions or such reasonable approximation of such conditions as may be acceptable to the Services Consultant. The Contractor shall repeat the requisite portions of the demonstration under full load conditions at such time(s) as it may be possible to do so.
- g) The procedure for commissioning and testing in accordance with sub-clause d) above shall be agreed with the Services Consultant. The Contractor shall similarly agree with the Services Consultant the precise method of carrying out the demonstration and tests called for in sub-clause e) to h) above inclusive and shall, when he has satisfied himself that the installations comply with his requirements of the Contract, give the Services Consultant adequate notice that he is ready to perform the demonstrations and tests.

The Contractor shall provide all facilities for the Services Consultant or his representatives to witness and check all such tests.

- h) The Contractor shall provide all necessary skilled and unskilled labour and also all necessary instruments for carrying out the commissioning and testing.
- i) The Contractor shall make complete records of the tests as carried out and when the tests have been successfully completed he shall provide, to the Services Consultant, test records and reports in a form to be agreed and incorporated within maintenance documentation detailed elsewhere in this specification.
- j) In cases where the overall building programme is such that Contractor will need to return for the purpose of testing, regulation, adjustment etc., to portions of the buildings which by that time may be in the occupation of the Client, the Contractor shall allow in his Tender accordingly and shall take all necessary precautions against damage when working in such areas.
- k) The contractor shall allow for fully demonstrating to the Client, or his representatives, the operation and maintenance of all systems, plant, equipment etc., to the satisfaction of the Services Consultant. The Contractors shall provide all necessary staff, equipment, and manufacturers representatives etc., to comply with this requirement.

Hydraulic testing

Upon completion of each suitable section of pipe-work and as otherwise specified, the Contractor shall subject the section to a hydraulic pressure test and demonstrate to the satisfaction of the Services Consultant that the section is sound and watertight.

It is recommended that all 1st fix pipe-work is sealed and left pressurised until all flooring Contractors have completed their works. This will ensure immediate knowledge of accidental breaches to any circuit and allow repair with minimal consequential damage. Should such occurrences present themselves, these will be charged accordingly.

The test shall be applied by filling the section to be tested with water or air, venting and raising its pressure to the figure specified hereafter. The whole of the testing gear required to be supplied by the Contractor, but the water by the Main Contractor.

The section shall then be left without further strokes of the pump and all joints must remain tight for a period of not less than two hours, the decision as to whether or not the section is sound being governed by the rate at which the pressure falls. Completion of a successful pressure test will not relieve the Contractor of his responsibility regarding water tightness of pipe-work systems.

Any fault discovered during the tests shall at once be rectified by the Contractor at his own expense and the test re-applied until the Services Consultant is satisfied that the section under test is sound.

On completion of the test, the water shall be released and drained completely away as rapidly as possible, the section then being thoroughly sluiced through to ensure the removal of all weld metal, sand, sediments, dirt etc., before being refilled and put into service.

- a) In cases where the installation are commissioned and tested portion-by-portion, the Contractor shall repeat the procedure a) to e) above in regard to each portion of the installations.
- b) The Contractor shall finally demonstrate to the satisfaction of the Services Consultant that all the portions of the installations already demonstrated separately are capable of simultaneous operation in accordance with the requirement of the Contract.

The test pressure to be applied to the various services shall be as follows and the pressure gauge readings for these tests shall be taken at the highest points in the respective systems.

- | | | |
|----|---|---|
| a) | LTHW heating, including vents feeds and drains | 7 bars (103 psi) |
| b) | Chilled water system, including vents, feeds and drains | 7 bars (103 psi) |
| c) | Gas mains | 2 bars (29 psi) Also to the requirements of the local Gas Authority |
| d) | Oil pipe-work | 7 bars (103 psi) |
| e) | Ductwork | This work shall be pressure tested in accordance with the HVCA Specification DW 142 |

The Contractor shall provide to the Services Consultant, test certificates in triplicate, giving details of each test carried out, including the duration of the test and the services on which the test was carried out. The test certificates shall be forwarded to the Services Consultant.

All plugs, caps, tees and drain fittings required to enable the tests to be carried out shall be provided by the Contractor.

Boilers, air heater batteries, automatic valves etc., shall be isolated from their respective pipelines during the tests unless the manufacturers of the various items of equipment allow the test pressures stated above.

The Contractor shall be responsible for making good damage caused to equipment should he fail to take these precautions during testing, 'free of charge' to the contract.

Commissioning

Specified performance tests will be required to demonstrate the satisfactory functioning of each system installed and records of these are to be furnished to the Services Consultant. Main systems shall be cleaned, tested and commissioned in accordance with the following standard documents:-

Air Distribution System	In accordance with CIBSE Code A
Boiler Plant	In accordance with CIBSE Code B
Automatic Control Equipment	In accordance with CIBSE Code C
Water Distribution	In accordance with CIBSE Code W

Results of tests

If the test results show that the plant and equipment is not installed and/or functioning in a satisfactory manner, the Service Consultant shall decide whether this is due to incorrect or faulty work by the Contractor and if this is the case the Contractor shall, when called upon, carry out at his own expense, remedial measures and/or adjustments as may be required to the Services Consultants complete satisfaction.

The Services Consultants decision as to what constitutes a satisfactory test shall be final.

Testing of materials

The Contractor shall, at his own expense, when called upon, test and prove the weight, structural stamina, thermal duty, output rating, thickness, gauge or any other components of any of the materials proposed to be used on the works at either the manufacturers or on his own Contractors premises, or when delivered to site before installation and shall make all necessary preparation for such tests, providing any cartage, labour and plant required as well as deliver up performance diagrams, certified weight, test pressure certificates, or any such evidence in respect of the required tests. Similarly the Contractor shall submit to the Services Consultant, free of charge, any samples of materials proposed for his approval of rejection.

The Services Consultant reserves the right to reject any of the materials offered by the Sub-Contractor, which do not precisely confirm in all and every respect to the requirements of the Specification.

Where the requirements of any gas, water or electricity authority call for the submission to them of any component part of the works for approval, testing, stamping or certifying, the Contractor shall at his own expense, submit and deliver such component part to a place required by such authority

and shall after such component part has been found satisfactorily approved, tested, stamped and certified, return any such component part to the site for incorporation in the works and shall at his own expense, pay to the authorities any charges required by them.

9. Acoustic & vibration isolation

Anti-vibration mountings - General

Where so indicated in the schedules, the mounting/hangers shall be provided with a positioning or restraining device, which will prevent the equipment position changing if its load changes; e.g. during draining down of the equipment or other maintenance.

All mountings shall provide the static deflection, under the equipment weight, shown in the schedules. Mounting selection should allow for any eccentric load distribution or torque reaction, so that the design deflection is achieved on all mountings under the equipment, under operating conditions.

It is the supplier's responsibility to ensure that all mountings offered are suitable for the loads operating and environmental conditions which will prevail.

All mountings shall be colour coded, or otherwise marked, to indicate their load capacity, to facilitate identification during installation.

Where use of resilient supports allows omission of pipe flexibles for vibration/noise isolation, it shall be the Mechanical Service Consultants or Contractors responsibility to decide whether such devices are required to compensate for misalignment or thermal strain.

10. Thermal insulation, painting & identification - General

All thermostat pockets, unions, test points etc., shall be left exposed with insulation tapered neatly at either side or around the perimeter.

All pipe-work connections, controls etc., shall project a minimum of 25mm clear of insulated surfaces.

The Contractor should not the specified provision for painting of ferrous materials prior to application of the thermal insulation.

Where two or more pipes run in close proximity the insulation shall not in any circumstances be bonded but shall have a clear space between each pipe of 25mm

Thermal insulation shall have a declared thermal conductivity of 0.04 W/M°C and a density of between 80 to 112Kg m/m³ to BS 5422/1977 and have the following thickness in mm.

NOMINAL PIPE DIA	HEATING & CONDENSE	DHWS	CWS INTERNAL	CHILLED OR COOLING WATER	STEAM
15	25	25	32	25	38
20	25	25	32	25	38
25	25	25	32	25	50
32	32	32	32	32	50
40	32	32	32	32	50
50	32	32	32	38	50
65	32	32	25	38	63
80	32	32	25	50	63
100	38	50	19	50	75
150	50	50	19	50	75
200 & FLAT SURFACES	50	50	19	50	75

Boiler flues

The thermal insulation to boiler flue gas pipe-work or ducting shall be performed mineral fibre rigid sections or slabs 50mm thick secured with 0.9mm (20swg) dia galvanised wire netting reinforcement protected and finished in 0.9mm (20swg) thick hammerclad aluminium covering with lapped joints secured with pop rivets. *UNLESS OTHERWISE AGREED.*

Pipe-work in boiler

All steam, condensate, LTHW heating DWS and CWS pipe-work, within the boiler house shall be insulated with performed rigid section secured with adhesive tape protected and finished in hammerclad aluminium casing with pop rivets. The aluminium casing shall be 0.7mm (swg) thick for thermal insulation having an overall diameter of 150mm and above and 0.5mm (24swg) for smaller pipe-work. *UNLESS OTHERWISE AGREED*

All valve bodies and flanges shall be fitted with boxes constructed from 0.9mm (20swg) thick hammerclad aluminium sheeting lined with fibre insulation of a similar thickness to the accompanying pipe-work suitability secured internally to the box with adhesive. Boxes shall be secured with quick release clips. *UNLESS OTHERWISE AGREED.*

Pipe-work general

Where external to the plant room visible pipe-work shall be insulated with performed rigid sections Class O finish. Class O shall be as defined in Regulation E15 of the Building Regulations 1976. Sections to be close butted with all longitudinal and circumferential overlaps sealed with adhesive. Insulation shall be provided with aluminium fixing bands at 450mm intervals. Depending on finish specified fixing bands should be fitted after painting. *UNLESS OTHERWISE AGREED*

Valve bodies and flanges 40 dia and above shall be insulated by muff covers finished with fabric applied with an adhesive. Covers shall be secure with clips for easy removal. *UNLESS OTHERWISE AGREED.*

Pipe-work concealed

Where pipe-work is concealed in voids, chases or duct without access, pipe-work shall be insulated with preformed rigid section with Class O finish. Sections are to be close butted with all joints and overlaps sealed with adhesive. *UNLESS OTHERWISE AGREED.*

Vapour barrier pipe-work

The vapour barrier and insulation shall not be pierced or damaged by supports and load distribution sleeves shall be provided where necessary. At discontinuities and the ends of sections the vapour barrier shall be returned to the pipe-work to prevent moisture from entering the insulation edges. Flanges shall be insulated by means of flange boxes or by increasing the thickness of the insulation to give at least 15mm cover. Where insulation is 50mm thick or more it shall be fitted in two layers with the joints staggered.

Concealed valve & flange boxes

When vapour sealed and concealed from view valves or flanges shall be insulated utilising the same insulation thickness and standard finish as the adjacent pipe-work. Joints to the adjacent insulation and covering of the valve bodies spindle shall be by self-adhesive soft aluminium foil tape to maintain continuity of the vapour barrier.

Valve & flange boxes

In plant rooms or where visible valve boxes and flanges shall be insulated. Where insulation is vapour sealed the continuity shall be maintained around valve bodies and spindles and adjoining pipe-work be self-adhesive soft aluminium foil tape.

External finish

Where pipe-work is positioned externally in open air or within external builders work ducts, insulation shall be performed rigid section with the following weatherproof finish. Roofing felt with minimum 50mm overlap sealed with adhesive, wrapped with 25mm mesh galvanised wire 0.9mm (20swg) thick, finally painted with two coats of bituminous paint, or alternatively covered with 0.8mm thick polyisobutylene sheeting, having a minimum tensile strength of 3.4 MN/m² with 25mm overlap joints sealed by solvent or cold welding. All ends of insulation at fittings, flanges, anchor points etc., shall be suitably sealed against ingress of water vapour.

At pipe-work supports the insulation and outer covering shall be continuous and shall not be punctured by the supports. At each hanger or support 300mm long heavy duty cork or equal sections shall be fitted complete with galvanised sheet steel cover and clip.

If the insulation requires a vapour barrier its continuity shall be maintained externally.

Refrigeration Pipe-work

Refrigeration discharge and liquid pipe-work shall be insulated with a closed cell expanded light grey colour acrylo nitrile rubber compound with smooth finish or bore and outside surface. The insulation shall be fire retardant complying to BS 476 Part 7 and have a surface flame spread as Class 1.

Pipe-work up to 80mm dia shall be insulated with a 13mm thickness and for pipe-work greater than 80mm dia with 19mm thickness. Where insulation is installed internally, no further finish is required, where externally, it shall be suitably weatherproofed with light grey coloured

polyisobutylene sheeting 0.8mm thick with all circumferential and longitudinal joints lapped and solvent welded.

Thermal insulation shall be type Armaflex AF manufactured by Armstrong Cork Co. Ltd., or equal and approved.

Painting

All ferrous materials, brackets, anchors etc., shall be thoroughly wire brushed, degreased if necessary and painted one priming coat before fixing and an additional priming coat on completion before application of an undercoat.

Ferrous materials in trenches, ducts or where exposed externally, shall be covered with one coat of black bitumastic based paint after installation.

All thermal insulation to pipe-work or ductwork exposed to view where not protected by aluminium foil or plastic finish shall be painted with one coat of undercoat and one coat of gloss paint. Insulation concealed from view and not readily accessible shall not be painted.

Identification

All pipe-work and ductwork services shall be identified by colour coding complying to BS 1710 Part 1 in the form of a proprietary self adhesive band or triangle.

Each colour band or triangle shall indicate by words or standard abbreviation the service to which it is affixed. Self-adhesive arrows shall indicate the direction of flow at or near to all items of equipment, at junctions, valves, flanges and any fittings requiring clarification. Identification bands, triangles and arrows shall be located in the most visible position such that they are clearly visible from the angle most likely to be viewed. Each identification shall be firmly applied square, level and in line with the pipe or duct.

Identification bands shall be a minimum of 150mm wide, triangles of at least 150mm side and be spaced not more than 5 metres apart, or as otherwise agreed with **Rob Berridge Heating Design Consultants**.

Colour coding - Colour coding to BS 1710 Part 1.

SERVICE	BASE COLOUR	BAND COLOUR
Mains Water	Green	Blue
Cold Water Down	Green	White/Blue/White
Fire Water	Green	Red
Cooling Water	Green	White
Chilled Water	Green	White/Lt.Green/White
Domestic Hot Water	Green	White/Crimson/White
LTHW Heating	Green	Blue/Crimson/White
MTHW	Green	Crimson/Blue/Crimson
Steam	----	Silver Grey
Condense	Green	Crimson/Lt.Green/Crimson
Gas	----	Yellow Ochre
Oil	----	Brown
Compressed Air	----	Light Blue
Fresh Air	Green	----
Conditioned Air	Red & Blue	----
Exhaust Air	Grey	----
Re-circulated Air	Grey	----

11. Direct expansion refrigeration pipe-work

Pipe-work – General

Refrigeration pipe-work shall be refrigeration quality copper tubing to BS 2871 either soft or half-hard grade, with brazed capillary joints made with silver brazing alloy. For tubing up to 15mm dia soft half-hard grade may be installed for diameters greater than 15mm only half-hard grade shall be installed.

The installation shall be complete with all necessary filters, driers, sight glasses, expansion valves and solenoid valves and shall be in accordance with BS 4434 Refrigeration Safety and BSCP 406 Mechanical Refrigeration. Pipe-work shall be reamed after cutting and shall be free from burrs, scale and other defects and shall be thoroughly cleaned before erection. Except when actual jointing is taking place all ends shall be capped and the system kept sealed prior to installation.

Dry Nitrogen shall be fed through the pipe-work whenever brazing is being carried out to prevent formation of oxide within the pipe-work system. When brazing adjacent to valves or equipment, adequate precautions shall be taken to ensure heat does not distort valve seats or damage equipment.

Pipe-work shall be designed and installed with double risers and oil traps where necessary so that any oil entrained with the refrigerant is carried through the system.

When pipe-work adjacent to a machine leaves in either a vertical or horizontal form without change in direction, two flexible connections shall be provided close together in each of the suction and discharge pipes, long sweep bends only shall be used.

Pipe-work Supports

Refrigeration pipe-work shall be supported along its complete length located in plastic covered cable trays. Pipe-work shall have a support bracket and clip incorporating an absorption insert at intervals or not more than 1 metre. The cable tray shall be supported as necessary - horizontally or vertically by galvanised, mild steel angle cleats or straps, at intervals not more than 1 metre. Materials of both brackets and fittings shall be selected to prevent electrolytic corrosion by contact between dissimilar metals.

Condensate drains

The pipes and fitting for condensate drains shall be UPVC to BS 4514.

The Contractor is to allow for the condensate drain from all relevant appliances, to run under gravity to the nearest drain position. Wherever possible the use of condensate pumps is to be avoided, however and should it prove necessary, than a suitable selected quiet running pump is to be utilised and allowed for by the Contractor.

12. Soil & waste pipe-work installation - General

The whole of the installation shall comply with the Bye-Laws existing in the area of the site and shall be installed in accordance with the requirements laid down in BS 5572 : 1978, the design intent shown on the Contract drawings and the requirement of the Local Authority's Building Inspector.

Any query concerning the Bye-Law requirements in relation to these works shall be made known and clarified prior to the commencement of the actual installation.

It shall be the Contractors responsibility to acquaint himself and comply fully with such Bye-Laws and to obtain all necessary approvals relative to the installation and testing of the installation.

Access pipes shall be fitted at the foot of all vertical stacks and at changes of direction where indicated in the drawings.

Where vertical pipes pass through fitments or worktops where rodding via the access pipe may prove difficult, the access pipe may at the discretion of the Architect, be fitted above fitment or worktop level.

Vertical sanitary discharge pipe-work (UPVC)

Pipe-work and fittings for UPVC WC manifold arrangements shall be in UPVC to BS 4514 : 1983 with neoprene ring seal and solvent welded joints all as manufactured by Key Terrain Limited or equal and approved.

Branch waste & ventilating pipe-work (copper)

Light gauge copper branch waste and ventilating pipe-work shall confirm to BS 2871 Part 1 Table X as manufactured by Yorkshire Imperial Metals Limited or equal and approved.

Pipe fittings shall be of the capillary type confirming to BS 864 as manufactured by Yorkshire Imperial Metals Limited, or equal and approved.

Branch waste & ventilating pipe-work (MUPVC)

MUPVC pipe-work and fittings shall conform to BS 5255 : 1976 and shall be as manufactured by Key Terrain Limited, or equal and approved.

Polypropylene pipe-work and fittings shall conform to BS 5254 : 1976 and shall be as manufactured by Key Terrain Limited, or equal and approved.

All pipe-work shall be installed and supported in strict accordance with the manufacturers printed instructions.

Jointing pipe-work

Copper pipe shall be jointed using capillary soldered fittings conforming to BS 864 as manufactured by Yorkshire Imperial Metals Limited or equal and approved. All fittings shall be swept in the direction of flow. Newly completed joints shall not be cooled by applying additional flux. After cooling, all excess flux shall be removed from pipe-work and fittings.

Where space is restricted and with the approval of the Consultant Engineer, use may be of the silbrallo method of jointing. All branch connections shall be swept in the direction of flow.

UPVC and MUPVC pipe-work shall be jointed using a combination of solvent welded and ring seal fittings as manufactured by Key Terrain Limited, or equal and approved.

Joints shall be made according to the manufacturers requirements and standards. Ring seal expansion joints shall be as specified by the manufacturer and shall be provided between all fixed points.

'Anchor points' shall be deemed to be at the location of each branch connection, which shall be rigidly fixed to the structure by means of a holderbat in conjunction with a ring seal joint immediately upstream of the fixing. Solvent welded joints shall be made using only the materials supplied by the manufacturer.

Polypropylene pipe shall be jointed using fittings incorporating a ring seal socket as manufactured by Key Terrain Limited or equal and approved. Adequate provision shall be made for thermal expansion within the systems and to the manufacturers recommendations.

Joints between dissimilar materials

All joints between dissimilar materials shall be made using the correct adaptor or fitting as recommended by the manufacturer.

UPVC to cast iron and ductile iron joints shall be made by means of a UPVC caulking bush with ring seal joint for expansion. The joint between the metal socket and caulking compound such as Philplug PC45R or equal.

Copper to cast iron and ductile iron joints shall be made by means of a male iron x copper adaptor or copper alloy caulking bush.

Copper to PVC and polypropylene joints shall be made by means of a PVC or polypropylene adaptor incorporating the correct ring seal as recommended by the manufacturer.

The pipe-work shall be installed and supported in strict accordance with the manufacturers printed instructions, particular care being taken with the provision for and control of thermal expansion.

The manifold arrangements shall be factory prefabricated to suite the dimensioned detailed Architects toilet layout and shall be site assembled. The Contractor shall submit for approval the manufacturers working drawings prior to manufacture.

Furnco couplings complying to relevant usage are acceptable and must be thoroughly checked.

Jointing WC outlets to PVC

WC outlet to discharge pipe-work joints shall be made by means of either a straight or bent UPVC connector as required and shall be provided complete with rubber seal ring and suitable connection for the WC spigot outlet.

Cutting timesaver, copper & PVC pipe-work

Copper and PVC pipe-work shall be cut by means of a fine tooth saw, taking care to remove all excess burrs and swarf. 'Timesaver' and 'Stanflex' pipe-work shall be cut by wheeled cutters or 'Telford' pipe-cutter (Angle Grinder). Snap type cutters shall not be used.

The end of the pipe shall be square to the axis after cutting and where required the spigot end shall be chamfered in accordance with the manufacturers requirements. Stanflex pipe shall be reamed to ensure the pipe bore is not restricted.

Roof terminals

Where pipe-work passes through the roof, a purpose made sheet lead weathering piece shall be supplied and installed. The pipe-work shall terminate 450mm above roof level with a copper wire balloon or UPVC terminal.

Fittings in general

All fittings used shall be free of burrs and swarf and shall be of the easy sweep pattern, on no account shall mitred fittings be used, or attempts made on site to manufacture or alter such fittings.

Traps to sanitary fittings

All traps shall be 75mm deep seal, two-piece tubular pattern with union inlet and outlet to facilitate easy removal

Copper alloy traps shall conform to BS 1184 and shall be chromium plated where appearance is important. Polypropylene traps shall conform to BS 3943.

Fixing of pipe-work generally

Fixing of pipe-work shall be by means of the standard bracket pattern fixing recommended by the manufacturers and these shall be fitted around the pipe-work in accordance with the printed recommendations. Special care shall be taken that the brackets installed at locations other than 'fixed points' should stabilise the pipe-work whilst still making due allowance for movement and the absorption of expansion at the proper points.

Brackets shall be provided at the specified intervals for vertical and horizontal pipes and shall be of the standard pattern for cast iron and ductile iron pipe-work and of the PVC coated metal type for UPVC discharge pipe-work. Supports for copper pipe-work shall be of the brass ring type.

The following table give maximum fixing centres for straight lengths of pipe. Additional supports shall be provided on bends, branches and specials for all materials.

Maximum distance between pipe supports

PIPE MATERIAL	PIPE SIZE	VERTICAL PIPES	LOW GRADIENT PIPES
	mm	m	m
Cast iron	All sizes	3.0	3.0
Copper	15 – 28	2.4	1.8
	35-42	3.0	2.4
	54	3.0	2.7
	67-108	3.7	3.0
	159	4.6	3.7
UPVC	32-40	1.2	0.5
	50	1.2	0.6
	75-100	1.8	0.9
	150	1.8	1.2
MUPVC	32-40	1.2	0.5
	50	1.2	0.6
Polypropylene	50	1.2	0.6

Access for cleaning

Rodding eyes shall be of the screwed type with threaded mechanical joint and shall be provided on all vertical and horizontal small diameter waste pipes serving more than one sanitary appliance.

Access shall be provided at all branches and changes of direction on main discharge stacks. A square door access fitting shall be provided at the base of each stack immediately prior to connection to the drainage system.

Waste pipe falls

Horizontal waste pipe-work shall be installed to provided a natural fall to the discharge pipe or drain ensuring complete continuous flow for the waste effluent. They shall have a gradient of 2/3 degrees, and on no account shall the fall be less than 1 degree.

Pipe sleeves

Where pipes pass through walls, floors or general structure, flush pattern tubular sleeves shall be fitted and be of a size to accommodate the pipes so that no pipe shall touch the sleeve of the building structure. The space between pipe and sleeve shall be packed with non-combustible packing at completion of installation. Sleeves through waterproof floors shall stand 20mm above finished floor level and the space between pipe and sleeve shall be filled with a non-hardening mastic compound.

Main discharge pipe-work may at the discretion of the Consultant Engineer, be built into the structure. This must not be carried out without his approval.

As directed by the Engineer, polished chromium plated, wall, floor or ceiling plates, shall be fitted at all positions where waste pipes are exposed to view and pass through walls, floors and ceilings.

All purpose made brackets and hangers shall be primed and painted 2 coats red oxide prior to erection and all drop rods and hanging assemblies in unheated and exposed areas shall be galvanised or have other suitable approved type of finish.

The whole of the works contained within this section shall be handed over on a sound and clean condition on completion of the Contract to the entire satisfaction of the Consulting Engineer and the Contractor shall issue all Test Certificates duly signed.

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I hereby confirm that I have read, understand and will adhere to the contents of this specification
(PART 3)

Signed: Date:

Please print name:

Company: