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PROJECT

Mechanical and PH Engineering Services Specification for 24 Heath Drive, London NW3 7SB

Project No.: 16/117
Date: September 2018
Revision: 02

CONTENTS

REVISION HISTORY

(Changes highlighted in Yellow)

Revision	Description
00 – January 2018	Initial Issue
01 – June 2018	Tender Issue
02 – Sept. 2018	Changes to sections 7.11, 9.5, 9.6, 14.5, 16.2, 16.4

SECTION 1

1 INTRODUCTION

1.1 GENERAL DESCRIPTION

The works referred to in this Specification and the Drawings listed herein are for the supply and installation of new Mechanical and Public Health Engineering Services to 24 Heath Drive, London NW3 7SB.

In general, the building within Heath Drive is grade II listed, therefore all work should be carried out with the greatest of care, particularly where the work has an impact on the fabric of the building or its structure or structural integrity.

The existing building shall be refurbished with a new basement level added. The house will consist of Basement, Ground, First and Second Floors.

After practical completion, the Contractor shall be responsible for a twelve months' period of defects liability and to provide twelve months' maintenance services.

The specification sets out general standards that shall be applied to the installation and workmanship. Where drawings have also been issued this specification shall be read in conjunction with those drawings.

Only the highest quality of workmanship will be accepted.

1.1.1 Heating Systems

A new heating system shall be provided of the low pressure hot water type with new gas-fired boilers to heat the calorifiers, air handling units, pool plant and building heating. The system shall be sealed with expansion vessel. A new flue system shall be installed to rise within existing chimney and discharge above roof level.

Heating water shall be supplied via pumped circuits to the radiators, manifolds, calorifiers and air handling units.

The heating systems shall be provided with automatic system filling devices, complete with de-aerators, dirt pockets, commissioning sets, expansion vessels and pumps.

All concealed heating pipework shall be thermally insulated.

1.1.2 Cooling Systems

Packaged air cooled VRF type condenser unit shall be located in an acoustic enclosure (if required by acoustic engineer) in the back of the garden and connected to a system of concealed fan coil units throughout the building.

Fan coil units will be incorporated sympathetically into the new architectural room finishes as will new supply and return air diffusers and grilles.

New VRF controls shall be installed to allow the systems to be controlled and monitored.

1.1.3 Ventilation Systems

New ductwork shall be provided from the main cooker hood (supplied and installed by others) to discharge as per mechanical layouts. All kitchen extract ductwork shall be fire rated, complete with clean-out doors and shall be leak tested.

New heat recovery air handling units shall be located in the basement floor plantroom supplying fresh air to the internal areas of the basement area. Multi leaf volume control dampers shall be provided on all duct branches in accessible locations.

All bathrooms, WCs and utility areas shall be provided with mechanical extract ventilation. Bathroom extract fans shall be provided within joinery or ceiling voids where possible, complete with system and atmosphere attenuators, anti-vibration mountings, etc. Flexible connections shall be provided at the grille connections etc.

1.1.4 Hot and Cold Water Services

A new incoming mains water supply shall be provided as part of these works by Thames Water, connected to a water storage tank located in the basement plantroom. A booster pump set shall draw water from the storage tank and shall supply the boosted hot and cold water service.

Hot water storage calorifiers shall be provided in the basement plantroom to provide hot water for the building.

To avoid long dead legs and to ensure fast delivery of hot water, pumped secondary hot water circulation systems shall be provided from each calorifier.

A water softening system shall be installed in the basement plantroom to supply softened water to the hot water outlets.

1.1.5 Natural Gas System

A new incoming gas supply shall be provided to the house as part of these works by National Grid with a new gas meter supplied as part of these works. The new gas pipe will route into the lower basement plantroom to serve the house.

The gas shall be fully ventilated to the room along its route in accordance with the Gas Safe regulations. Tracpipe shall be utilised where possible to minimise gas venting requirements. Gas cocks shall be provided at each appliance.

1.1.6 Controls

A new controls system shall be installed to control and monitor all Mechanical plant and equipment installed in plant room and boiler room. This shall be complete with all required sensors and controllers. The system shall be integrated with a Heatmiser house heating control system.

1.2 SCOPE

The Works shall include, but not be limited to, the following:

- Final design of specialist systems
- Working, installation and builders' work drawings
- Space Heating System
- Space Cooling Systems
- Hot Water Supply System
- Cold Water Supply System
- Natural Gas Service
- Controls and wiring
- Mechanical Ventilation Systems
- Acoustic and Vibration Control
- Electrical Equipment and Wiring associated with the Mechanical services
- Thermal Insulation
- Water Treatment and Filtration

- Record Documentation and O&M Manuals
- New Above-Ground Drainage installation

1.3 DRAWING LIST

The following drawings are issued as an integral part of this package of works. All elements indicated on Tender Drawings and/or scheduled within this Specification are deemed as inclusive within the M&PHE Contract content.

Drawing No.	Drawing Title	Scale	Size
16/117-M01	Basement Floor Domestic Services Layout	1:50	A1
16/117-M02	Ground Floor Domestic Services Layout	1:50	A1
16/117-M03	First Floor Domestic Services Layout	1:50	A1
16/117-M04	Second Floor Domestic Services Layout	1:50	A1
16/117-M05	Basement Floor CC & Ventilation Services Layout	1:50	A1
16/117-M06	Ground Floor CC & Ventilation Services Layout	1:50	A1
16/117-M07	First Floor CC & Ventilation Services Layout	1:50	A1
16/117-M08	Second Floor CC & Ventilation Services Layout	1:50	A1
16/117-M09	Riser Details	1:20	A1
16/117-M10	Basement Plantroom A Layout	1:20	A1
16/117-M11	Basement Plantroom B Layout	1:20	A1
16/117-M12	Second Floor Boiler Room Layout	1:20	A3
16/117-M14	Outdoor Services Layout	1:50	A1
16/117-M15	Typical Comfort Cooling Installation Details	1:20	A1
16/117-M16	Primary Plant Pipework Schematic	NTS	A1
16/117-M17	Domestic Water Services Pipework Schematic	NTS	A1
16/117-M18	Domestic Heating Services Pipework Schematic	NTS	A1
16/117-M19	Comfort Cooling System Schematic	NTS	A1
16/117-PH01	Basement Below Slab Drainage Layout	1:50	A1
16/117-PH02	Basement Floor Soil & Waste Plumbing Layout	1:50	A1
16/117-PH03	Ground Floor Below Slab Drainage Layout	1:50	A1
16/117-PH04	Ground Floor Soil & Waste Plumbing Layout	1:50	A1
16/117-PH05	First Floor Soil & Waste Plumbing Layout	1:50	A1
16/117-PH06	Second Floor Soil & Waste Plumbing Layout	1:50	A1

Drawing No.	Drawing Title	Scale	Size
16/117-PH07	Roof Soil & Waste Plumbing Layout	1:50	A1
16/117-PH08	Sunken Plantroom Soil & Waste Plumbing Layout	1:50	A1

1.4 OPERATING CONDITIONS

1.4.1 Temperatures to be Maintained

The installations have been designed to provide the minimum internal temperatures as scheduled below when the external temperature is -3°C db

Accommodation	Room Temperatures
Living Areas/Bedrooms	23°C db
Bathrooms/Cloakrooms	24°C db
Lobbies/Landing/Staircases	20°C db
Kitchens/Utility Rooms	20°C db

1.4.2 Summer Conditions

Accommodation as scheduled below shall be cooled and maintained at the temperature listed during the summer when the external temperature of 30°Cdb is not exceeded.

Accommodation	Room Temperatures
Internal Areas with Comfort Cooling	23 °C DB +/- 1°C

1.4.3 Boiler Plant

Primary Boiler Flow Temperature	80°C
Primary Boiler Return Temperature	60°C
Secondary Flow to Calorifiers	80°C
Secondary Return from Calorifiers	60°C
Secondary Flow to Heating System	80°C
Secondary Return from Heating System	60°C
Secondary Flow to Swimming Pool Plant	80°C
Secondary Return from Swimming Pool Plant	60°C

1.4.4 Domestic Water System

Boosted water Operating Pressure	5 bar
Hot Water Service Storage Temperature	65°C
Hot Water Service Flow temperature (max)	60°C
Blended Flow Temperature	43°C

1.4.5 Gas

Supply gas pressure (minimum)	20.0mbar

SECTION 2

2 CONDITIONS OF TENDER AND PRELIMINARIES

2.1 CONDITIONS OF TENDER

The Conditions of Tender shall be as stated in the Contract Conditions and Bill of Quantities. Detailed requirements for drawings are shown in Section 3, and the section entitled Inspection, Testing and Handover, of this document.

The Contractor appointed shall be deemed to have been aware, at the time of his tender, of the General Conditions and Preliminaries of the Main Contract and to have made allowance for these in his tender.

2.2 DEFINITIONS

"The Employer"	This shall mean The Estate Office, The Roma Building, 32-38 Scrutton Street, London EC2A 4RQ.
"The Architect"	This shall mean Studio Kyson, 28 Scrutton Street, London EC2A 4RP.
"The Engineer"	This shall mean Edward Pearce LLP, Old School House, 35 Ewell Road, Surbiton, Surrey. KT6 6AF.
"The Structural Engineer"	This shall mean FORM Structural Design, 77 St John Street, London EC1M 4NN.
"The Quantity Surveyor"	This shall mean The Estate Office, The Roma Building, 32-38 Scrutton Street, London EC2A 4RQ.
"The Contract Administrator"	This shall mean The Estate Office, The Roma Building, 32-38 Scrutton Street, London EC2A 4RQ.
"The Contractor"	This shall mean the Contractor employed to carry out the Works described in this specification.
"The Main Contractor"	This shall mean Construction Management Company, Gardiner Theobald.
"Tender Documentation"	Drawings and other documentation as appropriate to the agreed procurement method prepared to enable those tendering to interpret the design for the Works and to submit a tender for executing all or any part of the Works.
"Installation Drawings"	Drawings based on Tender Documentation issued as "Construction Issue" and/or Coordination Drawings showing details of proposals by Contractors or Sub-Contractors for the execution of the Works. The Installation Drawings will be in such detail as to enable the Works to be installed.
"Builders Work Details"	Drawings prepared by Contractors based on Installation Drawings showing requirements for

	building works necessary to facilitate the installation of the Works (other than where it is appropriate to mark out on site).
"Builders Work Information"	Drawings and/or schedules that may be prepared by the Engineer pre tender to show the provisions required to accommodate the Works which significantly affect the design of the building structure fabric and external works. Such drawings and schedules will have been issued to assist the Quantity Surveyor in budgeting and the Structural Engineer in compilation of his schemes. These drawings will be superseded by the Contractor's Builders Work Details.
"Coordination Drawings"	Drawings showing the inter-relationship of two or more engineering services and their relation to the structure and architectural details. Such drawings shall be provided to a scale of not less than 1 to 50 unless otherwise agreed and be prepared in such detail as to demonstrate that the engineering services will be properly separated from one another and can be satisfactorily installed and maintained. The Coordination Drawings shall embrace other engineering services not part of these Works.
"Record Drawings"	Drawings prepared by the Contractor in order to provide the Client with a record of the Works as installed.
"Construction Drawings"	Drawings issued by the Engineer to enable the Contractor to prepare and issue his Installation/ Shop Drawings.

2.3 PRE-TENDER QUOTATIONS

The Contract Administrator may have, as is normal, obtained several quotations from various companies during the design stage of this project. It should not be assumed that quotations given to Edward Pearce LLP are correct, as the design may have changed since the quotation was given. The tenderers shall be responsible for obtaining and checking quotations against the tender documents.

2.4 DEVIATIONS/VARIATIONS

The Contractor shall when requested prepare within 14 days a Quantified Schedule of Rates which shall total to the value of the Contract and be sub-divided in accordance with the sub-division of Tender. Within each sub-division the Contractor shall list all components and exact quantities of same, complete with a unit cost and total cost. All these items shall then be added together to equal the sub-division total.

Other than where provisional sums or contingencies have been allowed no lump sums will be permitted within the schedule.

The said Quantified Schedule of Rates shall be submitted and agreed with the Contract Administrator **BEFORE** the award of the Contract and shall form the basis of pricing any additions, omissions or variations.

If during the course of the Contract a new item arises which is not included in the Schedule of Rates, then a rate shall be agreed with the Contract Administrator. This rate shall include the establishment charges, profit, etc., pro rata with those on which the tender and previously agreed rates are computed.

The Contractor shall present all prices and details of all deviations to the Contract Administrator for checking immediately they arise and co-operation in this is essential to ensure smooth and speedy execution of the works and to keep financial commitments up to date.

No claims for extras will be allowed unless the Contractor has, prior to putting same in hand, obtained written instructions from the Contract Administrator in respect of such extras, or unless the Contactor has received from the Main Contractor an official deviation order. No drawings or other documents except such deviation order will be recognised or construed as an order for extras.

Work in connection with variations shall not be carried out on a daywork basis unless agreement is given thereto in writing by the Contract Administrator before the work is commenced.

List of materials or time sheets signed by the Clerk of Works as being correct in fact, will not necessarily imply that the work carried out will be valued on a daywork basis.

All claims for works carried out on a daywork basis shall have supporting time sheets attached to the claim and be submitted with the final account. The time sheets are to be signed by the Clerk of Works, having been previously submitted to him weekly by the Contractor as the work proceeds. The Clerk of Works will require a copy of the time sheets as he signs them and these will be retained until the Contractor's final account is received.

If variations involving dayworks are agreed by the Contract Administrator, the labour rates used shall be those currently authorised by the National Joint Council for the Industry. Any additional inducement, bonus, or other plus rates, will only be allowed if prior written authority for their inclusion has been obtained from the Contract Administrator.

2.5 SITE MEETINGS

Regular meetings at agreed intervals shall be held on site if required. The Contractor shall arrange to have an accredited representative present at each of these meetings until completion of the Works.

2.6 COMPLIANCE WITH BYE-LAWS, ETC.

The Contractor shall comply with and give all notices required by any Act of Parliament or by any regulation or bye-laws of any local authority or any public service company or authority who has any jurisdiction with regard to the works or with whose systems are the same, or will be connected, and he shall pay any fees or charges legally demandable under such Act of Parliament, regulation or bye-law in respect of the Works.

2.7 PATENT RIGHTS

The Contractor shall pay any claims, costs or expenses in connection with any patented, copyright or protected article supplied by the Contractor or his suppliers and used on or in connection with the work and any payments or royalties payable in one sum or by instalments shall be included and paid by the Contractor to whomsoever they may be due.

2.8 VISITS TO SITE

The Contractor shall visit the site before submitting his tender in order that he may make himself thoroughly acquainted with the nature and extent of the works, and to obtain all details necessary for estimating purposes as no allowance can be made from neglect of this clause.

2.9 DELIVERY OF ACCOUNTS

The Contractor shall from time to time as may be directed by the Contract Administrator, deliver to him a detailed account in such form as he shall direct, setting out the quantities of work done and material delivered, the sums claimed by the Contractor to be payable to him under the Contract and in respect of increased or varied work.

2.10 PAYMENTS TO CONTRACTOR AND CERTIFICATES

Payments shall be made to the Contractor in accordance with the Conditions of Contract.

2.11 TESTS AT CONTRACTOR'S WORKS

Except where otherwise provided in the Contract, the Contractor shall provide all labour, materials, power, fuel, stores, apparatus and properly calibrated and certified instruments for carrying out necessary tests at his own or his suppliers works.

The Contractor shall give the Contract Administrator written notice when any portion of the plant is ready for test.

2.12 TESTS AT SITE

The Contractor shall carry out such pressure, insulation and other tests and performance and taking over tests on site as may be required by the Contract Administrator and unless otherwise indicated in the Specification, provide all necessary duly certified instruments, labour and materials required for the purpose of the tests, and all fuel, oil and accessories required for any trial runs and for the tests, until the prescribed tests have been passed to the satisfaction of the Contract Administrator.

In the event of the plant not passing the tests, all reasonable expenses incurred by the Contract Administrator or Main Contractor, due to the repetition of such tests shall be deducted from the monies due to the Contractor. This shall particularly apply to abortive visits to witness commissioning.

2.13 USE OF DEFECTIVE WORK

If the defective portion of the Works be required by the Employer for commercial use, he shall be entitled to make use of the same in a proper manner, for a time sufficient to enable him to obtain other plant to replace it, the Contractor being allowed a proper sum for the use of same.

In the case where the Contractor although willing to do so, is unable to repair defects in certain parts of the work, in consequence of the Employer not being able to allow such parts to be placed in his hands for the requisite time owing to their being in use, the Contractor shall be paid in full for such portion of the Works on giving an undertaking with security if required, to remedy the defects as the same can be placed in his hands for the purpose.

2.14 INSTRUCTION OF OPERATORS

The Contractor shall on the 'taking over' of the Works instruct the staff appointed by the Employer in the correct adjustment and operation of the plant and equipment installed and thereafter during the defects liability period make additional attendances, without charge at the Works as may be reasonably necessary for the Contractor to satisfy himself that such instructions are being carried out by the appointed staff.

The Contractor shall also hand to the Employer or to his duly appointed representative the manufacturer's instructions for operating, greasing, oiling and adjusting the said plant.

2.15 COMMENTS ON DRAWINGS

Where comment on drawings etc. is offered, it shall not relieve the Contractor of his obligations under common law. The comments will only cover the checking of details to assist the Contractor in reducing the potential for error and shall be subject to the detailed requirements of the specification and drawings. Full responsibility for the accuracy and eventual correct functioning of equipment or systems shall remain with the Contractor.

SECTION 3

3 GENERAL REQUIREMENTS

3.1 GENERAL

This section of the Specification deals with the standards of materials, workmanship and approved methods of installation required in connection with the Mechanical Engineering Services.

This section must be read and applied in conjunction with later detailed sections of the Specifications and the drawings and schedules issued herewith.

Except for materials or items of equipment which are specified as being supplied and/or fixed for the Works by others, these Works shall include the supply, delivery to site, installation, testing, adjusting, regulating, commissioning and leaving in satisfactory working order the complete systems as specified and scheduled herein and/or indicated on the drawings issued herewith.

The Contractor appointed shall be deemed to have been aware, at the time of his tender, of the General Conditions and Preliminaries of the Main Contract and to have made allowance for these in his tender.

3.2 MATERIALS, WORKMANSHIP AND PERFORMANCE

All the Works shall be executed with the materials of the respective kinds specified with guaranteed performance to recognised national testing methods and procedures to the reasonable satisfaction of the Contract Administrator.

The installation and all equipment used therein shall comply with all relevant Acts of Parliament, Regulations, Statutory Instruments, British Standards Specification and Codes of Practice and the requirements of:

(1) BS 7671 - The "Requirements for Electrical Installations" issued by the Institution of Electrical Engineers and the British Standards Institute.

(2) The Fire Officer

(3) The Local Electricity Gas and Water Undertakings

(4) The Local Authority

(5) The Electricity (Factories) Acts Special Regulations 1908, 1944 (The Electricity Regulations).

(6) Electricity at Work Regulations.

(7) Health and Safety at Work Regulations.

(8) All relevant British Standards.

(9) The Construction (Design and Management) Regulations.

In the event of a discrepancy between this Specification and any British Standard Specification and/or Code of Practice the most stringent requirement shall be followed.

All persons engaged upon the Works shall be properly qualified to the appropriate grade.

All materials considered by the Contract Administrator to be unsound or not in accordance with the Specification and all work carried out imperfectly or with faulty materials shall be removed immediately and properly replaced to the satisfaction of the Contract Administrator at no cost to the Works. In the event of neglect or refusal to carry out replacement or remedial works, the Contract Administrator reserves the right to make alternative arrangements for the Works to be carried out in accordance with the prevailing contractual conditions.

3.3 MAKES OF MATERIALS AND COMPONENTS

These shall be as specified elsewhere in this document, any deviation from this shall be declared by the Contractor at the time of tender.

3.4 CONSISTENCY OF COMPONENTS

The agreed components shall wherever practicable be used throughout the particular service or system affected and throughout all services or systems run together on the same installation, for matching and to reduce the need for different attention and spares.

3.5 ORDERS TO SUPPLIERS

Upon receipt of the order to commence the Works, all orders shall be placed with suppliers and a timed delivery programme arranged to ensure that materials are on site at the time necessary to conform with the agreed Main Contractor's programme.

3.6 DEFECTS LIABILITY

The defects liability shall be as stated in the Contract Documents which will not be less than 12 months from the day named in the Certificate of Practical Completion of the Works.

3.7 AMBIGUITY OR DIVERGENCE

If any ambiguity or divergence between the drawings and/or the Specification is disclosed, this shall be referred immediately to the Contract Administrator in writing, together with application for any necessary instructions from the Contract Administrator in relation thereto.

In the event of any ambiguity or divergence in or between the tender drawings and/or this Specification, the most stringent requirements shall be deemed to have been included for in the tender.

3.8 DEFINITION OF DRAWINGS

The following definitions are as set out in BSRIA Technical Note TN 21/97 Appendix A.

3.8.1 Detailed Design Drawings

A drawing showing the intended locations of plant items and service routes in such detail as to indicate the design intent. The main features of detailed design drawings is as follows:-

- Plan layouts to a scale of at least 1:100. Plant areas to a scale of at least 1:50 and accompanied by cross sections.
- The drawings will not indicate the precise position of services, but it should be feasible to install the services within the general routes indicated. It should be possible to produce coordination drawings or installation drawings without major re-routing of the services.
- Represent pipework by single line layouts.

- Represent ductwork by either double or single line layouts as required to ensure that the routes indicated are feasible.

3.8.2 Coordination Drawing

A drawing showing the inter-relationship of two or more engineering services and their relation to the structure and building fabric. The main features of a co-ordination drawing are as follows:-

- Plan layouts to a scale of at least 1:50, accompanied by cross-sections to a scale of at least 1:20 for all congested areas.
- A spatially co-ordinated drawing, i.e. no physical clashes between the system components when installed at the scaled-off positions shown on the drawing. Provide dimensions in areas where tolerances are minimal.
- Make allowance for the service at its widest point for spaces between pipe and duct runs. Allow for insulation, standard fitting dimensions and joint widths on the drawing.
- Make allowance for those plant items specified by the designer and identified in the design specification.
- Make allowance for installation working space and space to facilitate commissioning and maintenance.
- Indicate positions of main fixing points and supports where they have significance to the structural design.
- Arrange the services so that it is possible to demonstrate a feasible sequence of installation.
- Support the drawing with individual services drawings for clarity.
- Plantroom layouts to a scale of at least 1:20, accompanied by cross-sections and elevations to a scale of at least 1:20.

3.8.3 Installation Drawing

A drawing based on the detailed drawing or co-ordination drawing with the primary purpose of defining that information needed by the tradesmen on site to install the works. The main features of installation drawings should be as follows:

- Plan layouts to a scale of at least 1:50, accompanied by cross-sections to a scale of at least 1:20 for all congested areas.
- A spatially co-ordinated drawing, i.e. no physical clashes between the system components when installed at the scaled-off positions shown on the drawing.
- Make allowance for inclusion of all supports and fixings necessary to install the works.
- Make allowance for the service at its widest point for spaces between pipe and duct runs. Allow for insulation, standard fitting dimensions and joint widths on the drawing.
- Make allowance for installation details provided from shop drawings.
- Make allowance for installation working space; space to facilitate commissioning and space to allow on-going operation and maintenance in accordance with the relevant health and safety requirements.
- Make allowance for plant and equipment including those which are chosen as alternatives to the designers specified option.
- Provide dimensions where the positioning of services is considered to be important enough not to leave to the tradesmen on site.
- Plantroom layouts to a scale of at least 1:20, accompanied by cross-sections and elevations to a scale of at least 1:20.

3.8.4 Installation Wiring Diagram

Drawing showing the interconnection of electric components, panels etc in accordance with the design intent indicated in the schematic drawings and incorporating the details provided on manufacturer's certified drawings.

Indicate the following: maximum electrical loading for each supply cable; cable

termination facilities; and cable identification and all terminal numbers.

3.8.5 Shop Drawings
Drawing prepared by a fabricator or supplier unique to the project. Including supplier's drawings for ductwork, pre-fabricated pipework, medical gas systems, pneumatic tube transfer system, roof support system, sprinkler systems, control and switchgear panels and associated internal wiring.

3.8.6 Manufacturers' Drawings
Drawing provided by a manufacturer or supplier to indicate a typical representation of the product, components or plant items to be supplied for a particular project.

3.8.7 Manufacturer's Certified Drawing
Drawing provided by a manufacturer or supplier to indicate details of the produce, component or plant items and which the manufacturer or supplier guarantees the supplied equipment will comply with.

3.8.8 Record Drawing
Drawing showing the building and services installations as installed at the date of practical completion. The main features of the record drawings should be as follows:-

- Provide a record of the locations of all the systems and components installed including pumps, fans, valves, strainers, terminals, electrical switchgear, distribution and components.
- Use a scale not less than that of the installation drawings.
- Have marked on the drawings the positions of access points for operating and maintenance purposes.
- The drawings should not be dimensioned unless the inclusion of a dimension is considered necessary for location.

3.8.9 Builder's Work Drawing

Design Stage
A drawing to show the provisions required to accommodate the services which significantly affect the design of the building structure, fabric and external works. Also drawings (and schedules) of work to be carried out by building trade, and required to be costed at the design stage, e.g. plant bases.

Installation Stage
Drawing to show requirements for building works necessary to facilitate the installation of the engineering services (other than where it is appropriate to mark out on site).

3.8.10 Controls Logic Diagrams
Diagrams, drawings and/or schematic details of all control components and instruments showing the layout with each item uniquely identified together with a description of the controls operation and details of the associated interlocking.

3.8.11 Switchgear, Start and Control Instrumentation Panel Drawings
Drawings showing the construction and internal wiring diagrams of the starters, panels and/or other devices.

3.8.12 As-Installed Drawings
Drawings/records retained on site to record the progress of and any site modifications to the Works including any changes to software.

3.9 DRAWINGS TO BE SUBMITTED BY THE CONTRACTOR

Detailed design drawings as defined in clause 3.8.1 will be provided by the design team.

The Contractor shall provide as part of these works the following drawings:

- Coordination Drawings as defined in clause 3.8.2.
- Installation Drawings as defined in clause 3.8.3.
- Installation Wiring Diagrams as defined in clause 3.8.4.
- Shop Drawings as defined in clause 3.8.5.
- Manufacturers' Drawings as defined in clause 3.8.6
- Manufacturers' Certified Drawings as defined in clause 3.8.7.
- Record Drawings as defined in clause 3.8.8.
- Builders' Work Drawings as defined in clause 3.8.9.
- Control Logic Diagrams as defined in clause 3.8.10.
- As Installed Drawings shall be maintained on site as defined in clause 3.8.12.

The Contractor shall provide for the Contract Administrator's comment dimensioned drawings giving details of all builder's work, including service ducts, chases and holes to be left in construction, bases for apparatus and equipment, foundations etc. Builder's Work Drawings shall be issued to suit the Main Contractor's programme allowing 21 days for the Contract Administrator's comments prior to use.

The Contractor shall a comprehensive wiring diagram for the mechanical controls systems and submit this for the approval of the Contract Administrator before the installation of the Works.

The Contractor shall be responsible for the accuracy of all wiring diagrams provided by him and for the correct internal wiring of all pre-wired equipment.

The Contractor shall also provide, prior to manufacture or installation, detailed installation and coordination drawings for the entire installation, purpose-made equipment including pipe, ductwork, conduit, trunking and other supports, brackets, frameworks, panels, sheet metal works, ladders, gangways, plating, etc.

Installation drawings shall be fully co-ordinated with other services and where more than one service shares the location within the building, the other services must be shown whether or not they form part of this Contract.

The Contractor shall allow in his tender for revising his installation drawings in accordance with revisions to all other drawings which may be issued by the design team.

The Contractor shall be responsible for the accuracy of the drawing submitted by him, although the Contract Administrator may have previously issued similar drawings for planning or tendering purposes.

The Contractor shall be responsible for all builder's work drawings and detailed drawings being available in conformity with the Main Contractor's programme, and shall supply to the Main Contractor for general distribution 4 sets of such drawings, or such other number as may be specified elsewhere.

The Contractor shall be responsible for any discrepancies, errors or omissions in the drawings supplied by him or his Sub-Contractors, and for leaving the installation complete and in proper working order whether or not the whole of the work is properly and correctly shown on the drawings.

All drawings submitted by the Contractor shall be clearly dimensioned with due regard to mounting heights, false ceiling accommodation, recessed lighting fittings, beams, columns, etc., as shown on the tender drawings and/or Contract Administrator's drawings/structural drawings.

The Contractor shall be held responsible for any extra costs incurred by him or his Sub-Contractors engaged upon the Works for additional or abortive works which in the opinion of the Contract Administrator is due to the Contractor's failure to comply with these provisions.

The Contractor shall provide for the Contract Administrator's comment dimensioned drawings giving details of all builder's work, including service ducts, chases and holes to be left in construction, bases for apparatus and equipment, foundations etc. Builder's Work Drawings shall be issued to suit the Main Contractor's programme allowing 14 days for the Contract Administrator's comments prior to use.

The Contractor shall be responsible for the accuracy of all wiring diagrams provided by him and for the correct internal wiring of all pre-wired equipment.

The Contractor shall also provide, prior to manufacture or installation, detailed installation and coordination drawings for the entire installation, purpose-made equipment including pipe, ductwork, conduit, trunking and other supports, brackets, frameworks, panels, sheet metal works, ladders, gangways, plating, etc.

Installation drawings shall be fully co-ordinated with other services and where more than one service shares the location within the building, the other services must be shown whether or not they form part of this Contract.

The Contractor shall allow in his tender for revising his installation drawings in accordance with revisions to all other drawings which may be issued by the design team.

The Contractor shall be responsible for the accuracy of the drawing submitted by him, although the Contract Administrator may have previously issued similar drawings for planning or tendering purposes.

The Contractor shall be responsible for all builder's work drawings and detailed drawings being available in conformity with the Main Contractor's programme, and shall supply to the Main Contractor for general distribution 4 sets of such drawings, or such other number as may be specified elsewhere.

The Contractor shall be responsible for any discrepancies, errors or omissions in the drawings supplied by him or his Sub-Contractors, and for leaving the installation complete and in proper working order whether or not the whole of the work is properly and correctly shown on the drawings.

All drawings submitted by the Contractor shall be clearly dimensioned with due regard to mounting heights, false ceiling accommodation, recessed lighting fittings, beams, columns, etc., as shown on the tender drawings and/or Contract Administrator's drawings/structural drawings.

The Contractor shall be held responsible for any extra costs incurred by him or his Sub-Contractors engaged upon the Works for additional or abortive works which in the opinion of the Contract Administrator is due to the Contractor's failure to comply with these provisions.

3.10 SETTING OUT WORKS

The Contractor shall set out the whole of the Works in strict compliance with the tender and detail drawings, and shall be responsible for the correctness of the position, levels and dimensions of the Works.

It shall be the responsibility of the Contractor to ascertain from room layout drawings the positions of equipment, piping, conduit and the like, and to install the services having regard thereto.

If at any time during the progress of the work any error shall appear or arise in the position, levels or dimensions of the Works, the Contractor, on being required to do so by the Contract Administrator, shall at his own expense remove and amend the work to the satisfaction of the Contract Administrator.

In setting out the Works, and in the course of installation, the Contractor shall require to take due consideration of the need for reasonable access to equipment, etc., for maintenance purposes.

3.11 REMOVAL OF MATERIALS AND REINSTATEMENT

The Contractor shall remove all waste, temporary supports, surplus materials and equipment, make good any damage caused and carry out any reinstatement necessary as and when required and to the satisfaction of the Contract Administrator. The Contractor shall allow for all redundant materials to be removed from site and disposed of safely.

3.12 PROGRESS OF WORKS

The Contract Administrator will inspect the Works during the progress of the installation and will advise the Main Contractor and Contractor of his opinion of the engineering works and specific deficiencies or defects. It is not in any way part of the Contract Administrator's duty to progress the Works on behalf of the Main Contractor.

The Contractor as part of his obligations is required to produce both builder's work, detailed working and coordination drawings and these are to be presented to the Contract Administrator for consideration. It is essential that such drawings are prepared well in advance of their being required for use to allow a reasonable period for study and comment. Normally the period should be two weeks from receipt to the issue of comments by the Contract Administrator. The party or parties issuing the drawings for consideration shall be deemed responsible for any claim for delays in site works if sufficient time as stated is not given to the Contract Administrator.

It is expected of the Main Contractor in collaboration with his Sub-Contractors to show clearly on programme charts or networks the proper allocation of dates, times and periods for the preparation and issue of builder's work and detailed working and coordination drawings plus the consideration time for the Contract Administrator's scrutiny and the date for the completion of the snagging.

The programme must also allow a minimum period of 4 weeks between completion of the Works and handover so that the Contractor can properly commission and record the operation of the completed Works and give time for the Contract Administrator to evaluate the Works and if necessary organise with the Contractor for the rectification work which may be necessary due to a design or installation fault.

The Contract Administrator cannot and will not agree to accept the Works until the end of the commissioning and evaluation period and not then if the plant is not properly operational to his satisfaction.

Should this situation arise the Client will be informed that the Contract Administrator recommends deferring acceptance of the whole project until the engineering works are operating as designed.

3.13 NAMEPLATES, ETC.

All plant and apparatus shall be provided with engraved metal nameplates or embossed lettering, showing the maker's name, reference number, and any other relevant particulars.

3.14 SAFEGUARDS AGAINST DETERIORATION OF PLANT

Notwithstanding any protection to be provided by the Main Contractor, all necessary action shall be taken by the Contractor to prevent deterioration of all materials, components and machinery, etc., before, during and after installation for the duration of the Contract and any amount to cover this shall be included in the Tender.

Ferrous metalwork not galvanised shall have a protective coat of paint or other material before despatch from works.

Any deterioration or damage to manufacturer's protective coating during storage and following installation shall be made good to the satisfaction of the Contract Administrator.

Plugs, caps, covers, etc., shall be fitted to materials delivered to site on all openings and on ends of tubes to prevent entry of foreign matter, water and the like.

As far as possible, machinery, electric motors, valves, other bright metalwork, fine equipment, such as instruments, etc., shall not be installed or exposed until the building is sufficiently advanced and closed to give complete protection from the weather. Whether installed before this time or afterwards, the Contractor shall be responsible for the care of the equipment and for seeing that it is properly protected in such a way that dust, building material and water cannot affect it, or enter working parts, and so that it cannot be damaged by others. Equipment which is in any way unsatisfactory due to inadequate storage will not be accepted.

All ironwork, brackets, supports and the like shall be painted one coat of primer before despatch to site or immediately after manufacture if made on site. All welds and the exposed threads of joints shall be similarly painted by the Contractor immediately they have been made.

3.15 SAFETY PRECAUTIONS

The Contractor shall take all safety precautions to prevent the possibility of accidents which may be caused mechanically or electrically or otherwise. He shall also provide detachable guards to cover all moving machine parts wherever they may be located and whether they are intended to be permanent or temporary. Details of all guards and their method of fixing shall be submitted to the Contract Administrator for comment before manufacture is commenced.

3.16 METAL CUTTING

The use of welding torches for cutting openings, in steel brackets and the like for trimming, studding, etc. is strictly prohibited.

3.17 MATERIALS

None of the following materials shall be used on the Project:-

a) Lead (all solders shall be lead free).

b) High alumina cement

c) Woodwool slabs used in permanent shuttering.

d) Calcium chloride in admixtures for use in reinforced or pre-stressed concrete.

e) Asbestos or asbestos based products.

f) Aggregates for use in reinforced concrete which do not comply with British Standard Specification BS:882 and aggregates for use in concrete which do not comply with the provision of British Standard Specification BS:882 and aggregates for use in concrete which do not comply with the provisions of British Standard Specification BS.8110.

g) Urea-formaldehyde foam or materials which may release formaldehyde in quantities which may be hazardous with reference to the limits set from time to time by the Health & Safety Executive.

h) Silicate bricks or tile.

i) Crocidolite.

j) Tropical Hardwoods

k) Any other substances not in accordance with British Standards and Codes of Practice and good building practice current at any relevant time.

3.18 FIXING TO THE STRUCTURE

These Works shall include for the provision of all necessary supports and fixings to the structure. The Contractor shall seek approval of the Contract Administrator before commencement of work on site, to the proposed method of support, drilling, clamping or securing to the structure.

3.19 ATTENDANCE

The Main Contractor shall provide attendance upon the Contractor in accordance with the Conditions of Tender, preliminaries and Main Contractor documentation.

3.20 DRYING OUT THE BUILDING

The Main Contractor will provide temporary equipment, fuel and attendance for drying out and controlling the humidity of the building works. The Works shall not be used for this purpose.

3.21 USE OF INSTALLATION PRIOR TO HANDOVER

The Main Contractor may wish to make use of all or part of the completed installation, e.g. for heating, ventilation, site lighting, power for hand tools, etc. The Contractor shall only be permitted the use of any part of the completed installation if all of the following conditions are fulfilled:-

a) The Contract Administrator has given his written approval to the proposal.

b) The section of the installation to be made live has been completed and tested in accordance with the requirements of this Specification.

c) The Main Contractor has confirmed in writing that for the period in question, he has control of the installation and is the occupier culpable for injury to any party as the result of an accident occurring in the installation.

d) Arrangements have been made to monitor the cost of fuel consumed for eventual settlement by the Main Contractor and such arrangements are approved by the Contract Administrator.

e) Arrangements have been made to monitor the hours of use of any plant and lamps and a formula agreed for the rate of charge to be made for eventual settlement by the Main Contractor.

3.22 BUILDER'S WORK

In general the Builder's Work etc., required in connection with the Works, will be carried out by the Main Contractor, unless otherwise specified. The Contractor shall be responsible for the accurate detail drawings or marking out of such builder's work and the cost of any work due to the Contractor failing to comply with this condition shall be borne by the Contractor.

Builder's Work by the Main Contractor will include the following:

- The excavation of trenches for pipes, cables, etc., backfilling and reinstatement.
- The building of manholes, pits, ducts, etc., and the provision of all covers and frames, except chequer plate covers and their frames where these are specified, to be supplied by the Contractor.
- The formation of concrete bases, plinths, foundations, etc.
- The cutting and forming of chases, recesses and holes in or through walls, floors, ceilings, partitions, roof etc., and making good.
- The cutting away for and the building in of brackets, bolts, holderbats, clips and other forms of fixings, etc., and making good except the drilling of holes not exceeding 20mm diameter and 100mm depth for plastic, fibrous or other similar proprietary plugs which shall be supplied and fixed by the Contractor.

The Contract Administrator's approval shall be obtained before cutting or drilling structural steelwork or using any expanding type bolts.

3.23 IDENTIFICATION

This shall be in accordance with BS. 1710 employing the Optional Colour Code Appendix D and as the example Appendix E.

In plant rooms, ducts, false ceilings, roof spaces, etc., identification shall be fitted to all main cables, trunking, conduit runs and pipework adjacent to valves and at approximately 3m centres on straight runs.

This shall also apply to all services in exposed areas where positioned 3m or higher from finished floor level, except that in these positions the spacing may be extended to 5m.

On electrical installations connected to 3 phase supplies, each phase conductor throughout the installation shall be plainly marked adjacent to its termination by coloured sleeves to indicate the phase to which it is connected.

3.24 LOOSE MATERIALS

Items of "loose materials" or "unfixed materials" shall be handed to the Contract Administrator at handover.

3.25 LABELS, IDENTIFICATION AND NOTICES

Unless otherwise specified, all multiple components, control and monitoring equipment shall be identified by Labelling to correspond with the terminology used in this Specification and the legend used in relative drawings.

All distribution and control equipment, metal clad switches, switch fuses, distribution boards, bus bar chambers, link boxes, contactors, time switches, etc., shall have Labels with characters of at least 5mm height on each.

All Labels and Notices unless otherwise scheduled, shall have black letters on a white background made from laminated self-coloured materials or a hot stamping process. The engraving shall penetrate the outer lamination and expose the appropriate coloured lamination beneath. Each Label shall be firmly fixed on to or adjacent to its item of equipment by self-tapping screws, or drive pins. Sufficient screws or drive pins shall be used to ensure that the Label or Notice does not buckle. Adhesive labels shall not be permitted.

The identification of multiple components within control and distribution equipment, e.g. relays and fuses, may be by self-adhesive, printed paper labels, varnished over.

3.25.1 Auto Start Motors

A notice having red characters on white of 10mm minimum height, shall be provided in a prominent position, wherever these Works include for the final connection to any motor which is arranged for automatic re-start. The legend shall be as follows:

MOTOR AUTOMATICALLY CONTROLLED AND MAY START WITHOUT WARNING

3.25.2 Supplies to Solid State Controls

Wherever Solid State Electronic Controls are connected to a distribution board, or part of a Control Panel, a notice shall be provided as described for CIRCUIT LISTS, to warn of possible accidental damage to equipment during insulation tests.

3.25.3 Drinking Water

Plates of a design to be approved by the Contract Administrator.

3.26 QUIETNESS IN OPERATION

Every effort shall be made to minimise noise generation from the various systems. Anti-vibration fixings and ferrules shall be used wherever practicable, and essentially the whole installation and every item thereof shall be free from drumming and rattle.

The Contractor shall trace and remedy the source of any noise considered greater than the permissible level set out in the Operating Conditions specified herein, including replacement of items as may be necessary.

When attenuation equipment is specified, this shall be installed such that, wherever practicable, it is bolted to the wall of the plant room so as to avoid "flanking" noise which might otherwise occur.

3.27 LOCATION AND MOUNTING HEIGHTS FOR APPARATUS

Mechanical/Electrical fittings and/or appliances, conduits, cables, pipework, ducts, etc., are indicated on the drawings for tendering purposes and guidance during installation. Exact positions and routes shall be settled on Site in relation to other services and fixtures and in accordance with the Contract Administrator's Detailed Room Layouts, where issued.

The Contract Administrator reserves the right to make minor alterations up to one metre in route length to the position of wiring accessories or plant shown on the drawings without incurring additional charges.

SECTION 4

4 PIPE DISTRIBUTION

4.1 GENERAL

Pipework materials to be used shall be as detailed in the schedule at the end of this section.

4.2 WELDING

All forms of welding shall be in accordance with the conditions, techniques and methods laid down in the appropriate British Standard and the HVCA manual, Welding of Mild Steel Pipework.

Cut and shut or segmented bends SHALL NOT BE USED except in special cases approved by the Contract Administrator.

Welders employed shall be experienced pipe fitters with at least six months welding experience and shall hold current recognised "Certificate of Competency" applicable to the plant conditions involved, issued by a recognised body or shall otherwise pass the tests laid down in BS 4872 Part I to the satisfaction of the Contract Administrator before commencing on the Works.

All pipework of 65mm and above shall be welded.

4.3 BENDS AND SPRINGS

For all springs, sets and 90° bends pulled on site, cold bending will be permitted up to and including 50mm bore, but only if approved formers and bending machines are used. Pipes larger than 50mm bore shall be forged, also smaller pipes where it is necessary that they shall be bent to a short radius.

Galvanised bends and springs shall not be forged on site as far as practicable, but where this is essential they shall be galvanised after manufacture.

Cold bending WILL NOT BE PERMITTED on galvanised pipe.

All bends, sets, etc. shall be to the same specification as the tube, and care shall be taken to avoid undue thinning of the outer wall due to the bending.

All radii shall be as long as practicable.

4.4 EXPANSION RELIEF

The Contractor shall be responsible for satisfactory provision for expansion and the relief of strains due to it and also for seeing that movement of pipes due to expansion is not restricted by the position of brackets, or by building fabric, or the rigid building in of branches, etc.

Expansion bends or expansion bellows shall be installed where required to relieve expansion and made to the maximum dimensions practicable within the space in which they are located.

Expansion bends shall be fabricated from one continuous length of piping where practicable, that is, neither fittings nor welding shall be used. Where joints are necessary due to the total length of the tube in the loop, they shall be made in the middle of each leg.
When inserted in position and fixed during erection all expansion bends shall be opened to the full extent of the cold draw.

Where two parallel pipes are following around the loop, the one on the inside (or the shorter) shall be the return or cooler pipe.

Expansion bellows shall be installed where indicated on the drawings or where expansion can not be accommodated within the pipework. On the services in which these are fitted, adequate guides shall be provided throughout the length of the run.

The contractor shall ensure that all pipework in contact with the structure is suitable isolated from the structure to ensure that no noise occurs due to pipework expansion and contraction.

4.5 SLEEVES

All piping passing through or entering walls or floors shall be provided with sleeves of the same material as the pipe and of sufficient length, all as detailed and the Contractor shall be responsible for ensuring that the sleeves shall be correctly aligned and finished not less than 3mm, nor more than 12mm clear of the wall finish, etc. on completion of the Works.

After the installation of the piping the space between the pipe and sleeve shall be packed with ceramic mineral wool and sealed with Dow Corning Fire Sealant as manufactured by Dow Corning Ltd., TEL: 0932 351911 to give a 2 hour fire resistance to effect a fire seal. Sealant penetration shall be in accordance with the manufacturer's instructions.

4.6 PIPES, ENTRIES OR DEPARTURES

All pipes entering or departing from the building at external walls, floors and roofs as indicated, shall be installed with sleeves.

The Contractor shall seal all pipe entry/departure sleeves against the ingress of water, gas, dust, vermin and spread of fire.

The sleeves shall be sealed by the application of specially formulated duct sealing products manufactured by Dow Corning Ltd., TEL: 0932 351911.

The method of preparation and application shall be strictly in accordance with the manufacturer's published recommendation.

4.7 DRAIN AND EMPTYING POINTS

At all low points on all pipework systems, a drain-off cock shall be provided. These shall be suitable to affix a hosepipe to.

4.8 VENTING

In general, wherever practicable, hot water pipes shall be graded so as to rise in the direction of the flow, that is, the high point shall be at the far end of the flow, and at the near end of the return, on each main and sub-main. Needle seated air cocks or air eliminators shall be fitted on all points where it is possible for air to accumulate.

Unless otherwise indicated on the drawings or agreed with the Contract Administrator, each vent line shall be brought down to 1.5m above finished floor level and the cock fitted.

4.9 AIR COLLECTING POINTS

Air collecting chambers shall be provided at all venting points on the mains unless otherwise indicated on drawings or agreed by the Contract Administrator.

These shall be 32mm bore for pipes that size or smaller, the same size as the pipe to which they are connected between 40mm and 80mm bore, and 80mm for pipes over that size, unless otherwise indicated on drawings or agreed by the Contract Administrator.

4.10 AUTOMATIC AIR ELIMINATORS

Automatic air eliminators of the type as scheduled shall be provided where indicated on the drawings. A cock shall be fitted on the inlet. An open relief pipe on the outlet shall be run to a suitable position.

4.11 POCKETS FOR TEST THERMOMETERS/BINDER TEST POINTS

Binder test points/pockets for test thermometers shall be provided adjacent to the temperature measuring points of all instruments and controls on the main flows and returns in the boiler room, calorifier rooms, mixing stations, etc., and on the flow and return connections of each heat exchange battery.

The pockets shall be of the capped well type and suitable for the thermometers specified elsewhere, which shall be provided and arranged without undue obstruction to flow and so that a long stem mercury in glass testing thermometer can be inserted sufficiently deeply and read easily, the purpose being to check adjustment and calibration.

The pockets shall be steel, but for copper installations they shall be brass.

4.12 PIPE AND FITTINGS

Unless otherwise specified, all piping shall conform to the following British Standards:

Steel up to and including 125mm bore	BS 1387
Steel above 125mm bore	BS 3601
Hard drawn copper (Thinwall)	BS 2871 (Part 1, Table Z)
Half hard copper	BS 2871 Part 1, Table X)
Cast Iron	BS EN 545, 598 and 969
Unplasticised PVC	BS 3505

Fittings shall conform to the following British Standards:

Steel	BS 143-1256 BS 1965
Copper	BS 864 (Part 2)
Cast Iron	BS 4772

Where hard drawn copper tube to Table Z is specified, this shall be used for all straight runs in conjunction with half hard copper tube to Table X for non-standard bending and all offset work.

Except where otherwise specified, steel pipe may be screwed or butt welded or welded steel socket and spigot pipes may be used for long straight runs.

Fusion welding SHALL NOT BE USED for galvanised steel pipes. All joints shall be screwed.

Except where otherwise specified, copper pipe may be fusion welded or jointed by the 'Sifbronze' process or by capillary solder or compression joints. The capillary fittings shall be of the integral solder ring pattern. Only lead free solder shall be used.

All steel pipework concealed in structural ducts, trenches, chases and the like, where complete access is not provided, shall be wrapped in the correct grade of Densotape, or similar and to the maker's instructions, throughout its length and thermally insulated as specified elsewhere.

Reducing fittings shall be used to prevent air pockets, etc. Bushes SHALL NOT BE USED.

All burrs shall be removed with a reamer and all pipes shall be brushed or blown through to remove all dirt, mill scale, swarf, etc., immediately before erection.

Steel pipes shall be coated externally with anti-corrosive varnish before leaving the Works and re-coated where necessary on arrival at site.

Bends shall be made from the same material as the pipe where practicable. Elbows shall not be used, except with the agreement of the Contract Administrator in certain cases where bends may be impracticable, or undesirable.

Pipe lines shall in all cases follow the lines of the building both horizontally and vertically and around projections such as columns and the like, and shall be run in their correct positions in relation to the building, appliances and other services, bearing in mind that pipe lines on small scale drawings are intended to be diagrammatic and cannot be scaled.

Unless otherwise agreed by the Contract Administrator, branches on circulation shall be connected with a sweep in the direction of flow. Pipe ends left disconnected during progress shall be closed by screwed plugs or caps and all necessary action taken to prevent the entry of foreign matter. Plugs of shavings, paper and the like shall not be used, and if these are, in fact, used contrary to the Specification, the Contract Administrator will require that the pipework affected is dismantled and thoroughly rodded through to eliminate any possibility of foreign matter or residues being left in the pipe.

The Contractor shall ensure that the fittings for the pipework are correctly supplied. Difficulties may arise when connecting into existing Imperial systems and equipment, and the Contractor shall allow for this contingency in the tender.

The clearance between pipework, inclusive of any insulation and walls and any other fixtures, shall be not less than 25mm.

Horizontal pipework shall be fixed not less than 75mm clear above floors or as indicated.

4.13 PIPE JOINTS

All pipework concealed in structural duct, trenches, chases and the like, where complete access is not provided, shall have welded joints.

Where galvanised pipework is specified, the fabrication shall be galvanised after manufacture.

Unions and flanges shall be used only for mating to valves and components and, subject to the prior agreement of the Contract Administrator, in certain other locations where necessitated by restricted space.

Where unions or flanges are permitted, unions shall only be used on pipes up to and including 50mm bore and flanges shall be used on pipes over that size.

Connectors or long screws shall not be used.

Unions shall be conical seated pattern.

Flanges shall be of wrought steel, except where otherwise specified, bored and threaded to suit the respective size pipes, faced right across at right angles to the pipe axis with jig drilled bolt holes. All such flanges shall be screwed or expanded on. Flanges of a type suitable for welding may be used and they shall be either slip on type welded both inside and outside by metal arc process, or neck flanges butt welded with either arc or gas processes.

The flanges shall be flat-faced to BS 10, Table A, if connected to Imperial size, otherwise the flanges shall have raised faces BS 4504 Tables 6/2 or 6/5 where joints are welded and Table 6/4 where the joints are screwed. Flanged joints shall be made with flat ring gaskets. HRH black bolts and nuts with washers shall be provided.

Bolts shall protrude through the nuts 2 - 6mm when finished, otherwise the excess shall be sawn off and burrs removed or the bolt changed and no additional charge shall be allowed for this.

Screwed joints shall be made with jointing compound approved by the Contract Administrator, long yarn being used on low temperature water services only.

All joints shall be properly cleaned and trimmed. There shall be no joints within the thickness of walls or floors.

4.14 PIPE SUPPORTS, FIXINGS AND ANCHORS

The Contractor shall be responsible for the satisfactory support and fixing of all items in all respects.

All supports, fixings and anchors shall be subject to the approval of the Contract Administrator and such approval shall be obtained before the use of all standard supports and before the manufacture of all purpose-made supports, etc.

The style, material and spacing shall be correct for the service pipe, structure, etc. to which it is fixed, with due regard to appearance and architectural requirements.

Pipe supports shall carry piping neatly so that it is free to move due to expansion or contraction without undue strain and so that it does not deflect between supports.

Pipework shall be supported at intervals and not exceeding the following :

Mild Steel or Cast Iron		
Diameter	**Vertical**	**Horizontal**
15mm	2.5m	2.0m
20mm-25mm	3.0m	2.5m
32mm	3.0m	2.75m
40mm-50mm	3.5m	3.0m
80mm	4.5m	3.75m
100mm-125mm	4.5m	4.0m
150mm-200mm	4.5m	4.5m

Copper or Plastic				
Diameter	**Vertical**		**Horizontal**	
	Copper	**Plastic**	**Copper**	**Plastic**
15mm	2.0m	0.3m	1.0m	0.5m
22-28mm	2.5m	0.5m	2.0m	0.5m
34-42mm	3.0m	0.5m	2.5m	0.8m
54mm	3.0m	0.5m	2.75m	0.8m
64-108mm	3.75m	0.5m	3.0m	0.8m

In addition all vertical pipes shall be supported at not less than two points.

Additional pipe clips to half the spacing scheduled shall be provided on low level horizontal pipe runs where these might be used as foot rests.

Where swinging pipe hangers are specified or required they shall be arranged so as to move freely for the full distance necessary. The moving parts (support rod of not less than 300mm) shall be clear of the full thickness of thermal insulation (if any), the finished line of which shall be unbroken. Hemispherical washers shall be used on swinging hangers where applicable. Pipes carrying fluids of like temperature may be double hung from a single bracket. All brackets shall be selected from the B.S.S. Boss Flame O pipe support system.

The Contractor shall supply full information and details to enable provision to be made in the structure for the fitting of supports and fixings during construction.

Where standard schoolboard clips are provided they shall be fixed so as not to restrict expansion. They shall be as type Crane Limited, Fig. 501. for steel pipe.

Rigid pipe anchors shall be provided between all provisions for the relief of expansion. In each case these shall be rigidly fixed to the pipe (by welding where practicable) and bolted to the structure or other anchor bed with seating mat approved by the Contract Administrator.

All chilled water supports shall be provided with hard wood inserts between the pipe and support of the same thickness of the insulation.

4.15 CAPILLARY LINES

All capillary lines shall be neatly clipped on galvanised cable trays fixed to the wall and shall be dressed and lined up both horizontally and vertically to give a neat finished appearance.

4.16 TERMINATION OF BRANCHES ON HOT AND COLD WATER SERVICES

The Contractor shall connect up to all items of sanitary ware and kitchen equipment and include an isolation valve/gas cock at each outlet.

4.17 TERMINATION OF BRANCHES ON GAS SERVICES

Unless otherwise indicated, the Contractor shall connect up to all items of gas burning equipment, workshop bench outlets, kitchen equipment, etc.

4.18 DOMESTIC HWS CIRCULATION

The return circuit provided on the DHWS system is to be extended to a point as close as physically possible to each DHWS outlet. In each case immediately after the return ‘tee’ connector, a self-regulating valve shall be installed on the return branch.

4.19 CLEANING AND CHLORINATION

All cold water services both mains and down services including storage tanks shall be cleaned and chlorinated as required by the local Water Supply Authority before being commissioned.

Each system shall be flushed out at least twice and further as necessary until free of debris.

With all draw-off taps closed in the cistern/tank each system shall be refilled with clean water and sterilising chemical added during the filling to ensure that when full, the cistern/tank contains water having a concentration of 50mg/l of chlorine in the solution. The sterilising chemical is to be prepared strictly in accordance with the manufacturer's instructions. The supply to the cistern/tank shall then be stopped and all the draw-off taps on the distributing pipes shall be opened progressively, working away from the cistern/tank. Each tap to be closed when the water begins to smell of chlorine. The cistern/tank shall then be topped up with water and sufficient sterilising chemical added to give a concentration of 50 mg/l chlorine.

The cistern/tank and pipes shall remain charged for 24 hours, whereupon a test be made for residual chlorine. If none is found the chlorination procedure and testing shall be repeated.

Finally, the cistern/tank and pipes shall be thoroughly flushed out before any water is used for domestic purposes.

The discharge following chlorination shall be de-chlorinated via a temporary holding tank using sodium sulphite before discharging to waste.

The Contractor shall include for all necessary work and/or temporary valves, fittings, etc. to enable cleaning and chlorination procedures to be followed.

4.20 PRE-COMMISSIONING CHEMICAL CLEANING - HEATING & CHILLED WATER SYSTEMS

Upon completion of the installation of the chilled water and heating systems the entire installation should be thoroughly and efficiently cleaned by a water treatment specialist.

Prior to the commencement of the cleaning operation, the Contractor shall have ensured the following:

1) That the systems are full, vented and that all pipe runs are completed and pressure tested.

2) That all circulation pumps, manual/automatic valves, and equipment having direct effect on water flow, are fully operational and tested.

3) That adequately sized draining/flushing valves are installed at all low points throughout the systems.

4) That an adequately sized 'quick fill' has been provided not less than 1¼" B.S.P. and a water supply having a pressure of 20 psi in excess of the static head of the system shall be provided. Any pressure sensitive equipment shall be isolated before this is carried out.

5) That an adequate and accessible 'safe' drainage be available at all times close to draining and flushing points.

6) That any items of plant that may be damaged during cleaning are 'by-passed'.

No claims for additional costs related to the provision of these items will be accepted.

4.21 OBJECTIVE OF CLEANING PROGRAMME

The Contractor shall ensure that the following is achieved during cleaning:

1) All foreign material accumulated during installation is removed.

2) All grease, oil and other hydro-carbons within the systems are emulsified and removed.

3) All loose scale and corrosion products within the system are removed.

4.22 DOSING POT

The Contractor shall include in each heating system a dosing pot to be fitted across the pump suction and discharge pipes.

The dosing pot shall be of mild steel construction and shall be complete with:

- welded end caps
- air cock
- inlet and outlet valves
- filling funnel
- drain connections

4.23 SCHEDULE OF PIPE AND FITTINGS

SERVICE	LOCATION	MATERIALS	FITTING	REMARKS
Heating Mains	Internal but accessible	Black mild steel (heavy gauge)	Malleable iron. Steel butt welding	
	External and external ducts	Black mild steel (heavy gauge)	Malleable iron. Steel butt welding	Denso tape wrapping
	Inaccessible	Black mild steel (heavy gauge)	Malleable iron. Steel butt welding	Denso tape wrapping
Primary Mains	Internal but accessible	Black mild steel (heavy gauge)	Malleable iron. Steel butt welding	
	External and external ducts	Black mild steel (heavy gauge)	Malleable iron. Steel butt welding	Denso tape wrapping
	Inaccessible	Black mild steel (heavy gauge)	Malleable iron. Steel butt welding	Denso tape wrapping
	Internal	Half hard copper (light gauge)	Capillary/Compression	
Hot Water	Internal but accessible	Half hard copper (light gauge)	Capillary/Compression	
	External and external ducts	Galvanised mild steel (heavy gauge)	Galvanised malleable iron	Denso tape wrapping
Cold Water Services	Internal	Half hard copper (light gauge)	Capillary/Compression	
	External and external ducts	Half hard copper (light gauge)	Capillary/Compression	
	Internal	Galvanised mild steel heavy gauge	Galvanised malleable iron	
	External and external ducts	Galvanised mild steel heavy gauge	Galvanised malleable iron	
	External and external ducts (not above ground)	Medium Density Polyethylene	Compression/1 Fusion or butt welding	Laid in sand
	Buried underground	Medium Density Polyethylene	Compression. Fusion or butt welding	Laid in sand
Condensate from Cooling Coil Trays	All	Half hard copper (light gauge)	Capillary/Compression	

SERVICE	LOCATION	MATERIALS	FITTING	REMARKS
Gas	Internal	Half hard copper (light gauge)	Capillary/Compression	
	External and external ducts	Half hard copper (light gauge)	Capillary/Compression	
	Buried underground	Annealed copper (buried underground)	Welding compression	Denso tape wrapping
	Internal	Black mild steel (heavy gauge)	Malleable iron, subject to Supply Authority, steel butt welding	
	External and external ducts	Black mild steel (heavy gauge)	"	Denso tape wrapping
	Buried underground	Black mild steel (heavy gauge)	"	Denso tape wrapping
	External and external ducts	Polyethylene	Compression fusion or butt welding	Laid in sand
	Buried underground	Polyethylene	Compression fusion or butt welding	Laid in sand
	External and Internal	Tracpipe	Compression	In accordance with Tracpipe requirements
Boiler Cold Feeds and Vent Pipes	Internal and External	Galvanised mild steel (heavy gauge)	Galvanised malleable iron.	Denso tape on external
	Internal and External	Half hard copper (light gauge)	Capillary/Compression	

GENERAL

The gauge and/or class of each pipe and the fittings thereon shall be approved by the Supply Authority before installation is commenced.

Where Denso products are specified, the pipe shall be wrapped in the correct grade of tape, to the maker's instructions, throughout its length.

All pipes shall be chlorinated as specified and as required by the Water Supply Authority before commissioning.

"Lead shall not be used in any circumstances which would cause or be likely to cause contamination of water. All solders shall be lead free.

Capillary fittings on any pipe service shall be of the integral solder ring pattern.

SECTION 5

5 VALVES, TAPS AND COCKS

5.1 COCKS FOR TEST GAUGES

Unless otherwise agreed a ½" BSP gunmetal test gauge cock shall be provided adjacent to the pressure measuring points of all instruments and controls, and on the inlet and outlet connections of each pump, and each compressor arranged so that a 150mm diameter test gauge can be attached and read easily.

5.2 VALVES AND STOPCOCKS

These shall be provided as scheduled.

All valves and stopcocks for all services shall comply in every respect with the Regulations and Bye-Laws of the appropriate Local Authority or Public Service Company and where any fees or charges are applicable, such as for valves and stopcocks being stamped etc., the Contractor shall provide for them.

Valves shall be installed as indicated on the drawings and on the inlet and outlet connections on all appliances such as:

- Boilers
- Gas Burners
- Heat Exchangers
- Heater Batteries
- Radiators
- Natural Convectors
- Fan Convectors
- Pumps
- Calorifiers
- Automatic Valves
- Coils
- Vessels
- Tanks

Where the heating medium is water one of the valves on natural convectors and radiators shall be lockshield type.

Heat exchangers and all regulating positions shall be complete with an isolating valve on the flow and a double regulating valve complete with commissioning set on the return of the type as scheduled.

Valves up to and including 50mm bore shall have screwed ends and all valves larger than 50mm bore shall have flanged ends with flanges and drillings to the appropriate British Standard Table, except that all valves shall be flanged where mating to a flanged component and small valves in a symmetrically arranged group or where all are attached to the same header.

All screwed valves shall be followed immediately by a union and the union shall be integral with the valve, where practicable.

All non-return valves shall be of the type scheduled and shall be fitted only on horizontal pipes.

All valves other than lockshield valves shall be provided with a handwheel or handle of suitable type. Two keys or loose handles for each size and type of lockshield valve, cock, etc., incorporated shall be provided and handed to the Contract Administrator.

Plug cocks shall be installed so that the operating lever can be moved from fully open to fully closed without obstruction. In the fully open position the level shall be in line with the direction of flow.

The double regulating valves with commissioning sets shall be provided as scheduled and shall be adjusted on completion to the satisfaction of the Contract Administrator. These valves shall incorporate means of isolation such that the balancing/regulation remains unaffected whether the valves are opened or closed subsequently.

Before handing over the Works, two sets of probe and test plug assemblies shall be handed to the Contract Administrator.

Each three-port control valve assembly shall be complete with a regulating valve in the bye-pass limb.

All valve glands shall be systematically followed up, re-packed and tightened where necessary after they have been put to work, but before handing over.

Each grease lubricated valve shall be packed with lubricant of the correct grade and stick size to suit the respective use and valve. After re-packing the glands, and before handing over the Works, one box of grease cartridges of the correct grade and stick size for each service and size of grease packed valve incorporated, shall be provided and handed to the Contract Administrator.

If in any location the Contractor considers that a valve is necessary for isolating, regulating or commissioning purposes, but no such valve is indicated on the drawings, he shall immediately refer same to the Contract Administrator for instructions.

A stopcock shall be fitted on each branch serving a fitting or range of fittings of hot and cold water services.

A gas cock shall be fitted on each branch serving a fitting or range of fittings of gas services.

5.3 VALVE LABELS

Valve labels shall be provided for all main valves, except those on natural convectors and radiators.

These shall be of white laminated plastic with the valve number and service engraved with black characters 25mm high.

Each label shall be secured with a brass chain to the valve it identifies. Valves in occupied areas situated lower than 2.5m above finished floor level shall be identified with similar labels secured to the adjacent wall.

5.4 STRAINERS

These shall be provided where indicated and shall be of 'Y' type pattern with removable cage. They shall be the same diameter as the main in which they are installed. The Contractor shall ensure that strainers are fully accessible for cleaning.

5.5 THERMOSTATIC RADIATOR VALVES

These shall have a low flow temperature dependence and be as scheduled. The gland seals shall be common to all sizes of valve and replaceable without the need to turn off or drain down the system.
Where the sensor/actuator forms an integral part of the TRV the valve shall be located such that the sensor/actuator is clear of heat emitting surface, direct solar radiation and draughts from openable windows.

The sensor/actuator shall be secured to the valve body by means of a clamp employing an 'Allen' screw or a threaded clamping ring.

Remote sensors shall be provided where indicated. The temperature sensing elements shall be enclosed to prevent coating with paint during redecorating operations and the capillary lines shall be neatly run following the contours of the building and fixed at intervals in accordance with the manufacturers recommendations.

When thermostatic valves are used as isolating valves when disconnecting radiators, it is essential that caps or plugs are fitted to the valves as these may open under very cold conditions.

Where motorised valves are being provided to control the room heating systems thermostatic radiator valves shall not be provided.

5.6 COMMISSIONING STATIONS

Commissioning stations shall be installed in those locations indicated upon the Tender drawings, and at each individual fan coil unit, underfloor heating manifold and individual feeds to trench heating.

For tendering purposes all commissioning stations are to be line sized. Individual fan coil units shall be provided with 20Ø stations and IV on chilled water lines, 15Ø stations and IV on heating.

At the time of producing his installation drawings, the Contractor shall submit a numbered schedule (cross-referred to installation drawings) of commissioning stations which will be used to determine final commissioning station sizes.

5.7 HOT WATER SELF BALLANCING VALVES

Self balancing valves shall be provided on all domestic hot water return pipework connections. These shall be 15mm TA-Therm valves as manufactured by Tour and Anderson. These shall be factory set at 55^{o}C.

The furthest branch on the domestic hot water return systems shall be provided with a double check commissioning valve set at the minimum hot water circulation pump flow rate.

5.8 SCHEDULE OF VALVES

Application	Cold Water Supply	Hot Water Supply	Chilled	LTHW MTHW	Condensate	Mains Water	Fire	Air Services	Oil	Gas
Isolating Valves	A,A2,B2	A,B2	A,A1,B1	A,A1,B1	A,B1	A2,A3	A,A4,B1,S	B2,S	B2	T
Regulating/Throttling	D	D2	D,D1	D,D1	D,B3			D,D1	D,D1	
Commissioning Valves	C	C	C,C1	C,C1						
Check Valves	E	E	E,E1	E,E1		E2	E2	E3		
Strainers	F	F	F,F1	F,F1					F,F1	
Radiator Valves				G						
Thermostatic Radiator Valves				H						
Diff. Pressure Relief Valves				J						
Safety/Relief Valves	K,K1	K,K1	K,K1	K,K1				K2	K	
Double Check Valves	L									
Ball Float Valves	M									
Drains	N	N	N	N	N		N		A	
Vents	R	R	R	R		R				
3-Way Drain & Vents		P		P						
Automatic Air Vents.	U	U	U	U						

NOTES:

- Valves on Cold and Hot Water Services and Mains Water shall not contravene the requirements of the water bylaws and shall be WRc approved and listed in the "Water Fittings and Materials Directory".
- For above-ground use Gate or Ball valves are acceptable for general isolation as an alternative to BS 1010 Stopcocks provided that they are listed in the "Water Fittings and Materials Directory".
- Unlined Cast Iron valves shall not be used in copper pipe systems. Electrolytic corrosion of the cast iron will occur to a greater or lesser degree depending upon service conditions.

SCHEDULE OF VALVES

Ref.	Valve Description	Manufacturer	Size mm	Catalogue or Fig. No.	Medium	Maximum Temperature °C	Maximum Pressure Bar
A	Bronze Gate	Hepworth Hattersley Crane	15 to 50	1400X 33X D151	Water	120	20
A	Bronze Gate	Hepworth Hattersley Crane	65 to 100	1407 35PN16 DM160	Water	120	16
A1	Cast Iron Gate	Hattersley Crane	65 to 300	M541PN16 FM63	Water	120	16
A2	Brass Stop Cock		15 to 50	BS 1010	Water	65	10
A3	CI Waterworks Gate	Hattersley Crane	65 to 300	M599PN16 598PN16 FM124	Water	20	16
A4	CI Waterworks Gate for Fire Service	Hattersley	65 to 300	M597PN16 M5991NTPN16	Water	20	16
B1	Butterfly EPDM	Hattersley Crane	65 to 300	950 F621	Water	120	16
B2	Butterfly Nitrile	Hattersley Crane	65 to 300	951 F611	Air/Oil	90	16
B3	Butterfly DR EPDM	Hattersley	65 to 300	953	Water	120	16
C	Low Flow 0.01–0.023 Commissioning Set	Hattersley Crane	15	2473L D942	Water	120	20
C	Med Flow 0.23–0.05 Commissioning Set	Hattersley Crane	15	2473M D942	Water	120	20
C	Bronze Commissioning Set	Hattersley Crane	15 to 50	2432 D940	Water	120	20
C1	Cast Iron Commissioning Set	Hattersley Crane	65 to 300	M2733PN16 DM940	Water	120	16
D	0.01 – 0.05 l/s Double Regulating	Hattersley Crane	15	1473 D922	Water	120	20
D	Bronze Double Regulating	Hattersley Crane	15 to 50	1432 D920	Water	120	20
D1	Cast Iron Double Regulating	Hattersley Crane	65 to 300	733DRPN16 DM920	Water	120	16
D2	Thermostatic Self Regulating	Tour & Anderson Ltd	15 & 20	TA-Therm	Water	90	16

Ref.	Valve Description	Manufacturer	Size mm	Catalogue or Fig. No.	Medium	Maximum Temperature °C	Maximum Pressure Bar
E	Bronze Check	Hattersley Crane	15 to 50	47 D138	Water	120	25
E	A1 Bronze Check	Hattersley	65 to 200	5870	Water	120	16
E1	Cast Iron Check	Hattersley Crane	65 to 300	M651PN16 FM492	Water	120	16
E2	Cast Iron Check Nitrile Faced	Hattersley Crane	65 to 300	M3751PN16 FM469	Water	20	16
E3	Bronze Lift Check	Hattersley	15 to 50	1213	Air	90	32
F	Bronze Strainer	Hattersley Crane	15 to 50	807 D297	Water	120	32
G	Radiator Wheel Angle	Hattersley Crane	15 to 25	2386 D880CP	Water	120	10
G	Radiator Lockshield Angle	Hattersley Crane	15 to 25	2386LS D881CP	Water	120	10
G	Radiator Wheel Straight	Hattersley Crane	15 to 25	2407 D890CP	Water	120	10
G	Radiator Lockshield Straight	Hattersley Crane	15 to 25	2407LS D881CP	Water	120	10
H	Thermostatic Radiator Angle	Hattersley Danfoss Drayton	15 & 20	2086 RAVL-S TRV4	Water	120	10
H	Thermostatic Radiator Straight	Hattersley Danfoss Drayton	15 & 20	2087 RAVL-S TRV4	Water	120	10
J	Differential Pressure Relief	Hattersley	20 to 32	302	Water	120	10
K	Safety Vented Systems	Hattersley NABIC	15 to 50 15 to 80	D0320 542	Water	140 195	12.5 10.5
K1	Safety Unvented Systems	NABIC	15 to 80	500	Water	195	10.5
L	Double Check	Hattersley	15 to 25 32 to 50	249C 249	Water	65	10
M	Ball Float	Hattersley	25 to 50 65 to 160	340 337	Water	38	10
N	Drain – Taps	Hepworth Crane	15 to 25	371 D340	Water	120	10
N	Drain – Gland Cocks	Hattersley Crane	15 to 50	81HU D344 1/2	Water	120	10

Ref.	Valve Description	Manufacturer	Size mm	Catalogue or Fig. No.	Medium	Maximum Temperature °C	Maximum Pressure Bar
P	3-Way Vent	Hattersley NABIC	25 to 50 20 to 65	110 503	Water	120	14
P	3-Way Lub. Plug	Hattersley	65 to 200	201TQPN16	Water	120	16
R	Bronze Vent Cock	Hattersley	6	425	Water	120	13
R	Bronze Needle	Hattersley	6 to 15	5NLS	Water	120	32
S	Globe Nitrile Faced	Hattersley Crane	15 to 50	13M75E D15	Air	90	32
T	Ball	Hattersley Crane	15 to 50	100 D191	Gas	20	7
T	Lubricated Plug	Hattersley	15 to 50 65 to 200	200M 201MPN16	Gas	20	7
T	Gas – Gate	Hattersley	80 to 300	M519PN16	Gas	20	7
U	Automatic Air Elmininator	Charles Winn	15	Type B Type MPHW	Water	93 149	7 7

5.9 SCHEDULE OF COMPRESSION END VALVES

Ref.	Valve Description	Manufacturer	Size mm	Catalogue or Fig. No.	Medium	Maximum Temperature °C	Maximum Pressure Bar
A	DZR Gate	Hattersley Crane	15 to 50	30C D155C	Water	120	5
A	Ball	Hattersley Crane	15 to 50	100C D191	Water	120	5
A2	Brass Stop cock		15 to 50	BS 1010	Water	65	10
C	Low Flow 0.01 – 0.023 Commissioning Set	Hattersley Crane	15	2473LC D942	Water	120	5
C	Med Flow 0.23 – 0.05 Commissioning Set	Hattersley Crane	15	2473MC D942	Water	120	5
C	Bronze Commissioning Set	Hattersley Crane	15	2432C D940	Water	120	5
D	0.01 – 0.05 l/s Double Regulating	Hattersley Crane	15	1473C D922	Water	120	5
D	Bronze Double Regulating	Hattersley Crane	15	1432C D920	Water	120	5
F	Bronze Strainer	Hattersley	15	807C	Water	120	5
T	Ball	Hattersley Crane	15 to 50	100C D191	Water	120	5

SCHEDULE OF VAVLES CONTD.

NOTES

Lockshield valves shall be used for isolation where specified on the drawings.

Commissioning sets shall be installed on the return with upstream and downstream lengths of straight pipe as specified by the manufacturer.

RADIATOR VALVES

The finish of the body and the colour of the lockshield dome shall, where relevant, match that of the radiator valve.

The inlet pipe connection for sizes 15 and 22mm shall be dual-ended, suitable for a threaded or compression joint.

Thermostatic valves MUST be installed on the flow (inlet to the radiator) to prevent noise.

Thermostatic radiator valves should be installed in vertical rise to top radiator connection.

5.10 SCHEDULE OF COMMISSIONING STATIONS

Ref.	Service	Pipe Dia (mm)	Flow Rate (l/s)	M.S. Signal (kPa)	Recommended Valve Size (mm)	Hattersley Fig. No.
CS01	Primary HTG	67	2.298	3.008	54	-
CS02	Primary HWS	35	0.716	2.827	35	-
CS03	Pool Plant	42	0.793	1.533	42	-
CS04	Secondary HTG	42	0.789	1.517	42	-
CS05	Basement MVHR	22	0.057	1.115	15	-
CS06	Basement HTG	22	0.096	3.164	15	-
CS07	Ground Fl. HTG	28	0.302	2.124	28	-
CS08	First Fl. HTG	22	0.194	2.790	22	-
CS09	Second Fl. HTG	22	0.131	1.272	22	-

SECTION 6

6 BOILERS AND ASSOCIATED PLANT

6.1 GAS FIRED MODULAR BOILERS

Two number Vaillant ecoTEC 100 wall hung natural gas condensing boilers shall be provided in the second floor boiler room, as manufactured by Vaillant. New specialist cascade flue system shall be provided to serve both boilers, routed to discharge through existing chimney terminating above roof with a proprietary flue terminal, in accordance with the manufacturer's installation instructions.

The gas fired boiler package shall consist of boilers, manifold kit with all valves, controls, boiler primary pumps, pressurisation unit, low loss header and cascade controller and shall be provided by the boiler manufacturer.

The boiler mounting frame shall include flow & return manifolds, boiler interconnecting pipes (flow & return), pipework insulation, gas manifold & boiler connection pipe, gaskets, fixing bolts & drain cock, floor standing low loss header, condensate, safety valve drainage pipework and cascade flue system incorporating motorised non return valve kits for each boiler.

The ecoTEC 80-120 boiler pump kit, including modulating pump, insulation and isolation valve insulation shall be matched to the boilers and shall be of the single head type. These pumps shall be selected and provided by the boiler manufacturer as part of the boiler package.

The operation of each boiler shall be controlled by the dedicated control panel.

The pressurisation unit shall be a Spirotech SpiroPress Fill MR0650 with two 150 litre vertical expansion vessels or equal and approved.

The dirt and air separator shall be model CX50C-RE manufactured by Dutypoint and dosing pot shall be model DP5 capacity 5 Litres manufactured by Dutypoint.

6.2 FLUE SYSTEMS

The system shall be manufactured to BS 4543

The system shall be a combined cascade system manufactured to BS 4543 and shall be designed, manufactured, supplied and installed by A1 Flue Systems (contact: Philip Beal 07808 205362) or equal and approved in full accordance with Vaillant recommendations.

The system shall be designed for a maximum operating temperature of 450^{o}C (negative pressure), 200^{o}C (positive pressure)

The system shall be manufactured and installed in accordance with ISO 9001:2000 quality system.

The flue system installer shall provide a condensate discharge from the flue low point to terminate at low level via a Salamander Condensafe and Hepworth Waterless trap.

The flue system installer shall carry out a leakage test of the flue prior to the boilers being operated and provide a certificate of air tightness to the Contract Administrator. A draught test shall be carried out by the flue system installer on each of the boilers to confirm the correct pressure across the burner and adjust the draught stabiliser as required. A test certificate for the completed tested installation shall be issued to the Contract Administrator.

The boiler flue shall terminate through existing chimney with an appropriate terminal arrangement to be agreed with and approved by the Architect.

6.3 CARBON MONOXIDE DETECTORS

Wall mounted carbon monoxide detectors shall be provided in the boiler room and all rooms containing an operational solid fuel fireplace.

Detectors to be Murco Gas Detector (MGD) as manufactured by Murco Ltd, 114a Georges St Lower, Dun Laoghaire, Co Dublin tel: + 353 1 284 63 88.

Detectors to be provided with Exd Remote Head / IP66. Sensors must be located within the appropriate wire lengths from the central control unit and mounted behind a decorative faceplate (standard: brushed stainless steel to fit a 44mm double gang back box).

Each sensor is to be monitored by the control panel for fault.

Plastic blanking plates are to be fitted to all sensor heads until handover.

SECTION 7

7 VRF COOLING SYSTEMS

7.1 GENERAL

One new VRF heat pump type cooling systems are to be provided by the Contractor as shown on the drawings.

The Contractor is to allow to produce proposed installation drawings of all such pipework, refnet joints etc. for the Contract Administrator's comment. Subsequent to receipt of such comments, the Contractor is to amend his installation drawings prior to commencing the works.

The Contractor is to provide all wiring (power and control), control panels, interface panels, insulation, diffusers necessary to delivery fully operational systems.

7.2 ROOM UNITS

The majority of room units are to be incorporated into architectural room consoles, or concealed above in ceiling voids. The room unit schedule indicates a reference to an arrangement type, which is to apply to each application. The Tender drawings are inclusive of a series of arrangement type drawings, providing particulars of the proposed arrangements, which vary according to both type and size of VRF unit concerned. The Contractor will be deemed to have included for all ductwork, acoustic linings, etc. to comply with the requirements of the 'type' drawings. In all cases intake and discharge ductwork is to be internally lined with acoustic insulation as specified in the Attenuation Section of the Works.

7.3 CONDENSER UNITS

If required (subject to confirmation by acoustic engineer) a closely designed attenuation package is to be provided as part of the main external condenser arrangement. The Contractor is to include for all necessary liaison between suppliers to ensure complete compatibility of both sets of equipment.

The Contractor is to provide large scale builders' work drawings, drawn subsequent to taking all necessary on-site dimensions, indicating the exact arrangement, fixing details, etc. required.

7.4 ELECTRICAL SUPPLIES AND CONTROLS

Others are to provide suitably sized, isolated power supplies to all condenser unit locations and adjacent to each fan coil unit. To this end the Contractor is to fully liaise with the relevant parties to ensure complete compatibility. From these points, the Contractor is to carry out all necessary power and controls wiring to facilitate fully functional automatic systems. All such wiring is to be in strict accordance with the manufacturer's recommendations and wiring schematics, supplied specifically for the project.

An Interface shall be provided for each fan coil unit, concealed in an accessible location in the void housing the unit. Room units are to be provided with a local controller however are to be operated via the central control system.

7.5 REFRIGERANT PIPEWORK

All refrigerant pipelines shall be installed in complete compliance with the manufacturer's refrigerant pipework schematics, produced exclusively for this project.

Degreased copper tube shall be used for all liquid and vapour refrigerant pipework lines, complying with BS 2871, Part 2, either in soft coiled sections, or half hard straight lengths. All such tube is to be deoxidised with ends fitting with rubber caps, which are to be kept in place as temporary seals during installation.

The complete installation is to comply with BS 4434, covering design, construction and installation of refrigerant systems.

Soft soldered joints are not to be used, all non-detachable joints being brazed using a low temperature copper phosphorous filler complying to BS 1845. During all brazing processes the system is to be purged with nitrogen to prevent the formation of oxides upon the inner pipework surfaces.

Where detachable joints are used, flanges (to BS 4504), or non-manipulative compression fittings are to be employed.

Upon completion the system is to be pressure tested using an inert gas to pressurise the system. The test pressure being not less than 1.2 times the maximum working pressure, the test remaining for a period of not less than 12 hours.

All external and riser insulation pipework is to be supported on suitably sized galvanised trays. These being sized to accommodate a single bank of pipelines, all of which being clipped to the tray.

7.6 REFRIGERANT/CONDENSATE INSULATION

All refrigerant lines shall be insulated with refrigerant grade Class 'O' Armaflex insulation. All such insulation shall be installed in compliance with the manufacturer's recommendations. All joints are to be glued closed, with the seams left on the visible side. Where the installation is found not to be in complete compliance with the manufacturer's recommended installation procedures, all such sections are to be replaced at the Contractor's cost.

All internal condensate drain lines are to be routed in Table X copper, and insulated with Class 'O' Armaflex throughout their entire routes.

All external sections of Armaflex insulation are to be painted with two coats of solar U-V protective paint, as supplied by the insulation manufacturer.

7.7 VRF CASSETTE CONDENSATE LINES

All room cassettes are to be provided with insulated condensate discharge drainage lines. Each line shall be connected into the foul drainage system, incorporating a waterless trap prior to final connection. Condensate drainage lines shall be installed to a continuous fall away from each cassette to drain (min. gradient 1:100), and of minimum line size 22Ø. All condensate lines to be routed in copper, Table X, fully insulated through the entire routes in Class 'O' Armaflex. At all changes of direction the condensate lines are to incorporate line sized capped "rodding tees" - the provision of such sufficient that the whole drain line may be rodded clear via this provision.

Where it is not possible to discharge the condensate via gravity a condensate lift pump type PCR-3, supplied with associated reservoir and float switch, all from Little Giant Pump Co. Ltd shall operate in conjunction with the units. In addition, an overflow switch shall be supplied, which shall be wired such that in the event of pump failure, the cooling unit shall be isolated.

7.8 REFRIGERANT GAS ALARM SYSTEMS

All bedrooms and wardrobe/dressing rooms provided with comfort cooling are to be provided with an automatic refrigerant leak detection sensor / sounder. The leak

detector is to be generally mounted within the architectural enclosure, or ceiling void in which the room unit is to be accommodated. All such sensors are to be linked to a central control panel, providing centralised indication of individual alarm points, test, mute and reset buttons and a detailed 'system map' or key.

The system shall be as supplied by J.A.M. Ltd., Tel: 01702 602333, with all interconnecting wiring carried out to the recommendations of the same.

A complete system shall be provided consisting of:

- One model EM – 8/20S central panel with volt-free contacts for remote alarm monitoring.

- One model RG-XX/12 refrigerant detector per fan coil unit, modified to incorporate a sounder/mute button.

Upon completion of the installation the Contractor is to arrange for the manufacturer to independently commission and test each system.

7.9 COMMISSIONING AND RECORD DOCUMENTATION

Each system is to be fully demonstrated in isolation from the central controls system. This exercise being carried out upon the main contract works reaching a suitable stage in completion, i.e. clean and sealed areas.

The Contractor is advised that great importance will be placed upon the clarity and accuracy of the record documents, which are to be produced as part of the Contract. To this end the Contractor is to include for recording the routes of pipework and locations of all components prior to the Main Contract Works progressing, (i.e. floors concealing installed/tested/insulated pipework). The Contract Administrator will request site of these marked up documents, which are to be held on site, during the progress of the Contract. The Contractor is advised that until such time that a complete and adequate set of such document is in the possession of the Contract Administrator, the systems will not be considered practically complete.

7.10 CONDENSER SCHEDULE

COOLING SYSTEM		
Condenser Reference		VRV-01
System		-
Refrigerant		R410A
Design Ambient Air Temperature	°C	30
Noise sensitivity		Acute
MODEL DATA - DAIKIN		
Model No.		RXYSQ10TY1
Cooling Capacity	kW	28.0
OVERALL UNIT DATA		
Depth	mm	460
Width	mm	940
Height	mm	1615
Approx. Operating Weight	kg	175
ELECTRICAL		
Power supply	Phase/Hz/V	3/50/380~415
Nominal running current	amps	10.7
Starting Current	amps	4
NOISE DATA		
Sound Pressure Level	dBA	55
Sound Power Level	dBA	74

7.11 FAN COIL SCHEDULE

FCU Ref.	Room	Output (kW, nom.)	Arrangement	Dimensions WxHxD (mm)	Model	Manufacturer	Condenser
FCU-B.01	Multipurpose Room	4.5	Horizontal	200 x 950 x 620	FXDQ40A	Daikin	1
FCU-G.01	Living Room	5.6	Vertical	950 x 620 x 200	FXNQ50A	Daikin	1
FCU-G.02	Living Room	5.6	Vertical	950 x 620 x 200	FXNQ50A	Daikin	1
~~FCU-G.03~~	~~Dining Room~~	~~4.5~~	~~Vertical~~	~~950 x 620 x 200~~	~~FXNQ40A~~	~~Daikin~~	~~1~~
FCU-F.01	Master Bedroom	4.5	Horizontal	200 x 950 x 620	FXDQ40A	Daikin	1
FCU-S.01	Bedroom 6	3.6	Horizontal	200 x 750 x 620	FXDQ32A	Daikin	1
FCU-S.02	Living Room 2	5.6	Horizontal	200 x 950 x 620	FXDQ50A	Daikin	1
FCU-S.03	Bedroom 5	3.6	Horizontal	200 x 750 x 620	FXDQ32A	Daikin	1

Manufacturer: Daikin

SECTION 8

8 PUMPS

8.1 GENERAL

These shall be provided as scheduled.

Each pump shall be complete with an air cock and drain cock, unless otherwise specified.

All pumps having an electric motor with an output of 750W or more shall be tested at Works, to the specified duties, and a Certificate forwarded, in duplicate, to the Contract Administrator for approval before installation.

Duplicate pump sets shall be fitted with automatic changeover equipment as scheduled, complete with non-return valves. The changeover shall be indicated by means of a lamp at the main control panel.

Pump starters shall be mounted as scheduled with separate isolators adjacent to the pump powered from the Mechanical control panels.

8.2 CIRCULATING PUMPS

Floor mounted circulating sets shall be properly levelled, bolted down and grouted-in, on a brick or concrete base of 300mm minimum height. The Contractor shall be responsible for providing all dimensions and details to enable the bases to be set out. Anti-vibration mountings and flexible connections shall be provided. The Contractor shall ensure that the complete unit is efficiently balanced to eliminate noise and vibration. Belts, where fitted, shall be correctly aligned and tensioned.

An altitude gauge shall be connected to the main on each side of the circulator. On duplicate pump sets the gauges shall be connected to the common suction and delivery mains. Wherever possible the gauges shall be wall mounted on a hardwood block and at the same horizontal level. The gauges shall have flanged backs.

8.3 PRESSURE TESTS

The Contractor shall provide to the Contract Administrator detailed pressure drops through all proposed main items of equipment so that the final pump heads may be calculated, taking into account any changes in the pipe systems, before the pumps and their motors are ordered.

After the Contract Administrator has re-assessed the head pressures, the Contractor shall provide to the Contract Administrator a copy of the manufacturer's characteristic performance to be expected in relation to the calculated resistance of the various circuits. If the examination of this data indicates that any pump is likely to have a stalling or inefficient point close to the system operating point, then the Contract Administrator may require the Contractor and equipment manufacturer to re-select the pump and the cost of such a change shall be agreed with the Contract Administrator before implementation.

8.4 COLD WATER BOOSTER SET

This shall be as manufactured by Dutypoint Ltd, Shepherd Road, Gloucester, GL2 5EL (01452) 300592.

Plant Details:

Aquamatic range:	SCUBATANK DOUBLE
	60 litre hydraulic accumulator
	Set of flexible connections
	Set of anti-vibration mountings
	BMS Volt-free package
	2 quiet running, multistage, high efficiency pumps
	Control Panel

System Parameters:

Fluid Type:	Clean cold water at 15ºC
Suction Condition:	Flooded to nominal 0.15 bar
Pump Pressure:	4.5 bar
Duty Point Pressure:	4.5 bar
Duty Point Flow Rate:	2.6 l/s
Maximum Pressure:	6.9 bar (closed valve)
Capacity under above conditions:	
Duty pump:	1.3 l/s
Support pump:	1.3 l/s

Electrical Data:

Supply:	230 Volts 1phase, 50 Hz
Method of starting:	Variable Speed
Control voltage:	24 Volt AC
Total pumpset loading:	3.0 kW
Full load current of pumpset:	12.6 Amps

Control Panel

Automatic variable speed motor controlled by

- Packaged control panel;
- Pressure measurement transducer;
- Automatic alternation of all pumps;
- Adjustable pump run-on timer;
- Sequential pump starting;
- Hand/off/auto switches for each pump;
- Motor overload protection;
- Electronic low water protection;
- Interlocked door isolator;
- Re-Press Power restoration protection.
- RS 232/485 serial communication port;
- Data logging function, indicators for pumps run, hand/off/auto.
- Facia mounted keyboard for entering/retrieving data and system parameters.
- Illuminated 2 line LCD display for pressure, faults and information including: Power On, System Working Pressure, System Status, Low System Pressure, High System Pressure, Pump Hours Run; Pump Failed, Transducer Failed and Service Reminder;
- All enclosed in a sheet steel housing with lockable doors to IP54.

Break Tank

The ScubaTANK tank will be a GRP pre-insulated type with reinforced base, screened vent, overflow and warning pipe, all in accordance with the Water Regulations Advisory Scheme (WRAS). The capacity of the storage cistern to be – 1650 litres.

Actual Capacity:	1650 litres
Size:	1160 x 1500 x 1500

8.5 SCHEDULE OF PUMPS

PUMP NO.	SYSTEM	TYPE	MAX. W TEMP. °C	DUTY		PUMP SPEED RPM	POWER INPUT (W)	PHASE	PUMP WEIGHT (KG)	PUMP CONNS		REMARKS
				kg/s	kPa					Suct.	Del.	
P1	Primary HTG	MAGNA3 D 65-40F	90	2.298	12.1	1347	55	1	-	-	-	-
P2	Primary HWS	MAGNA3 D 32-40F	90	0.716	9.8	1551	18	1	-	-	-	-
P3	Pool Plant	MAGNA3 D 32-60F	90	0.793	21.2	2148	35	1	-	-	-	-
P4	Secondary HTG	MAGNA3 D 32-40F	90	0.789	15.4	1884	27	1	-	-	-	-
P5	HW Return	UPS 25-55 N 180	70	0.266	23.14	-	59	1	-	-	-	-

As manufactured by Grundfos Pumps Ltd Tel:- 01525 850000

SECTION 9

9 SPACE HEATING

9.1 RADIATORS

All radiators shall be provided free from rust or other corrosion and painted one coat of priming paint.

The heating surface for each individual radiator list in the schedule shall be regarded as a minimum.

All radiators shall be fitted with air vents of the flush pattern. Connections shall, where practicable, be B.B.O.E.

The Contractor shall be responsible for the safe transport, storage and handling on site and shall agree with the Main Contractor a time delivery programme for the radiators so that they are manufactured and delivered in the order necessary to arrive on site for each location to suit the progress of the Main Contract.

Radiators are to be exposed as indicated on the drawings. Refer to Architect layouts for details.

All radiator pipework to exposed uncased radiators shall rise up from the floor in a chasing in the wall to connect to the radiator.

9.1.1 Steel Type

These shall be as scheduled and shall be complete with concealed type supports welded on the back of the radiator and arranged to take up expansion.

9.1.2 Cast Iron Type

These shall be as scheduled. They shall be provided free from sand.

They shall be adequately supported on the manufacturer's standard type brackets without feet, supported, subject to suitability of structure, by built-in cantilever brackets fitted under the bottom hub of the radiator. With this arrangement on radiators up to 20 sections, two cantilever brackets and one retaining stop stay shall be fitted. On radiators over 20 sections three cantilever brackets and two top stays shall be fitted.

9.2 WET UNDERFLOOR HEATING SYSTEM

9.2.1 General

All areas indicated in mechanical drawings as UFH zone are to be provided with underfloor heating, which other than in rooms such as bathrooms/shower rooms, is to be of the “wet” type. Underfloor heating manifolds to be located as per mechanical layouts, subject to final detailed arrangement by Architect/Interior Designer.

The final design, production of installation drawings, installation and commissioning of the wet underfloor heating systems shall be undertaken by the Underfloor Heating System Manufacturer. This inclusive of a site survey prior to the production of his detailed installation drawings. These drawings shall be submitted to the Contract Administrator for comment, subsequent to the receipt of which, the manufacturer is to revise his drawings and re-submit.

The contractor shall select the following underfloor heating specialist to carry out the design, installation and commissioning of the systems as specified herein or equally submit an alternative specialist as required for approval.

Underfloor Heating Manufacturer/s:

To provide a suitable floor system designed & supplied for the suitability of the floor construction and available build-up height. Provision of installation to be via the manufacturers own network of registered installers or via a third party contractor as required

Nu-Heat UK Ltd, Heathpark House, Devonshire Road, Heathpark Industrial Estate, Honiton, Devon EX14 1SD Tel: 01404 549770

System option: **SC14** - Cliptrack system including 14mm fastflo tubing and edge expansion strip to be used with either traditional (65mm) or liquid screeds (40-50mm)

9.2.1 Manifold Cabinets

All manifolds are to be installed within purpose-made manifold cabinets as supplied by the Underfloor Heating Manufacturer. Cabinets are to be of the 'built in' type, provided with lockable doors, and individually sized to suit each manifold application. Cabinets shall be stove enamelled finish, and come complete with wall fixings and feet such that each cabinet is mounted no less than 200mm above finished floor level. A front removable 'skirting' length of cabinet shall be provided to conceal the incoming 'primary' heating mains and commissioning set.

9.2.2 Underfloor Distribution Pipework

All underfloor distribution pipework (downstream of manifolds) shall be of "PEX" multi-layered type incorporating an aluminium layer acting as an anti-oxygen barrier with a minimum material warranty of 50 years.

Connections to manifolds shall be made with purpose designed adapter connectors.

9.2.3 Screeded Floor Systems

The floor is to be formed of solid concrete "screed" floors. Insulation shall be provided on top of the concrete floor (XPS type recommended with 70mm minimum for ground floors and 30mm minimum for upper floors) with the underfloor heating pipework anchors as recommended/supplied accordingly by the Underfloor Heating Supplier. Prior to proceeding to screed the floors, all circuits are to be pressure tested (6 bar minimum) as stated herein.

9.3 Pressure Tests

Prior to screeding/boarding over any part of an underfloor heating system, the completed system must have been subject to a one hour (witnessed) 6 bar pressure test. These shall be witnessed by the Contract Administrator, who will inspect the whole system prior to covering. A sign-off process shall be adopted by the Contractor, documenting the progress of each floor system. Filtered water shall be used to carry out the pressure test, with the Contractor ensuring that all circuits are fully bled.

All systems shall be left at test pressure throughout the "covering" process. Should there be a risk of frost then the Contractor shall either provide temporary means of heating the areas at risk, or include anti-freeze in the initial test pressure fill volume. Should he adopt the latter, the systems must be fully flushed at least three times prior to connecting to primary heating supplies.

A fully signed and witnessed pressure test certificate is required for each floor.

9.4 COMMISSIONING 'WET' SYSTEMS

All manifold systems are to be fully commissioned prior to the delivery of heat from the central plant. All manifolds are to be commissioned in full accordance with the manufacturer's recommendations, this including subsequent (to initial commissioning) heat commissioning and a final balancing procedure. All such procedures in accordance with both the manufacturer's recommendations and BS EN 1264-2.

A fully documented and signed certificate of commissioning is required for system.

9.5 SCHEDULE OF RADIATORS / TRENCH HEATERS

Radiator Reference	Room Name	Length (mm)	Height (mm)	Depth (mm)	Output (Watts)	Model	Cased
RAD-G.01	Family Room	900	660	175	1395	MHS Ionic 60/4	No
RAD-G.02	Family Room	900	660	175	1395	MHS Ionic 60/4	No
RAD-G.03	Study	900	660	175	1395	MHS Ionic 60/4	No
RAD-G.04	Study	900	660	175	1395	MHS Ionic 60/4	No
RAD-G.05	Entrance Hallway	1260	660	175	1953	MHS Ionic 60/4	No
RAD-G.06	Kitchen Corridor	540	502	65	440	Multisec 2 Col.	No
RAD-G.07	Kitchen	1305	1202	139	4315	Multisec 4 Col.	No
RAD-G.08	Living Room	1020	960	175	2358	MHS Ionic 90/4	No
RAD-G.09	Living Room	1440	960	175	3329	MHS Ionic 90/4	No
RAD-G.10	Living Room	1440	960	175	3329	MHS Ionic 90/4	No
RAD-G.11	Side Corridor	320	1400	43	640	MHS Monoplan Vertical EK(11)	No
~~TH-G.01~~	~~Dining Room~~	~~3000~~	~~190~~	~~170~~	~~880~~	~~Zhender Terraline~~	~~N/A~~
~~TH-G.02~~	~~Dining Room~~	~~2800~~	~~190~~	~~170~~	~~815~~	~~Zhender Terraline~~	~~N/A~~
RAD-F.01	Bedroom 3	900	660	252	1995	MHS Ionic 60/6	No
RAD-F.02	Bedroom 3	900	660	252	1995	MHS Ionic 60/6	No
RAD-F.03	Bedroom 2	900	660	252	1995	MHS Ionic 60/6	No
RAD-F.04	Bedroom 2	900	660	252	1995	MHS Ionic 60/6	No
RAD-F.05	1F Hallway	1680	660	175	2604	MHS Ionic 60/4	No
RAD-F.06	Master Bedroom	2160	660	175	3348	MHS Ionic 60/4	No
RAD-F.07	Bedroom 1	2160	660	175	3348	MHS Ionic 60/4	No
RAD-S.01	Bedroom 6	1200	660	252	2660	MHS Ionic 60/6	No
~~RAD-S.02~~	~~Bedroom 5~~	~~540~~	~~660~~	~~175~~	~~837~~	~~MHS Ionic 60/4~~	~~No~~
RAD-S.03	Bedroom 5	1560	660	252	3458	MHS Ionic 60/6	No
RAD-S.04	2F Hallway	720	660	252	1596	MHS Ionic 60/6	No
RAD-S.05	Living Room 2	2400	660	252	5320	MHS Ionic 60/6	No

Manufacturer: MHS Radiators Limited or Zhender

Radiators to be provided with welded supports and angle valves.

Finishes and valves to be confirmed with Contract Administrator prior to ordering.

All radiators to be provided with Control T Electrothermic heads. These are to replace TRV heads on every radiator. All radiator valves to be agreed with Contract Administrator prior to ordering.

Colour to be confirmed with Contract Administrator before order is placed.

9.6 SCHEDULE OF UNDERFLOOR HEATING

Manifold Ref. & Zone	Area Served	Area (m²)	Room Temp (°C)	Heat Loss (kW)	Output from UFH (kW)	Flow Rate in UFH Cir. (l/s)	Number of Circuits	Control
UFH-M01								
M01/01	Poolside Gallery / Gym / Media Room	51.7	23	4.5				
M01/02	Treatment Room	6.7	24	0.5				
M01/03	Changing Room	5.9	24	0.5				
M01/04	Wet Room / Jet Shower	19.8	-	2.0				
UFH-M02								
M02/01	Utility Room	10.1	20	0.8				
M02/02	Kitchen	37.0	20	4.7				
UFH-M03								
~~M03/01~~	~~Dining Room~~	~~14.5~~	~~23~~	~~3.6~~				
Electric UFH - Refer to tender drawings and specification								

Table to be completed by underfloor heating supplier to confirm outputs, circuits and flow rates.

SECTION 10

10 NATURAL GAS

10.1 GENERAL DESCRIPTION

A new incoming gas supply shall be provided by National Grid with a new gas meter supplied as part of mechanical works.

The gas shall be ventilated along its route in accordance with the Gas Safe regulations, via the use of Tracpipe Gas cocks shall be provided at each appliance.

A main solenoid valve installed immediately after the gas meter, another solenoid valve in boiler room and a gas proving safety system provided linked to the fire alarm system and control panel to shut the valve if any of the main safety systems are operated as described in the controls section.

Unless otherwise indicated, the Contractor shall connect all items of gas burning equipment, etc. Each appliance shall be provided with an accessible gas cock.

On completion of the gas work the Gas Safe registered gas installer shall issue the following completed test certificates to the Contract Administrator:

- Gas Safety Certificate (CP1 and CP12).

SECTION 11

11 DUCTWORK AND FITTINGS

11.1 GENERAL

Ductwork and fittings shall be in accordance with the recommendations of H.V.C.A. publication DW/144, Specification for Sheet Metal Ductwork - Low and High Velocity/Pressure Air Systems and DW/151 uPVC ductwork.

Where possible ductwork shall be to the recommended H.V.C.A. sizes as indicated on the drawings.

Flexible ducting shall not generally be used. Where deemed necessary by the Engineer, flexible ducting shall be as short as possible and shall be as manufactured by Flexible Ducting Limited and shall be their "Thermaflex Range" type.

On circular ducts, all bends and offsets shall have a throat radius equal to one width of the duct, except flexible ducting where the manufacturer's recommendations shall not be exceeded.

All branches, except those on extract systems, shall enter or leave the main duct at an angle of not more than 45° to the axis of the main duct.

Control dampers for regulation shall be fitted on all duct branches. The setting of the damper blade shall clearly be indicated on an external face of the duct and the type and exact position of each damper shall be submitted to the Contract Administrator for agreement before manufacture is commenced.

Test holes shall be provided on the downstream and upstream side of each fan, heater battery, filter, control damper, the fresh air duct and re-circulation air duct. The position of these holes shall be indicated by the Contractor on the manufacturing drawings for examination and approval by the Contract Administrator.

All ductwork shall be made to site dimensions taken by the Contractor. In the course of this measuring, should the Contractor observe any impediment, barrier, and the like which may necessitate alteration to the original design layout, he shall agree any modifications with the Contract Administrator BEFORE commencing manufacture.

The mounting height clearances and tolerances as indicated shall be strictly adhered to and the Contractor shall agree any proposed encroachment with the Contract Administrator before commencing manufacture. In fitting canvas or other flexible connections the jointing shall be sufficiently strong and so secured as to prevent any reduction in the cross-sectional area for air flow.

Any material proposed to the Contract Administrator shall be to BS 476, Class 1, flame spread classification and shall not be used until the Local Fire Officer's agreement has been obtained by the Contractor.

All flanges and stiffeners shall be manufactured from galvanised iron sections.

All edges cut in works or on site on internal ducts, flanges, supports, stiffeners, etc. shall be painted with zinc rich paint.

Where ducts pass through the roof they shall be properly weathered and fitted with flashing plate sleeve and cravat of a design submitted to the Contract Administrator for approval before manufacture is commenced.

The sizes of all angle rings and frames to mate to all plant items shall be the same as are supplied by the manufacturer of the equipment concerned.

All ducting shall be securely supported and rigidly stiffened to prevent drumming and distortion. All ducting shall be manufactured to the internal dimensions shown on the drawings, true in section, and care shall be taken to ensure that it is not twisted or otherwise damaged.

11.2 KITCHEN VENTILATION DUCTWORK

All kitchen ventilation systems shall be installed in accordance with HVCA Specification DW/172.

All ductwork shall be low pressure Class A and be in accordance with HVCA Specification DW/144 with a minimum thickness of 0.8mm. Branch connections from kitchen hoods shall be flush on the underside.

Ductwork outside of the kitchen area shall be fire rated and shall comply with BS 3476 part 24 and BS 5588 part 9.

Access doors shall be provided at a maximum of 3m spacing to allow cleaning. Access panels shall be of the same thickness as the ductwork, be grease tight using a heat proof gasket and contain minimum projections into the duct. This shall be in accordance with HVCA publication TR/19.

11.3 FLAT DUCTWORK

Flat ducting and components shall be suitable for working temperatures -20ºC to 60ºC.

All components shall be made of flame retardant polypropylene. External air bricks shall be made from U.V. stabilised high impact polystyrene. Flame-retardant material shall conform to DIN41092 B1 and UL94 V2.

Flat ducts passing though fire barriers shall be provided with intumescent wraps suitable for use with the flat channel ducting system. In the event of a fire the wrap shall expand to crush the ventilation duct, sealing it against the fire. Wraps shall give 2 hours protection preventing the passage of smoke and gases and shall be tested to BS476 Parts 20 and 22. A plastic casing surround shall be provided to protect the internal intumescent felt strips. Wrap shall activate between 180-200ºC.

11.4 WIRE MESH GUARDS

All inlet and extract louvres and cowls, whether provided by the Contractor or not, shall be fitted with wire mesh bird guards, to be supplied and fixed by the Contractor. The bird guards shall be 20mm mesh extended over the whole internal face of the opening and be manufactured from 2.00mm galvanised wire adequately supported and stiffened.

11.5 FIRE DAMPERS

Where ducts pass through floor and walls etc., intumescent fire dampers shall be provided as indicated on the drawings, giving a fire resistance of 0.5 hours.
These shall be to the sizes and details given on the drawings. The Contractor shall obtain the approval of the Local Fire Officer to the manufacturing details of the fire dampers and the dampers shall be tested in accordance with BS 476.

Fire dampers for galvanised ductwork shall be Lorient LVH54 high performance intumescent dampers, complying with BS ISO 10294 Part 5. Dampers shall be manufactured using a zintec steel frame and stainless steel slat covering and graphite-based intumescent material. Dampers shall be sized to provide an equivalent free area as the containing duct size. The Contractor shall include the required ductwork enlargements and reductions to connect onto the larger fire dampers.

Fire dampers for plastic ductwork shall be intumescent dampers.

Fire dampers shall not be fitted in Kitchen Extract Ducts. The kitchen extract duct shall be run in fire rated ductwork from the kitchen to the roof to give a fire resistance of 2 hours.

11.6 ANTI-VIBRATION PACKINGS

Anti-vibration packings must be inserted at every support so as to prevent the transmission of vibration to the structure.

The loading on the packing shall not exceed 82 kN/m².

11.7 MULTILEAF DAMPERS

Each leaf of a multileaf damper shall consist of two plates of material in aerofoil section rigidly fixed to an operating spindle, the ends of which shall be housed in brass, nylon, oil impregnated sintered metal, PTFE impregnated or ball bearings. The ends of the spindles shall be linked so that one movement of the operating handle shall move each leaf an equal amount.

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SECTION 12

12 MVHR UNITS

12.1 GENERAL

All individual components of packaged air handling units shall comply with the appropriate sections of this Specification and be as scheduled.

Air handling units are to be fully assembled at the manufacturer's premises and tested. The manufacturer is to note that the Contract Administrator is to be given at least 10 working days' notice of such testing, such that if so required the Contract Administrator will arrange for witnessing of factory testing. Testing shall include noise levels with silencers fitted. Each air handling unit shall be tested.

Subsequent to satisfactory testing, the AHU is to be disassembled into components for delivery to site. Upon which, a representative of the manufacturer is to oversee the re-assembly of the units to his satisfaction. Upon completion, the manufacturer is to issue a relevant certificate for each unit, proving his acceptance of satisfactory on-site erection including the specified Class of DW 143 test.

12.2 CONSTRUCTION

The unit casing shall consist of insulated panels built into a penta post frame, each section having its own rigid 2mm thick aluminium framework material.

Each panel shall be double skin construction with an infill of CFC free rigid expanded polyurethane foam thermal and acoustic insulation having a minimum density of 50kg/m^3. This insulation shall bond the two skins together. Panels shall be formed from two sheets of minimum 0.6mm thick sheet metal, strengthened as necessary to prevent distortion and drumming. The outer skin shall be plastic coated in the manufacturer's standard colour. The inner skin shall be galvanised. All panels shall be easily removable to facilitate inspection and maintenance and shall be designed to fit into the frame and corner posts to give a smooth external face. Panels shall be adequately bolted to the frame and the joints shall be sealed to give an air-tight enclosure.

Panels shall be rigid, have a defection of not more than 1/120 when under operational load and fully comply with the Class 1 spread of flame requirements of BS 476 Part 7.

The units shall be designed to avoid bare metal bridges linking the inside to the outside and to avoid condensation occurring on the unit. All panels and section framework shall be manageable proportions for transportation and lifting. Lifting eyes shall not be positioned where they may obstruct installation.

Doors in access sections, fan section, inlet plenums and filter sections shall be full height for easy access and maintenance of the equipment. Each door shall be double skin construction with an infill of thermal and acoustic insulation to the same specification as the infill panels. Doors shall be designed to provide an airtight fit and to match the unit panels. Each door shall be supplied with hinges, handles and fasteners to hold the door seals in compression. Doors shall not occur behind existing steel posts.

Unit sections shall be mounted on a channel frame base 100mm high, with 15mm Tico pads positioned between it and the floor or base.

12.3 UNIT CONFIGURATION

The/each unit shall comprise of the components indicated and specified elsewhere in one continuous unit and shall be complete with all necessary access sections. Where cooling coils are provided eliminators with drains and traps shall be provided.

12.4 VIBRATION CONTROL

All components shall where necessary be isolated from the plant housing by internal anti vibration mounts. These shall ensure that no vibration is transmitted to the structure. Sections of 6mm thick Tico pad shall be provided between the AHU base frame and the structure.

12.5 ATTENUATORS

Attenuators shall be as specified elsewhere, but where indicated as being part of the Air Handling Unit, the outer casings shall be constructed to match the Air Handling Unit.

12.6 MIXING BOXES

Air mixing sections shall incorporate damper controls suitable for connection to a single damper motor, complete with a motor mounting bracket. The arrangement of dampers shall ensure adequate mixing.

12.7 HEAT RECOVERY COILS

Heat recovery coils shall be provided in air handling units as scheduled and shown on the drawings. Interconnecting pipework, pumps and valves shall be provided by the Contractor to circulate water between the coils when the air handling units and extract fans are operational.

12.8 SCHEDULE OF MVHR UNITS

REFERENCE			AHU-01
LOCATION			Basement Plant Room
System Served			Basement Floor
Unit Type			XBC25
Supply Components			
Inlet Section			c/w damper
Motorised Dampers			Yes
Heating Coil			
	Duty	kW	4.5
	Air on/off	ºC	-3 / 28
	LTHW on/off	ºC	80/60
	Water flow rate	l/sec	0.083
	Pressure drop	kPa	0.15
Combined Panel & Bag Filter		Grade	EU4/F7
Heat Recovery Coil			Yes
Supply & Extract Fan Sections			
	Duty volume	m^3/s	0.30
	External static pressure	Pa	150
	Volume control		INVERTER
	Electrical supply	V/ph/Hz	230V / 1ph / 50Hz
	Motor rating	kW	1
Fan Sound Power Levels			
Unit Dimension Overall			
	Length	mm	1750
	Width	mm	1210
	Height	mm	343
	Weight	kg	242

Air Handling Units shall be supplied by Nuaire Ltd, 08705 121 400

SECTION 13

13 FAN PLANTS

13.1 GENERAL

Fans shall be as manufactured by Airflow Developments Ltd, 01494 560800. These shall be provided as scheduled.

All motors shall be sized at 125% of the required duty to give the scheduled air volumes.

13.2 CENTRIFUGAL FANS (STEEL)

The fan casings shall be manufactured from mild steel plates with angle stiffeners and base angles riveted or welded together. The fan outlet shall be flanged and the air velocity through them shall not exceed that stated in the schedule.

Each fan shall have an overhung impeller statically and dynamically balanced to ensure true and quiet running and mounted upon an extended mild steel shaft revolving in self-aligning bearings carried on a substantial welded mild steel pedestal-type base. Each blade shall be properly secured to the steel back plate and shroud plate.

13.3 AXIAL FLOW FANS

The fan casings shall be manufactured from mild steel plates, welded together and complete with flanged ends.

Each impeller shall be fitted with aerofoil-type blades and the assembly shall be statically and dynamically balanced to ensure true and quiet running.

Each fan motor shall be adequately supported from the casing to maintain the motor in a rigid central position and the supports shall be so designed as to offer minimum resistance to air flow and noise generation. The lubrication of each assembly shall consist of tubes extended from the bearings through the casing and brought to a position so that lubrication can be carried out easily.

13.4 TOILET EXTRACT FANS

These shall consist of a factory-assembled packaged unit incorporating duplicate exhaust fans of the type and duty scheduled. The assembly shall be fitted with an easily removable plate for routine access, discharge louvres, bird guards and mounts.

The unit shall be complete with an automatic changeover device having facilities to energise the standby fan in the event of the duty fan stopping and the same device shall be provided with the means to select manually the duty fan, it may be that this device is to be incorporated into the central control system as detailed in the controls section.

13.5 FLEXIBLE CONNECTIONS

Extreme care shall be taken by the Contractor to ensure that the fan suction or discharge connection areas are not reduced due to the flexible connections contracting into the air stream.

13.6 PRESSURE TESTS

The Contractor shall provide to the Contract Administrator detailed pressure drops through all proposed main items of equipment so that the final fan heads may be calculated, taking into account any changes in the duct systems, before the fans and their motors are ordered.

After the Contract Administrator has re-assessed the head pressures, the Contractor shall provide to the Contract Administrator a copy of the manufacturer's characteristic curves for each fan set so that the Contract Administrator can approve the anticipated characteristic performance to be expected in relation to the calculated resistance of the various circuits. If the examination of this data indicates that any fan is likely to have a stalling or inefficient point close to the system operating point, then the Contract Administrator may require the Contractor and equipment manufacturer to re-select the fan and the cost of such a change shall be agreed with the Contract Administrator before implementation.

13.7 FAN SCHEDULE

Location Ref No.		Utility Room	WC	Master En-Suite	En-Suite 1	En-Suite 2	En-Suite 3
General		Airflow	Airflow	Airflow	Airflow	Airflow	Airflow
Unit Code		Aventa Silent 100	Aventa Silent 100	Aventa Silent 125	Aventa Silent 125	Aventa Silent 125	Aventa Silent 125
Unit Description		EXT-G.01	EXT-G.02	EXT-F.01	EXT-F.02	EXT-F.03	EXT-F.04
Quantity		1	1	1	1	1	1
Volume	**m³/s**	0.051	0.037	0.084	0.072	0.065	0.065
External Static Pressure	**Pa**	37	45	39	48	50	51
Electrical							
Motor Power (L/H)	**kW**	0.024 / 0.026	0.024 / 0.026	0.025 / 0.030	0.025 / 0.030	0.025 / 0.030	0.025 / 0.030
Motor Voltage	**V**	230	230	230	230	230	230
Motor Phase		1	1	1	1	1	1
Motor Frequency	**Hz**	50	50	50	50	50	50
Full Load Current (L/H)	**A**	0.10 / 0.11	0.10 / 0.11	0.11 / 0.13	0.11 / 0.13	0.11 / 0.13	0.11 / 0.13
Starting Current	**A**	0.61	0.61				
Sound							
Sound Press. Level @ 3m (L/H)	**dBA**	24 / 29	24 / 29	23 / 28	23 / 28	23 / 28	23 / 28
Other							
Length	**mm**						
Width	**mm**						
Height	**mm**						
Weight	**kg**						
Selected Ancillaries		1 x PIR for trickle and boost operation; 1 x switch for trickle and boost operation;	1 x PIR for trickle and boost operation;	1 x PIR for trickle and boost operation;	1 x PIR for trickle and boost operation;	1 x PIR for trickle and boost operation;	1 x PIR for trickle and boost operation;

Location Ref No.		**En-Suite 6**	**Family Bathroom**	**-**	**-**	**-**	**-**
General		Airflow	Airflow	-	-	-	-
Unit Code		Aventa Silent 100	Aventa Silent 125	-	-	-	-
Unit Description		EXT-S.01	EXT-S.02	-	-	-	-
Quantity		1	1	-	-	-	-
Volume	**m^3/s**	0.051	0.078	-	-	-	-
External Static Pressure	**Pa**	39	40	-	-	-	-
Electrical				-	-	-	-
Motor Power (L/H)	**kW**	0.024 / 0.026	0.025 / 0.030	-	-	-	-
Motor Voltage	**V**	230	230	-	-	-	-
Motor Phase		1	1	-	-	-	-
Motor Frequency	**Hz**	50	50	-	-	-	-
Full Load Current (L/H)	**A**	0.10 / 0.11	0.11 / 0.13	-	-	-	-
Starting Current	**A**	0.61		-	-	-	-
Sound				-	-	-	-
Sound Press. Level @ 3m (L/H)	**dBA**	24 / 29	23 / 28	-	-	-	-
Other				-	-	-	-
Length	**mm**			-	-	-	-
Width	**mm**			-	-	-	-
Height	**mm**			-	-	-	-
Weight	**kg**			-	-	-	-
Selected Ancillaries		1 x PIR for trickle and boost operation;	1 x PIR for trickle and boost operation;	-	-	-	-

SECTION 14

14 ATTENUATION PACKAGE

14.1 GENERAL

The Contractor is advised that the performance of all acoustic packages associated with the mechanical services is considered to be critical to the eventual successful completion of this project. To this end an Acoustic Specialist has been involved from an early stage to offer advice and design input, to ensure eventual compliance with the noise criteria levels to be complied with, and to match the Client's expectations. The products specified herein as part of this specification are derived as a result of such initial and continuing design investigations. All are to be supplied by Environmental Equipment Corporation, Tel: 01932 230940.

All pumps and pipework within the property are to be totally isolated from the building structure. To this end all pipework is to be sprung hung from purpose-made "goal posts", supported from the concrete floor. All pump sets are to be fitted within acoustic enclosures.

All silencers shall be provided as indicated on the drawings and included as part of the Works performance tests.

Silencers shall ensure that noise levels within all spaces do not exceed those set out in the Operating Conditions and are not less in size than those scheduled.

All silencers shall be free from odour and proofed against rot, moisture and vermin and shall be produced from material which is entirely non-combustible in accordance with BS 476, or be of non-combustible material faced with combustible material not more than 0.8mm thick and complying with Class 1 Flame Spread Requirements of BS 476. The material constituents shall be detailed and issued to the Engineer for approval before manufacture is commenced. Adhesives shall be compatible with sound absorbent material and should be non-flammable.

Where necessary the Contractor shall provide transformation sections to ensure silencers/attenuators marry up to fans and louvres - these shall all be provided with acoustic lagging. These shall be fitted as part of the assembly for Works testing.

Fan coil units shall be installed within bespoke joinery items and within new ceiling voids. These enclosures shall be acoustically lined as specified by EEC Ltd.

Fans, pumps and motors shall be isolated from the building structure by anti-vibration mountings.

14.2 DUCT MOUNTED SILENCERS/ATTENUATORS, GENERAL

All silencers shall be provided as indicated and scheduled and included as part of the Works performance tests.

Cross talk attenuators shall be provided on all ductwork between bedrooms on the upper floors.

Silencers shall ensure that noise levels within all spaces do not exceed those set out in the Operating Conditions and are not less in size than those scheduled.

All silencers shall be free from odour and proofed against rot, moisture and vermin and shall be produced from material which is entirely non-combustible in accordance with BS 476, or be of non-combustible material faced with combustible material not more than 0.8mm thick and complying with Class 1 Flame Spread Requirements of BS 476. The material constituents shall be detailed and issued to the Contract Administrator for

approval before manufacture is commenced. Adhesives shall be compatible with sound absorbent material and should be non-flammable.

The contractor shall check all attenuator connection sizes onto plant and equipment to ensure connections can be made with the minimal duct transformations. All attenuator sizes shall be checked prior to ordering to ensure there is adequate installation space.

Where necessary the Contractor shall provide transformation sections to ensure silencers/attenuators marry up to fans and air handling units - these shall all be provided with acoustic lagging. These shall be fitted as part of the assembly for Works testing.

14.3 ATTENUATOR CONSTRUCTION

The outer casings shall be constructed in accordance with DW 144 which shall include specifically for:

i) Lockformed and mastic sealed joints

ii) Formed profile flanges or rolled steel angle flanges and intermediate stiffeners.

iii) Side casings shall be cross-creased to give residual panel stiffness.

Splitter elements shall be constructed from inorganic and non-combustible acoustic materials, ensuring that all internal acoustic surfaces are covered with perforated metal sheet with fibre glass tissue behind, ensuring that all internal surfaces are sealed against fibre release.

Splitter elements shall be manufactured separately before assembly into casings. They shall have a peripheral channel frame which shall enclose and retain the mineral wool infill and the facing materials.

Aerodynamic fairings on the inlet of the attenuator elements shall be incorporated into splitter element design when required, such that specified pressure drops are not exceed in accordance with BS 4718.

All attenuators shall be end capped before delivery to site to prevent ingress of rubble and site rubbish while on site and also to reduce damage.

The direction of air flow shall be clearly marked on the casings, with an inspection label and a unit label which indicates the attenuator reference and location.

Circular attenuator casings and centre pod shall be constructed to DW 144 and in accordance with the foregoing.

All atmosphere side silencers shall be fitted with rolled steel angle flanges where connected direct to air handling units.

14.4 FAN COIL ATTENUATORS AND LINING

Final detailing of noise attenuation measures to fan coil units subject to space available in casings following final detailing by the architect. The Contractor shall allow for acoustically lined air intake and discharge plenums to be provided on all fan coil units. Refer to schedule.

14.5 SCHEDULE OF ATTENUATORS

Item	Location	Model	Design Criteria	Dimensions mm				Vol. m³/s	PD Pa
				W	H	L1	L2		
ATT-B.01	FCU-B.01 Supply	-	-	900	200	600	-	0.18	-
ATT-B.02	FCU-B.01 Return	-	-	900	200	600	-	0.18	-
ATT-B.03	MVHR-01 Extract	-	-	-	-	1200	-	0.30	-
ATT-B.04	MVHR-01 Supply	-	-	-	-	1200	-	0.30	-
ATT-B.05	MVHR-01 Exhaust	-	-	-	-	1200	-	0.30	-
ATT-B.06	MVHR-01 Intake	-	-	-	-	1200	-	0.30	-
ATT-G.01	FCU-G.01 Supply	-	-	900	200	600	-	0.21	-
ATT-G.02	FCU-G.01 Return	-	-	900	200	600	-	0.21	-
ATT-G.03	FCU-G.02 Supply	-	-	900	200	600	-	0.18	-
ATT-G.04	FCU-G.02 Return	-	-	900	200	600	-	0.18	-
~~ATT-G.05~~	~~FCU-G.03 Supply~~	~~-~~	~~-~~	~~900~~	~~200~~	~~600~~	~~-~~	~~0.18~~	~~-~~
~~ATT-G.06~~	~~FCU-G.03 Return~~	~~-~~	~~-~~	~~900~~	~~200~~	~~600~~	~~-~~	~~0.18~~	~~-~~
ATT-F.01	Master En-Suite Extract	-	-	-	-	600	-	0.09	-
ATT-F.02	FCU-F.01 Supply	-	-	900	200	600	-	0.18	-
ATT-F.03	FCU-F.01 Return	-	-	900	200	600	-	0.18	-
ATT-F.04	En-Suite 1 Extract	-	-	-	-	600	-	0.07	-
ATT-F.05	En-Suite 2 Extract	-	-	-	-	600	-	0.07	-
ATT-F.06	En-Suite 3 Extract	-	-	-	-	600	-	0.07	-
ATT-S.01	En-Suite 6 Extract	-	-	-	-	600	-	0.07	-
ATT-S.02	Family Bathroom Extract	-	-	-	-	600	-	0.08	-
ATT-S.03	FCU-S.01 Supply	-	-	900	200	600	-	0.14	-
ATT-S.04	FCU-S.01 Return	-	-	900	200	600	-	0.14	-
ATT-S.05	FCU-S.02 Supply	-	-	900	200	600	-	0.21	-
ATT-S.06	FCU-S.02 Return	-	-	900	200	600	-	0.21	-
ATT-S.07	FCU-S.03 Supply	-	-	900	200	600	-	0.14	-
ATT-S.08	FCU-S.03 Return	-	-	900	200	600	-	0.14	-

Manufacturer: Environmental Equipment Corporation, Walton-on-Thames, Surrey KT12 2TP Tel: 01932 230940

SECTION 15

15 FILTERS

15.1 GENERAL

Filters shall be complete with holding frames sufficiently robust to ensure that no distortion occurs in operation. All filters shall be installed with edge seals which shall remain effective even though the cells are periodically removed and refitted. Filters shall be arranged so that there is easy access for cleaning and/or removal and refitting. Any tools necessary for removal and refitting shall be provided, including a servicing rack.

A differential pressure gauge of the inclined manometer type shall be provided for each filter bank and shall be fixed in such a position outside the duct system that it is accessible and easily read.

Supply air filters shall have an efficiency of not less than 90% based on the test specified in ASHRAE/EUROVENT STANDARDS.

15.2 DRY REPLACEABLE MEDIA (PANEL OR BAG FILTERS)

The air velocity at the face of the filter shall not exceed 2 m/s, unless otherwise specified.

Sufficient spare media shall be provided to replace all of the filter media.

SECTION 16

16 GRILLES AND DIFFUSERS

16.1 GRILLES AND DIFFUSERS

Grilles and diffusers shall be as scheduled and shall be manufactured by Air Diffusion, Tel: 01746 761921.

Volume control dampers shall be provided in accessible locations to allow air volume control of each supply and extract grille.

The manufacturer shall attend site once the order has been placed and take site measurements of all grille positions and shall coordinate their location with the Architects construction issue drawings to ensure all plenum boxes and grilles can be installed as shown on the tender drawings.

Plenum boxes shall be provided for all active grilles, the final design of the plenum box shall be carried out by the manufacturer to fit the available space. Duct spigots shall be provided on all plenum boxes in a position agreed with all parties to ensure a ductwork connection can be made onto each box without restricting the air flow.

Dummy slot diffusers shall be supplied without plenum boxes, to be fitted in positions as shown on the tender drawings. The Contractor shall measure and order the required lengths of dummy slot diffusers and corner sections required to achieve the required continuous grille look within the rooms.

16.2 SCHEDULE OF SUPPLY & RETURN DIFFUSERS

Ref No	Description	Grille Type	Slot Height	Total Height	Throw distance (m)	Total Diffuser Length (m)	Active Diffuser Length (m)	Air Flow (l/s)	Comments
D-B.01	FCU-B.01 (Supply)	Air Diffusion 22-HT-FL10	25mm	107 mm	-	4.00	4.00	285	Plaster-In Frame
D-B.02	FCU-B.01 (Return)	Air Diffusion 22-HT-FL10	25mm	107 mm	-	4.00	3.00	175	Plaster-In Frame
D-B.03	MVHR-01 Extract	Slot in Ceiling Coffer	150mm	500mm	-	-	-	110	Builders Work Slot
D-G.01	FCU-G.01 (Supply)	MAP MB28SB+MS	180	180	-	1.50	1.50	208	With Swirl Diffuser
D-G.02	FCU-G.01 (Return)	MAP MB28SB	180	180	-	1.50	1.50	208	-
D-G.03	FCU-G.02 (Supply)	MAP MB28SB+MS	180	180	-	1.50	1.50	208	With Swirl Diffuser
D-G.04	FCU-G.02 (Return)	MAP MB28SB	180	180	-	1.50	1.50	208	-
~~D-G.05~~	~~FCU-G.03 (Supply)~~	~~Air Diffusion 22-JT-FL10~~	~~25mm~~	~~107 mm~~	~~-~~	~~1.80~~	~~1.80~~	~~175~~	~~Plaster in Frame~~
~~D-G.06~~	~~FCU-G.03 (Return)~~	~~Air Diffusion 22-JT-FL10~~	~~25mm~~	~~107 mm~~	~~-~~	~~1.80~~	~~1.80~~	~~175~~	~~Plaster in Frame~~
D-F.01	FCU-F.01 (Supply)	MAP MB28SB+MS	180	180	-	1.30	1.30	175	With Swirl Diffuser
D-F.02	FCU-F.01 (Return)	MAP MB28SB	180	180	-	1.30	1.30	175	-
D-S.01	FCU-S.01 (Supply)	Air Diffusion 22-HT-FL10	25mm	107 mm	-	2.30	2.30	133	Plaster-In Frame
D-S.02	FCU-S.01 (Return)	Air Diffusion 22-HT-FL10	25mm	107 mm	-	2.30	2.30	133	Plaster-In Frame
D-S.03	FCU-S.02 (Supply)	Air Diffusion 22-HT-FL10	25mm	107 mm	-	3.60	3.60	208	Plaster-In Frame
D-S.04	FCU-S.02 (Return)	Air Diffusion 22-HT-FL10	25mm	107 mm	-	3.60	3.60	208	Plaster-In Frame
D-S.05	FCU-S.03 (Supply)	Air Diffusion 22-HT-FL10	25mm	107 mm	-	2.30	2.30	133	Plaster-In Frame
D-S.06	FCU-S.03 (Return)	Air Diffusion 22-HT-FL10	25mm	107 mm	-	2.30	2.30	133	Plaster-In Frame

16.3 SCHEDULE OF AIR VALVES

Ref	Room	Fan / AHU	Air Volume (l/s)	Diameter (mm)	Make & Model
G-B.01	WC (Extract)	MVHR-01	20	125	Air Diffusion FlowDisc 125
G-B.02	Plantroom A (Extract)	MVHR-01	50	160	Air Diffusion FlowDisc 160
G-B.03	Treatment Room (Supply)	MVHR-01	50	160	Air Diffusion FlowDisc 160
G-B.04	Main Plantroom (Extract)	MVHR-01	100	250	Air Diffusion FlowDisc 250
G-B.05	Main Plantroom (Supply)	MVHR-01	100	250	Air Diffusion FlowDisc 250
G-B.06	Shower / Steam Room (Extract)	MVHR-01	20	125	Air Diffusion FlowDisc 125
G-B.07	Changing Room (Supply)	MVHR-01	40	160	Air Diffusion FlowDisc 160
G-G.01	Utility Room	EXT-G.01	51	160	Air Diffusion FlowDisc 160
G-G.02	WC	EXT-G.02	37	160	Air Diffusion FlowDisc 160
G-F.01	Master En-Suite	EXT-F.01	84	200	Air Diffusion FlowDisc 200
G-F.02	En-Suite 1	EXT-F.02	65	160	Air Diffusion FlowDisc 160
G-F.03	En-Suite 2	EXT-F.03	65	160	Air Diffusion FlowDisc 160
G-F.04	En-Suite 3	EXT-F.04	71	200	Air Diffusion FlowDisc 200
G-S.01	En-Suite 6	EXT-S.01	51	160	Air Diffusion FlowDisc 160
G-S.02	Family Bathroom	EXT-S.02	78	200	Air Diffusion FlowDisc 200

16.4 SCHEDULE OF EXTERNAL LOUVRES

Ref. No.	Location	Serving	Air Vol. l/s	Dimensions (mm)	Make & Model
L01	Ground Fl.	MVHR-01 (Intake)	300	450x550	Gilberts WGC-38
L02	Ground Fl.	MVHR-01 (Exhaust)	300	450x550	Gilberts WGC-38

Note:

Colours to be agreed with Contract Administrator prior to ordering.

SECTION 17

17 WATER SOFTENING AND FILTRATION

17.1 SOFTENING

A water softening system shall be provided in the basement plantroom to provide softened water to the calorifiers cold feed. The system shall consist of:

- 1x Goodwater Pegasus 140/2850 Simplex Water Softener

This shall be supplied by Goodwater Ltd, 23/24 Ivanhoe Road, Hogwood Lane Industrial Estate, Finchampstead, Wokingham, Berkshire, RG40 4QQ. Tel: 0118 973 5003

The softener assembly shall include a pressure vessel, water distribution and collectors within the vessel, a change of base exchange material, a salt storage tank/measuring tank and all integral piping with overflows and drains.

The components shall consist of but not be limited to the following-Water Softener, Control Valves, Low level salt alarm.

ONE - Water testing kit to match the softener assembly shall be supplied and handed to the Contract Administrator along with 10 x25 kg salt bags.

SECTION 18

18 CALORIFIERS, CYLINDERS AND TANKS

18.1 HOT WATER STORAGE VESSELS– MAIN HOUSE

Two number 600 litre high recovery, vertical stainless steel hot water cylinders are to be provided as indicated on the Tender drawings. The calorifiers are to be pre-insulated and supplied complete with a mains pressure pack.

These shall be manufactured by ACV (UK) Ltd (01383 820 100) to the size, capacity, etc., as detailed, constructed and tested to conform to BS 853/Part 1/96/A.

Duplicate test certificates shall be issued to the Contract Administrator. Each certificate shall state that the vessel has been manufactured and tested to BS 853/Part 1/96/A, to 7 Bar primary/secondary.

The vessels shall be:-

a) Made of stainless steel.

b) Supplied with primary hot water heater battery of galvanised mild steel with tinned copper heaters.

c) Supplied with suitable support cradles.

The vessels are to be arranged with expansion vessels, also supplied by ACV (UK) Ltd, as matching items to the calorifiers. The vessels shall have capacities of 100 litres and be constructed to WRC approval/DIN 487 (section 3) and each supplied with replaceable EDPM membrane bags.

The Contractor shall supply and install the unvented hot water cylinder where indicated on the Tender drawings. Pairs of cylinders shall be provided with individual primary control circuits as per the schematic shown on the tender drawings.

Manufacturer - ACV (UK) Ltd (01383 820 100)
Model - SL600
Capacity - 600 Litres
Number off - 2
Dimensions - 1901mm High x 817mm Dia insulated

The coil shall operate with primary water temperatures of 80°C flow and 60°C return.

Each vessel shall be complete with all necessary flanged and screwed connections including:

ONE - 20mm spring loaded pressure & temperature valve complete with padlock and key and a length of discharge pipe to within 225mm from finished floor level and set to relieve pressure as scheduled.

ONE - 100mm diameter dial, mercury-in-steel thermometer as scheduled range 0°C/100°C. Normal index 65°C. Red line 75°C.

ONE - 100mm diameter dial altitude pressure gauge, as scheduled, calibrated 50m/5 bar.

ONE - Cold water feed connection with isolating valve.

ONE - Hot water flow connection with isolating valve.

ONE - Set of adjustable feet.

ONE - Clean-out door.

ONE - Dual High Limit Stat

All bolted heads, inspection covers, etc. shall be secured with bolts and nuts NOT studs.

The detailed arrangement drawings(s) of the calorifier(s) shall be submitted to the Contract Administrator and his approval obtained before commencing manufacture.

Each cylinder shall be provided with adjustable feet and a purpose made steel support frame.

The cylinder shall have a control panel containing pre-wired control and limit thermostat for effective control of the domestic hot water flow temperature.

SECTION 19

19 THERMAL INSULATION AND TRACE HEATING

19.1 GENERAL REQUIREMENTS

All thermal insulation work shall be carried out by a specialist thermal insulation company, who shall also be a member of the Thermal Insulation Contractors Association.

All insulation shall be applied by skilled tradesmen and the manufacture and installation works shall comply with Control of Substances Hazardous to Health Regulation and current British Standards, Code of Practice and Standards for Fire Safety.

BS 3533	Glossary of terms relating to thermal insulation.
BS 5422	Specification for the use of thermal insulation materials.
BS 3958	Specifications for thermal insulation materials. Part 2. Calcium Silicate preformed insulation.
BS 3958	Specifications for thermal insulation materials. Part 3. Metal mesh faced Mineral Wool mats and mattresses.
BS 3958	Specifications for thermal insulation materials. Part 4. Bonded pre-formed Mineral Wool pipe sections.
BS 3958	Specifications for thermal insulating materials. Part 5. Bonded Mineral Wool Slabs (for use at temperatures above 50^{o}C).
BS 8927	Rigid Phenolic foam in the form of slabs and profiled sections.
BS 874	Methods for determined thermal insulating properties with definitions of thermal insulation terms.
BS 2972	Methods of test for thermal insulating materials
BS 476	Fire test on building materials and structures. Part 4. Non combustibility test for materials.
BS 476	Fire tests on building materials and structures. Part 12. Method of test for ignitability of products by direct flame impingement.
BS 476	Fire test on building materials and structures. Part 6. Fire propagation test for materials.
BS 476	Fire test on building materials and structures. Part 7. Surface spread of flame tests for materials.
BS 5970	Code of Practice for thermal insulation of pipework and equipment (in the temperature range of -73^{o}C to +816^{o}C).
BS 1710	Identification of pipelines and services.

All finishes applied to insulation in concealed or exposed to view areas shall conform to Class 'O' of the Building Regulations.

All work shall be left smooth, clean and properly finished of even thickness and homogeneous with no irregularities in the thickness of insulating material or in the material covering. To ensure that the correct thickness has been applied, one section of each type of insulation shall be cut out for inspection. If the inspection reveals any defects the Contractor shall cut out a further two sections for inspection. If these also prove defective then the insulation shall be rejected.

Pipework shall be insulated separately and adjacent parallel pipes shall not be married together in one insulation covering. All insulation material and associated products shall be applied in accordance with the manufacturer's recommendations and instructions.

All joints, surfaces, edges and overlaps shall be neatly finished with no damaged edges. Where possible, overlaps shall be arranged to be on the "blind" side and also to facilitate "water shedding".

Where allowance has to be made for pipe/duct expansions and/or contraction, insulation shall be finished in a neat and Approved manner permitting easy access and disconnection of removable items without disturbing the surrounding insulation.

A complete moisture and vapour seal shall be provided on all cold surfaces by vapour barrier jackets or coating. All vapour barriers shall be continuous and where appropriate the vapour barrier shall be returned effectively and sealed to the pipe or duct so as not to allow any ingress of moisture or water vapour.

No insulation shall be applied until pipes, plant and ductwork have been tested, cleaned, painted and trace heated if specified elsewhere.

Pipework and Ductwork supports shall be provided with inserts, to match the insulation thickness, to enable the insulation finishes to be continuous through the supports.

All insulation shall fit tight to the surfaces to be covered and all slabs and sections shall be built up close, butting edges being mitred, chamfered or shaped as necessary. Insulation applied to vessels and pipeline and ductwork ancillaries shall be neatly cut and finished around all manufacturer's name and test plates, test points and dampers to leave these visible.

Where aluminium foil finish is used all joint, brackets, junctions, penetrations, fittings and the like shall be 100% sealed with aluminium tape to not only provide a vapour seal, but also contain insulation Fibres.

Insulation shall be applied to flanged joints, expansion bellows, valves, strainers, calorifier chests and access manholes and the like, and shall be contained within purpose made aluminium removable covers fitted with quick release toggles.

When working on existing thermal insulation which contains asbestos, the Contractor is to ensure that his staff are to be supplied with the correct protective clothing and breathing apparatus as laid down by the Health & Safety Executive and the works shall be undertaken in accordance with the current legislation and regulations.

19.2 FIRE PERFORMANCE

All insulation materials installed within buildings, with or without facings, shall meet the Class ‘O’ requirements of the UK Building Regulations when tested to BS 476 Parts 6 & 7.

19.3 THERMAL INSULATION MATERIAL SELECTION

The following insulation materials are generally acceptable for installation within buildings, except where their use is restricted in specified areas:-

a) Rigid Phenolic foam pipe insulation, nominal density 35kg/m^3, aged thermal conductivity value 0.018 W/mK at mean temperature 10^{o}C. Bore Face of sections coated with a non odorous passivating solution. All sections with factory applied fully bonded reinforced aluminium foil facing. Kooltherm pipe insulation as manufactured by Kingspan Industrial Insulation or equal approved.

b) Rigid Phenolic foam slab insulation, nominal density 40kg/m^3, aged thermal conductivity value 0.018 W/mK at mean temperature 10^{o}C. Slab to have reinforced aluminium foil facing bonded to one side during manufacture. Kooltherm duct insulation as manufactured by Kingspan Industrial Insulation or equal approved.

c) Foil faced resin bonded Mineral Wool pipe insulation, nominal density 120kg/m^3, thermal conductivity value not exceeding 0.044 W/mK at mean temperature 100^{o}C. Rocklap 800 pipe sections as manufactured by RockWool Ltd, or equal approved.

d) Foil faced resin bonded Mineral Wool slab/blanket insulation, in a range of densities 33kg/m^3 100kg/m^3, dependant on location. Thermal conductivity value not exceeding 0.050 W/mK at mean temperature 100^{o}C. Lamella mat or slab as manufactured by RockWool Ltd.

e) Pre formed sections of Calcium Silicate insulation, nominal density 240kg/m^3, thermal conductivity value not exceeding 0.054 W/mK at mean temperature 100^{o}C. Hitherm Calcium Silicate Insulation as manufactured by Kingspan Industrial Insulation or equal approved.

f) Pre formed closed cell, flexible, elastomeric nitrile rubber tube, minimum density 65kg/m^3, thermal conductivity value not exceeding 0.037 W/mK at 10^{o}C mean temperature. Class 'O' grey Armaflex as manufactured by Armstrong World Industries or equal approved.

19.4 INSULATION MATERIAL RESTRICTIONS

a) All insulation materials shall be free from the use of CFC's in their manufacture and as a finished product.

b) Nitrile Rubber shall not be installed on pipework or equipment operating at temperature in excess of 105^{o}C, nor in smoke sensitive areas.

c) Phenolic foam shall not be installed on pipework or equipment operating at temperatures in excess of 120^{o}C.

d) Insulation materials containing man made Mineral Fibre shall not be installed in kitchens, food preparation areas, food storage areas or other similar aseptic areas (including ceiling voids and ducts and access from these areas). Calcium Silicate which does not contain MMMF to be installed as a replacement on services operating above 120^{o}C.

19.5 DUCTWORK INSULATION

Ductwork insulation is to be bonded to the ductwork using adhesive applied to the whole of the surface of the duct and inside face of the insulation (two-way contact bond).
In addition, aluminium fixing pins or clips and washers are to be adhered to the duct at 450mm centres to provide extra support for the insulation on all inverted surfaces and on sides of ducts where they exceed 0.5 metres in depth.

All longitudinal and circumferential joints are to be taped with matching 100mm wide self-adhesive aluminium foil tape. Where specified cladding and/or galvanised wire shall be applied taking care not to over-tension or to puncture the vapour barrier.

Unless otherwise stated, all ductwork and plenum boxes shall be insulated, unless it is warm air exhausted directly to outside.

19.6 PIPEWORK INSULATION

Pre-formed pipework insulation with a facing applied shall have longitudinal and butt joints sealed with 50mm wide self-adhesive aluminium foil tape. Bends and fittings to be mitred and cut to fit on site and sealed with 50mm wide self-adhesive aluminium foil tape. Unless a cladding finish is to be added, non-ferrous bands shall be fitted at each end of each preformed section and at least one midway between the ends and these shall be applied after any vapour barrier application.

Plain preformed sections shall be secured by non-ferrous bands fitted at each end of preformed section and at least one midway between ends.

Where flexible insulation is specified for cold surfaces all longitudinal and circumferential joints shall be sealed with an approved adhesive to provide a continuous vapour barrier.

19.7 ARMAFLEX INSULATION

Armaflex shall be used where scheduled and shall be manufactured by Armstrong World Industries Ltd.

Armaflex shall be installed and applied strictly in accordance with the manufacturer's published installation manual and if this is found not to be the case then the Contractor will have to remove the relevant sections of insulation and replace at no cost to the Contract.

19.8 ALUMINIUM CLADDING

Shall be stucco embossed aluminium sheeting to the thicknesses as shown in BS 5970 : 1992 Table 5 (page 56) and fabricated/secured to the recommendations of clauses 26 and 27 of this Code of Practice.

19.9 THICKNESS OF INSULATION

Insulation thicknesses shall generally comply to the minimum recommended in BS 5422 : 2001 as stated in the following tables. Pipe nominal diameters are based upon steel pipework. Where copper or plastic pipework is used the equivalent outside diameter of the pipe shall be used.

Note: The Environmental Thickness Tables in BS 5422 : 2001 are specified as the basis of qualification for Enhanced Capital Allowances and as a means of satisfying the Building Regulations, Approved Documents L1 & L2 (Conservation of fuel and power)

19.10 INSULATION OF PIPELINE FITTINGS

All line fittings, including, but not limited to, valves, cocks, strainers and flanges found on insulated piped services shall be insulated.

In plantroom, boiler room and other viewable areas fittings are to be contained within purpose made 1.2mm thick two-piece aluminium boxes secured with quick release toggle fasteners.

The boxes are to be lined with insulation to match thickness and type of insulation on adjacent pipework.

Fittings on external services are to be contained in boxes which are designed to be weatherproof.

In ceiling voids and other hidden areas insulation shall comprise flexible purpose made covers to suit size and shape of line fitting. The covers shall fully contain the insulant and be complete with all necessary ties and Velcro fastenings.

The covers shall have Fibreglass base fabric, finished silver silicone rubber containing 50mm of Mineral Wool. They shall be suitable for an operating temperature range of -37^{o}C to 260^{o}C and be of Class 1 surface spread of flame characteristic in accordance with BS476 Pt 7.

Covers shall be manufactured by Unitherm Insulation Systems Ltd., Rugeley Staffs or equal and approved.

19.11 IDENTIFICATION OF SERVICES

All insulated pipework irrespective of location is to be identified with self-adhesive colour banding having colours complying with BS 1710. The banding is to be located at all entries and exits to plantrooms, service ducts voids etc and at connections or branches to or from headers, pipe runs etc. otherwise provide identification banding at intervals not more than four metres, which will include arrows indicating the direction of flow.

Identification coding for ductwork shall be in accordance with the information given in HVCA specification DW/144:1998.

19.12 INSULATION MATERIAL/COVERING SELECTION

Service	Location	Insulation Material 01 Phenolic foam Section 02 Phenolic Foam Laminate 03 Exp Nitrile Rubber Tube 04 Mineral Wool Section 05 Mineral Wool Ductwrap 06 Mineral Wool Slab/Laminate *07 Calcium Silicate Section *08 Calcium Silicate Slab								Covering A Aluminium foil B Aluminium sheet C PVC sheet D PIB sheet			
		01	02	03	04	05	06	07	08	A	B	C	D
LTHW DHW	Plant rooms Occupied Areas	0			0						0	0	
	Ducts/Cavities	0			0					0			
	External	0			0						0		0
CWS and Chilled Water	Plant rooms Occupied Areas	0		0	0					X	0	0	
	Ducts/Cavities	0		0	0					X			
	External	0		0	0					X	0		0
Air Conditioning Ductwork	Plant rooms Occupied Areas		0				0		0	X	0	0	
	Ducts/Cavities		0			0	0		0	X			
	External		0				0		0	X	0		0
Refrigeration Pipework	Plant Rooms	0								X	0	0	

0 Indicates optional choice of insulation or finish.
X Indicates mandatory requirement for a foil vapour barrier over Phenolic Foam or Mineral Fire.
* Calcium Silicate which does not contain MMMF to replace Mineral Wool in sterile areas.

TABLE I: CHILLED & COLD WATER SERVICES

Required thicknesses of Phenolic Foam or Expanded Nitrile Rubber or Mineral Wool for condensation control and energy conservation - still air conditions of 25°C and 80% relative humidity.

Pipe Size		Thickness of Insulation (mm)								
		Temperature of Water (°C)								
NB (mm)	OD (mm)	0°C			5°C			10°C		
		PF	ENR	MW	PF	ENR	MW	PF	ENR	MW
15	21	20	76	60	20	65	50	20	50	40
20	27	20	76	60	20	65	50	20	50	40
25	34	25	76	60	20	65	50	20	50	40
32	42	25	76	60	20	65	50	20	50	40
40	48	25	76	60	20	65	50	20	50	40
50	60	30	76	65	25	65	50	20	50	40
65	76	30	76	65	25	65	50	20	50	40
80	89	30	76	65	25	65	50	20	50	40
100	114	35	76	65	25	65	50	20	50	40
125	140	35	76	65	30	50	40	20	50	40
150	168	40	100	65	30	50	50	20	50	40
200	219	40	100	65	30	65	50	20	50	40
250	273	40	100	100	35	65	50	20	50	40

Thickness of Phenolic Foam insulation are based on BS 5422:2001- Table 8 and thickness to be not less than 20mm.

It is estimated that thicknesses for Expanded Nitrile Rubber and Mineral Wool will show a similar resistance to heat gain in watts per linear metre of pipe.

Insulation materials containing MMMF not to be installed in areas as defined in clause 19.4

TABLE II: HOT WATER SERVICES

Required thickness of Low K Phenolic foam or Mineral Fibre faced with bright Class 'O' aluminium foil for non-domestic hot water services operating at 60°C with ambient at 10°C.

PIPE SIZE		THICKNESS OF INSULATION (mm)	
NB (mm)	**OD (mm)**	**PF**	**MW**
15	21	20	40
20	27	20	40
25	34	20	40
32	42	20	40
38	48	20	40
50	60	25	50
65	76	25	50
80	89	25	50
100	114	25	50
125	140	30	50
150	168	30	50
200	219	30	50
250	273	35	60

Thickness of Phenolic Foam insulation are based on BS 5422:2001-Table 13.
It is estimated that thicknesses for Mineral Fibre will show a similar resistance to heat loss in watts per linear metre of pipe.

Finishes

Plant Rooms - Stucco embossed aluminium sheeting/P.V.C. Sheeting
Hidden Areas - Aluminium Foil
External - Mastic finish or PIB

Material Restrictions

Mineral Fibres shall not be installed in areas covered by clause 19.4

TABLE III: Heating System Pipework

Required thickness of Low K Phenolic Foam or Mineral Fibre faced with bright Class 'O' aluminium foil for non-domestic heating services operating at 80°C with ambient at 10°C.

PIPE SIZE		THICKNESS OF INSULATION (mm)	
NB (mm)	**OD (mm)**	**PF**	**MW**
15	21	20	40
20	27	20	40
25	34	20	40
32	42	20	40
38	48	20	40
50	60	25	50
65	76	25	50
80	89	25	50
100	114	25	50
125	140	30	50
150	168	30	50
200	219	30	50
250	273	30	50

Thickness of Phenolic Foam insulation are based on BS 5422:2001-Table 12 (75ºC).
It is estimated that thicknesses for Mineral Fibre will show a similar
resistance to heat loss in watts per linear metre of pipe.

Finishes

Plant Rooms	-	Stucco embossed aluminium sheeting/P.V.C. Sheeting
Hidden Areas	-	Aluminium Foil
External	-	Mastic finish or PIB

Material Restrictions

Mineral Fibres shall not be installed in areas covered by clause 19.4

TABLE IV: Heating Systems Pipework

Required thickness of Low K Phenolic foam or Mineral Fibre faced with bright Class '0' aluminium foil for non-domestic heating services operating at 100°C with ambient at 10°C.

PIPE SIZE		THICKNESS OF INSULATION (mm)	
NB (mm)	OD (mm)	PF	MW
15	21	20	40
20	27	20	40
25	34	20	50
32	42	25	50
38	48	25	50
50	60	25	50
65	76	30	50
80	89	30	60
100	114	30	60
125	140	30	60
150	168	35	60
200	219	35	60
250	273	35	65

Thickness of Phenolic Foam insulation are based on BS 5422:2001 (Table 12-100ºC). It is estimated that thicknesses for Mineral Fibre will show a similar resistance to heat loss in watts per linear metre of pipe.

Finishes

Plant Rooms - Stucco embossed aluminium sheeting/P.V.C. Sheeting
Hidden Areas - Aluminium Foil
External - Mastic finish or PIB

Material Restrictions

Mineral Fibres shall not be installed in areas covered by clause 19.4

TABLE V: Steam or HTHW Services

Required thickness of Mineral Fibre Insulation or Calcium Silicate Insulation for services operating at 175ºC, with ambient temperature taken as 20ºC.

PIPE SIZE		THICKNESS OF INSULATION (mm)	
NB (mm)	OD (mm)	MW	CS
15	21	50	100
20	27	60	105
25	34	50	110
32	42	60	110
40	48	60	110
50	60	60	110
65	76	65	110
80	89	65	110
100	114	75	115
125	140	75	115
150	168	75	115
200	219	75	120
250	273	80	120
300	324	90	120
Vessels and Flat Services		100	125

Thickness of Mineral Fibre insulation are based on BS 5422:2001 (Table 12-150ºC). It is estimated that thicknesses for Calcium Silicate will show a similar resistance to heat loss in watts per linear metre of pipe.

Calcium Silicate insulation to be fitted to these services in areas where the use of Mineral Fibre is restricted. (Clause 19.4 refers).

Finishes

Plant Rooms - Stucco embossed aluminium sheeting/P.V.C. Sheeting
Hidden Areas - Aluminium Foil
External - Mastic finish or PIB

Table VI: Minimum Thickness of Phenolic foam Laminate or Foil Faced Mineral Wool Slab on Warm Air Ductwork

Temperature Difference Between Internal Warm Air and Ambient Air					
Up to +10°C		+11 to 25°C		+26 to +50°C	
Thermal Conductivity W/mK					
0.020	0.040	0.020	0.040	0.023	0.040
Economic Thickness of Insulation (mm)					
20	40	25	50	35	65

Table VII: Minimum Thickness of Phenolic Foam Laminate or Foil Faced Mineral Slab for Condensation Control on Chilled Air Ductwork. Air Handling Plants, Cooler Battery Casings, Vessels, Tanks and other Associated Equipment

Minimum Temperature of Air Inside Ductwork							
0°C		5°C		10°C		15°C	
Thermal Conductivity W/mK							
0.020	0.040	0.020	0.040	0.020	0.040	0.020	0.040
Thickness of Thermal Insulation							
50	100	40	75	25	50	20	30

Data based on an ambient temperature of +25°C with a relative humidity of 80%.

Extract and Recirculation Ductwork

All air conditioning and ventilation ductwork extract and recirculation ductwork shall be insulated with rigid Phenolic Foam laminate or foil faced resin bonded Mineral Wool Slab.

	MW	**PF**
In plant rooms	38mm	20mm
Shafts to plantrooms		
Externally exposed	65mm	30mm
In offices and occupied areas	None	None

Finishes

Plant Rooms	-	Stucco embossed aluminium sheeting/P.V.C. Sheeting
Hidden Areas	-	Aluminium Foil
External	-	Mastic finish or PIB

Material Restrictions

Mineral Fibres shall not be installed in areas covered by clause 19.4

SECTION 20

20 CONTROLS AND GENERAL ELECTRICAL SPECIFICATION

20.1 GENERAL

Two dedicated control panels shall be installed to control and monitor buildings' heating, ventilation and water systems.

The new controls systems are to be integrated with the Heatmiser neoKit heating control system to allow the room set point temperatures to be interrogated and adjusted via the Heatmiser system. This will require careful liaison between the Controls Specialist and the provider of the Heatmiser system, to ensure adequate communication signals are provided.

The Mechanical Plant shall be powered and controlled from the Control Panels. The Electrical Contractor shall provide suitably sized electrical isolators adjacent to the panels for connection to the panels by the controls specialist.

Equipment not served from the Control Panels e.g. Fan Coils and local exhaust fan systems etc will be powered from local switched spurs provided by the Electrical contractor. The Mechanical contractor shall connect the equipment to these spurs.

Circuit cables shall be run within false ceiling voids, where created or within floor voids below floorboards and above finished ceilings. Where cables are run in floor voids they shall be run through holes cut in the centre third of the joist or through existing notches. Holes cut in joists for cables shall not be larger than 50mm without first seeking approval for the Contract Administrator and Structural Engineer. Where existing notches are re-used then steel 'safe plates' shall be fitted over the cables. No new notches shall be cut without the express permission of the Contract Administrator.

Under no circumstances shall Low voltage control cables be installed in the same notch or hole as main voltage cables, nor shall they run parallel to mains voltage cables unless separated by a minimum distance of 150mm.

Vertical cable runs up or down walls to sensors etc. or other outlets shall be protected by earthed steel conduit recessed into walls. These conduits shall protrude into the ceiling/floor void to ensure that it is possible to withdraw the cables, if necessary, back into the horizontal void. All conduit ends shall be bushed using screwed brass bushes.

The controls system shall be designed and installed by:

Imperium Building Systems Ltd.
Lavender House
23 Nork Way
Banstead
Surrey, SM7 1PB
Tel: 07852 724 199

The Controls Specialist's scope of works shall include, but not be limited to, the following:

20.2 MAIN HOUSE

20.2.1 HEATING SERVICES CONTROLS

The heating systems shall be controlled by local Hetmiser Neo controllers (supplied by UFH contractor) linked to a Heatmiser neoKit (supplied by UFH contractor) and plantroom control panel to enable the boiler and heating circulation pumps when heating is called for in any of the rooms, systems or time schedules.

With a demand for heating the duty LTHW primary pump will be started. A differential pressure switch, sensing across the pump set will confirm water flow. Should water flow not be established, following a time adjustable period, the standby pump shall be automatically started and an alarm raised at the control panel.

Once water flow has been established the LTHW Boiler will be energised. The boiler shall then operate under the dictates of its own control and limit thermostats, the control stat shall be set to 80°C (adjustable), with a 20°C temperature difference.

The Boilers shall be hardwired interlocked with the LTHW pressurisation Unit to prevent operation due to system High or Low pressure. The pressurisation unit shall be powered from the boiler room control panel and monitored at the Control Panel for a Common fault condition.

The duty (Radiator & UFH) Pump shall start on a demand for heating, as determined by the room temperature sensors, and within the programmed time schedules. The pumps water flow quantity will be determined via a system differential pressure sensor that shall adjust the pump speed through interlocks with the pumps integral speed control Inverter. A differential pressure switch, sensing across the pump set will confirm water flow. Should water flow not be established, following a time adjustable period, the standby pump shall be automatically started and an alarm raised at the Control Panel.

The duty DHWS primary pump shall start on a demand for heating, as determined by the DHWS calorifier immersion temperature sensors, and within the programmed time schedules. A differential pressure switch, sensing across the pump set will confirm water flow. Should water flow not be established, following a time adjustable period, the standby pump shall be automatically started and an alarm raised at the Control Panel.

The duty swimming pool heating pump shall start on a demand for heating and/or swimming pool AHU, as determined by AHU heating valve positions, and within the programmed time schedules. A differential pressure switch, sensing across the pump set will confirm water flow. Should water flow not be established, following a time adjustable period, the standby pump shall be automatically started and an alarm raised at the control panel.

Room temperature control shall be provided by local Hetmiser Neo controllers (supplied by UFH contractor) with in-built room temperature sensors, monitoring room air temperature (remote thimble temperature sensors where indicated on tender drawings). The output of the controllers shall operate the room's zone valves located on manifolds as per tender drawings. Where there is more than one radiator in a room, these shall be looped together to operate simultaneously under the dictates of a single room temperature sensor.

The Contractor shall confirm the finish of controller and remote sensor (where applicable) with contract administrator prior to ordering. The location of each sensor shall be agreed on site with the Contract Administrator. The Contractor shall include all necessary back boxes and conduits required to achieve a discrete sensor where required.

A log shall be kept identifying the EXACT position of the sensors and cable routes. These shall be recorded on a dimensioned wall elevation and included in the O&M manuals.

Each room heating system shall be able to be programmed to operate on its own time setting via the Heatmiser.

20.2.2 UNDERFLOOR HEATING SYSTEM

The UFH temperature from the underfloor heating manifolds shall be controlled on a schedule according to outside air temperature, by modulating the three way mixing valve under the dictates of a supply water temperature sensor on the flow from each manifold.

A high temperature thermostat located adjacent to the supply water temperature sensor shall, via hardwired interlocks, drive the mixing valve to the flow bypass position and raise an alarm at the Control Panel if an adjustable flow temperature is exceeded. The system shall resume automatic operation once a flow temperature of 40°C (adjustable) has been detected.

Underfloor heating manifolds shall be controlled direct from the MCC within the subterranean plantroom.

20.2.3 GAS SAFETY SYSTEMS

A Gas Solenoid Valve shall be provided in the plantroom on the main gas supply to the building. A gas monitoring and proving system shall be provided in the gas meter room consisting of a model GPPS-L panel as manufactured by Medem, 0161 233 0600. A fire alarm input shall be wired into the unit in series with an input from the control system to shut the gas supply to the building in the event of an emergency. The system shall incorporate a gas proving system across inlet and outlet ports on the solenoid valve to ensure the gas supply to the building is not re-established until all gas appliances and outlets around the building have been closed. The Auto-Stop function shall be disabled.

The gas monitoring and proving panel shall be powered from the boiler room control panel. The system shall monitor the Gas On circuit within the panel to confirm if the gas supply to the building is available. The control panel shall include the relevant delay protocols to account for the delay in gas being available to the building during the proving process, around 30 seconds.

A Fire Test Isolation Panel Model FTIP-1 as manufactured by Medem, 0161 233 0600 shall be located next to the main building fire alarm panel to allow the gas safety systems to be temporarily disabled whilst a fire alarm test is being carried out. When this button is pressed the fire alarm input shall not close the solenoid valves or disable any of the plant items. The button shall self-reset after a set (adjustable) time has elapsed and shall re-enable the gas safety systems. The control system shall include all necessary connections to allow this to be carried out.

All gas safety systems shall be commissioned by Medem.

A gas safety system shall be provided in the boiler room, consisting of a Gas Solenoid Valve on the incoming gas supply, interlinked with the Boiler Electro Thermal Link, Door Emergency Knock-off button, Natural gas sensor, carbon monoxide detector and the Buildings Fire Alarm System. Activation of any sensor, ETL, Knock-off button or fire alarm shall close the gas solenoid valve, shut down the Boiler and alarm at the Control Panel.

20.2.4 DOMESTIC HOT WATER SERVICES AND WATER FILTRATION CONTROLS

Secondary hot water shall be circulated to the sanitary outlets via a pump set mounted on the hot water service secondary return which will be installed on a programmable timer (included in control panel). This pump shall operate continuously and be monitored by the controls system for fault.

The hot water generation system shall be controlled by the central control panel to operate the boiler and heating circulation pump when heating is called for by the calorifiers.

Immersion Temperature sensors shall be provided within the calorifiers to monitor the hot water storage temperature and call for heating when required. Individual Three port motorised valves shall be provided on the primary water connections of the calorifiers to control the flow of heating water. These shall be controlled by the Trend system to maintain a storage water temperature of 65^{o}C.

Should a high shell temperature occur, as sensed by an automatically reset High Temperature thermostat, the three-way control valve will motor to the bypass position.

The water softening and filtration system shall be complete with standalone controls systems provided by the manufacturer. The controls specialist shall monitor the softening and filtration systems for a common fault and a low salt alarm condition and raise alarms on the head end computer.

20.2.5 AIR HANDLING UNITS AND EXTRACT FANS

The heat recovery air handling unit will operate under the dictates of the control panel time programme.

The unit shall be complete with their own integral control system, which will be enabled and monitored for faults by the control panel.

Hot water shall be provided to the heater batteries by a main heating circuit with duty/standby pair of heating pumps. These shall be controlled on a schedule according to outside air temperatures by modulating the three-way mixing valve under the dictates of a supply water temperature sensor.

20.2.6 BATHROOM EXTRACT VENTILATION

The Bathroom fans shall operate in trickle mode at all times and ramp up to full speed by means of local PIR sensors with run-on timer (adjustable).

The Contractor shall be responsible for final commissioning of the unit and adjustment of fan speeds where applicable to achieve the specified duty points.

20.3 CONTROLS PANEL GENERAL

Panels shall include all items necessary to enable the controls to operate as described.

The control panel shall provide the power supplies and switchgear for the following Plant and other equipment outlined in this specification.

The general siting of the control panels shall be as indicated on the drawings. The precise siting of the panel and access to within shall be as agreed with the Engineer before manufacture and installation. The cable entries shall be either top and/or bottom as required.

All fuses, control boxes, contactors, starters, indicator lamps and instruments shall be mounted in a steel control panel.

The panel shall be secured to the building fabric by means of rawlbolts (or equal and approved), and the panel casing shall incorporate integral lugs or drillings for concealed fixing.

The construction shall be of folded mild steel sheet of minimum thickness 2.5mm or of mild steel angle frame which supports sheets of mild steel of minimum thickness 1.25mm. No sharp edges or corners will be allowed, and all exposed screws, bolts or other fixings shall be rounded heads with protective and decorative plating.

The panel shall be adequately stiffened and reinforced as necessary to ensure rigidity and shall be provided with complete access to the interior by means of lockable hinged doors at the front and back as necessary. The control panel shall be the manufacturer's standard colour. All surfaces shall be properly prepared before final finishing and the external appearance shall be of a high standard.

Each section of the control panel shall incorporate a door interlocked switch so arranged that access to the interior is only possible with the switch in the 'OFF' position. The switch shall, however, incorporate a mechanical override mechanism so that the supply can be restored after opening the panel to assist in checking the operation of controls.

Fuses shall be grouped and mounted so as to be readily accessible without danger.

Three phase fuses serving individual circuits/equipment shall be positioned in line and together.

Internal equipment shall be secured to purpose-made rails or mounting bars. All fixings shall incorporate shake-proof washers or other vibration resistant fastenings.

All indicating lamps, instruments and controls shall be of the same manufacture and style, to provide uniformity of appearance and to facilitate maintenance. Externally visible equipment shall be flush mounted with minimum projection and be fixed securely to the front panels of other members.

Indicator lamps shall be under-run and shall be supplied from a low voltage output transformer complying with BS 3535, or shall incorporate individual step-down transformers having a low voltage secondary LED. Glasses of not less than 25mm (1") diameter shall be fitted.

Internal wiring shall be coded and in general shall be bunched and run on trays or in purpose-made slotted plastic cable trunking. All cables ends shall be permanently identified.

The control panel shall incorporate terminal strips in a position to suit incoming cables and to which internal PVC cables will be connected. The strips shall contain the requisite number of pinching screw terminals and shall be marked, identified or numbered with reference to the circuit schematic.

Grouped terminal blocks of adequate capacity with permanent labels shall be provided for all wires leading to equipment outside the panel. Removable covers or other facility shall be provided for the entry of incoming cables, conduits and trunking etc.

The insulation of wiring and cabling shall be taken up to the terminal with the minimum of bare conductor necessary for an efficient connection.

The security of the cables shall be such that no appreciable mechanical stress can occur on the wiring/cabling terminations.

The slack left on the cables and wires shall not be excessive, but sufficient to allow easy removal from the terminal or removal of the item for maintenance purposes.

The terminal spacing shall be sufficient to enable the termination to be re-made in situ without risk or making contact with other terminals or metalwork.

Mains power terminals incorporated within the panel shall have crimped socket lug or spade type terminals approved by the cable manufacturer.

All fuses shall be of the 500 volt totally enclosed H.R.C. cartridge type or MCCB's to BS. EN60898.

Devices protecting motor circuits shall be of the rating recommended by the manufacturer of the fuses with regard to the capacity, type, duty, full load and starting currents of the protected motor.

Where it is agreed by the Engineer that it is necessary to mount equipment on opening doors, all cables shall be fully supported so that the cables are not subject to strain and shall be so arranged as to coil free of the door opening when the door is closed.

20.3.1 Wiring

The Contractor shall supply and install all wiring for all mechanical plant and controls. The works shall be carried out in accordance with the current IEE Regulations.

The Contractor shall instruct the control panel manufacturer to include for terminal identification within the control panel and shall also arrange for the earliest possible issue of manufacturer's control wiring drawings.

The Contractor shall allow 7 working days for these drawings to be commented on/approved by the Contract Administrator before making a general issue.

Before advising the Contract Administrator of the completion of the field wiring, the Contractor shall test all wiring in accordance with the current IEE Regulations. After final connection the Contractor shall repeat all tests in accordance with the Regulations.

It is essential that the Contractor uses full wiring diagrams of the controls system since the drawings issued with these documents are for TENDER PURPOSES ONLY. The Contractor shall declare at the initial site meeting the anticipated date of issue of the control system wiring, so that all parties may programme their works.

20.3.2 Wiring System to be adopted

Wiring Systems shall be LSF insulated single core cables in galvanised conduits or trunking.

20.4 CONTACTORS

Contactors shall comply with BS EN 60947-4-1. They shall be rated in accordance with "uninterrupted duty" and "utilisation category" AC3, unless otherwise indicated or directed by the Engineer. All coils shall be 240V AC rectified to DC to avoid hum.

Contactors shall only be used for motor ratings less than 0.3 kW. Motor ratings above this shall have starters as detailed elsewhere.

Contactors shall normally be rated for 'intermittent' or 'frequent' duty, but where, due to the form of thermostatic or automatic control, the number of starts is likely to exceed 15 per hour, starters for 'frequent' duty shall be provided.

20.5 STARTERS AND MOTOR CONTROL EQUIPMENT

Starters and control equipment shall be correctly matched to the motor rating.

The type, duty and electrical characteristics of starters shall be as stated elsewhere in this Specification, but all starters for main supply motors of 370 watts and above shall include the following:-

One adjustable overload release per phase, correctly matched to motor, to be controlled and set to provide proper protection.

Three phase starters shall be fitted with means (in addition to (i) above) to provide immediate automatic disconnection of the supply in the event of a supply failure on any one phase.

“HAND / OFF / AUTO” switches, unless otherwise indicated specifically.

All starter operating coils shall be suitable for single phase A.C. operation unless otherwise shown as D.C. with integral bridge rectifier on the controls wiring schematic.

Starters and control circuits shall be protected by fuses of the HRC cartridge type complying with BS 88 or MCCBs to BS. EN 60898, appropriate MCB’s will be acceptable as an alternative to HRC fuses shall be grouped and mounted so as to be readily accessible without danger. One spare set of fuses for each rating of fuse installed shall be supplied and fitted on the inside of the panel door or in some other conveniently accessible position.

Starters shall normally be rated for 'Intermittent' or 'Frequent' duty, but where, due to the form of thermostatic or automatic control, the number of starts is likely to exceed 15 per hour, starters for 'Frequent' duty shall be provided.

The types of starter to be used are listed below:

Motors up to 0.37 kW (0.5 h.p.) output - ON/OFF switch or direct on line (or contactor where automatic control required).

Over 0.37 kW (0.5 h.p.) and up to 5.5 kW (7.5 h.p.) - Direct on line.

Over 5.5 kW (7.5 h.p.) - Star Delta, or other approved form of assisted start.

Where specified or indicated on the schedules or drawings, starters shall be fitted with additional contacts to give remote indication.

20.6 TESTING OF CONTROL PANELS

The panels shall, as far as is practicable, be manufactured, equipped, wired and tested before delivery to site.

The manufacturer of the panel, together with the control and instrument suppliers, shall jointly commission the installation on site.

20.7 CABLES LSF INSULATED

LSF cables shall consist of stranded annealed copper conductors, LSF insulated, to BS 7211. No LSF insulated cables of nominal cross-sectional areas less than 1.5mm² (7/0.50mm) will be permitted.

No single strand LSF insulated cables will be permitted.

No through joints will be permitted in any cable without the Contract Administrator's prior approval.

20.8 TERMINATION OF LSF CABLES

LSF insulated cable terminations at distribution boards, accessories, equipment etc., shall be run in a neat and uniform manner, to the appropriate terminals and wherever possible, a length of slack cable shall be left at each termination.
Conductors up to 4mm cross-sectional area shall be doubled over before insertion into terminal barrels wherever possible.

20.9 CONDUIT STEEL SCREWED

Screwed steel conduit and fittings shall be to BS.4568, Parts 1 and 2.

No conduit having a nominal diameter of less than 20mm shall be used.

Conduit and fittings installed throughout shall have Class 4 protection (i.e. Heavy Protection both inside and outside) galvanised.

With galvanised conduits, ALL accessories used in conjunction therewith shall be galvanised.

20.10 CONDUIT FLEXIBLE

Flexible conduit shall comprise layered leaded steel and kraft paper and black PVC outer sheath and shall be as manufactured by Kopex International Ltd. For normal use 'LS1 PVC Pliable' or equal and approved.

Where the temperature in use is likely to exceed 105□C high temperature type 'LS1 - Pliable' shall be used or equal and approved.

Connectors shall comprise aluminium bodies, with nylon compression ring and galvanised steel back nut, as supplied by the conduit manufacturer, Type C12 or equal and approved.

20.11 CONDUIT ACCESSORIES

Conduit boxes installed for draw-in purposes on single conduit runs shall be of the standard circular pattern, with spouts to take conduit ends to the correct length.

Deep boxes or extension rings on standard boxes shall be used where necessary to bring the front face of each box flush with the finished surface of the wall or ceiling.

Where many conduits converge, large malleable cast iron boxes or approved sheet steel adaptable boxes may be used, in order to preserve neatness and avoid crossing of conduits. At sheet metal boxes the conduits shall be rigidly connected mechanically and electrically by screwed couplings.

In all accessories mentioned, conduits shall be screwed tightly.

20.12 INSTALLATION OF CONDUIT, GENERAL

Where the finish of steel conduits has been impaired by installation, by installation operations or rust, it shall be made good by thoroughly wire brushing and painting with zinc rich paint.

Where conduits cross structural expansion joints, the rigid conduit shall terminate in a circular through box at either side of the joint and the joint shall be spanned with a short length of flexible conduit. Earth continuity shall be maintained between the two sections of conduit by a circuit protective conductor of appropriate cross-section.

This circuit protective conductor shall be terminated at a tag type connector and fixed by means of a brass round head screw drilled and tapped into the bottom of the conduit box and clamping the earth continuity conductor between two suitable brass washers.

The conduit shall be properly and tightly jointed between the various lengths and into the fittings into which it runs or terminates, so that the wiring is continuously and effectively protected throughout its length. The conduit shall in no part be under undue mechanical stress.

The conduit throughout shall be of sufficiently large section and so arranged with draw-in boxes to allow easy draw-in or out of any one or of all the cables in the conduit system.

All conduit boxes and accessory boxes shall be securely fixed by no less than two screws. All fixing screws shall be roundhead, except for use with distance saddles and where pre-countersunk holes are provided in equipment cases, or boxes, when countersunk screws shall be used. Countersunk screws shall be used. Countersunk holes shall be sufficiently drilled to prevent screw heads projecting and possibly abrasing cables.

Brass or sheradised screws shall be used with Class 4 Protection.

Conduit runs shall be determined by the Contractor and agreed by the Contract Administrator before any work is started. Conduit shall be run at least 150mm clear of plumbing and mechanical services, unless otherwise indicated, or with the Contract Administrator's prior written approval.

Conduit run on the surface shall be run truly vertical, horizontal or parallel with the features of the building. Where bends and sets occur in multiple conduit runs, they shall be arranged symmetrically to present a uniform and neat arrangement.

When installing conduit care shall be taken to ensure that the runs do not obstruct equipment or impede access for maintenance purposes or obstruct headroom.

Fixing saddles generally shall be of the spacer bar type.

For use in external situations, adaptable conduit boxes shall be of the malleable cast iron galvanised type with a machined surface around the perimeter mating with a similar machined surface on the box.
Where special fixings or straps are required these shall be protected and painted as specified.

The inside surface of the conduit, the ends of the conduit and all fittings used in connection therewith shall be smooth, free from burrs and other defects.

Where conduits are laid "in situ" concrete or laid on structural floors for concealment within floor screeds, the Contractor shall provide proper attendance and supervision by a competent person whilst concrete pouring or screed-laying is being carried out by others, to ensure that the conduit work remains in good condition and in the correct position and that any damage or displacement is remedied.

Manufactured tees or elbows will not be permitted, except that with the prior written approval of the Contract Administrator, "back outlet" inspection elbows may be used in such special circumstances as and when surface run conduit is necessarily taken around beams or columns.

The total conduit length between draw-in points shall not exceed 10m for straight or near straight runs, or 8m for runs including 2 right-angle bends, without the Contract Administrator's prior written approval.

Where necessary, conduits may be fixed to structural steelwork by approved purpose-made clips, but drilling of such steelwork will not be permitted without the Contract Administrator's prior written approval.

The Contractor shall supervise the preparation of chases by others and shall ensure that they are sufficiently deep to provide at least 15mm cover over conduits.

Where it is necessary to cross conduits in floors they must be so set as to form the minimum diversion compatible with the provision of adequate cover over the conduits.

Conduits must be securely fixed to prevent movement and mechanical damage by others during building operations.

In all cases where a sunk conduit leaves a ceiling, wall or floor, a joint shall be made such that the conduit coupling is left accessible at or near to the point where the conduit becomes exposed.

All conduits and accessories shall be fixed and completed before wiring in any particular section is commenced. On flush installations, draw-in boxes shall remain accessible on completion for possible future re-wiring. Cables shall not be drawn-in until plasterers, screeds, etc., have been supplied and have set, and the conduits have been swabbed out.

Plugs shall be fitted at all open conduit ends to prevent the ingress of plaster, or other foreign matter which could cause blockage of the conduit.

All accessory boxes used in conjunction with conduit systems shall be standard depth. Plaster depth boxes will not be permitted.

20.13 INSTALLATION OF SCREWED STEEL CONDUIT

Surplus screwing lubricant shall be wiped from threads prior to fixing of the conduit.

For screwed steel conduit termination, a hexagonal smooth bore male brass bush shall be screwed in to the socket from the inside of the case and the shoulder of the bush shall be pulled up tightly against the inside of the case or box.

Bends shall be made on a pipe bending machine fitted with formers of the correct size and radii for the particular conduit.

Exposed conduit threads shall be given a coat of zinc rich paint.

The fixing centre dimensions shall not exceed 1.5m on vertical runs or 1.2m on horizontal runs.

20.14 TRUNKING STEEL

Steel cable trunking shall be provided where indicated or agreed by the Contract Administrator to avoid multiple conduit runs. Steel cable trunking shall be to BS. 4678, Part 1. Trunking shall be Class 3 throughout, galvanised inside and outside.

All Cable Trunking shall be steel unless specifically indicated or specified otherwise.

The access cover plate of the trunking shall be removable in easily handled sections over the entire length of straight runs and fixed by rustproof mushroom or dome head screws. Self-tapping screws will not be accepted. Overlapping collar sections or other similar linking arrangement shall be provided at the junction of the various sections of the trunking. The cross-sectional area of the trunking shall not be restricted at any point.

Positive continuity links shall be supplied and fixed at all trunking joints and inter-connection points.

Manufacturer's standard fittings shall be used. Only where these are inadequate to meet special local situations will fabricated fittings be accepted.

Where special fittings or sections of trunking are fabricated, they shall be prepared and finished to the same standard as manufacturer's standard items.

Standard flanged couplings shall be used to terminate trunking at apparatus and at adaptable boxes.

The practice of cutting and bending the material of the trunking to form flange attachments will not be accepted.

Connections between trunking and apparatus shall be by screwed coupler and bush, or a standard flange coupling or an adaptor neck, fabricated or cast. Direct attachment of trunking to apparatus will only be permitted if cable entries are provided with smooth bore bushes or grommets and the return edge of the lid of the trunking is left intact.

Fixing screws shall be round head except where countersunk holes are provided when countersunk screws shall be used. Countersunk holes shall be sufficient to prevent screw heads projecting into trunking and abrasing cables.

Brass or sheradized screws shall be used with Class 3 Protection.

Vertical runs of trunking shall be fitted with pin racks or other type of cable support approved by the Contract Administrator at not more than 2m intervals to carry the weight of the cables.

Internal cable retaining clips shall be provided at intervals of not greater than 900mm to retain cables in trunking when covers are removed.

Trunking shall be at least 150mm clear of plumbing and other mechanical services, unless otherwise indicated, or with the Contract Administrator's prior written approval. When installing trunking, care shall be taken to ensure that the runs do not obstruct equipment or impede access for maintenance purposes, or obstruct headroom.

Where fixed surface trunking traverses construction expansion joints, the trunking shall incorporate a sliding joint capable of taking up the possible structural movement. This shall be achieved by means of an inner sleeve to the body and an outer masking section to the lid of the trunking. A flexible copper braided tape shall be fixed across the joint to ensure continuity.
Where trunking passes through floors, walls, partitions or ceilings, internal fire resisting barriers shall be provided to prevent the spread of fire.

The fire barriers shall comprise 'Fireblock' material as manufactured by Dufaylite Developments Ltd., or other approved asbestos-free material.

Where steel trunking has been cut after manufacture, the cut ends shall be protected by painting with two coats of zinc rich paint and two coats of paint to match the trunking finish.

20.15 ARMOURED CABLES, XLPE SWA LSF

Armoured cables shall comprise sector shaped conductors, XLPE insulated, bedded, armoured and LSF sheathed overall.

The cables shall be to BS. 6724, Category A. Voltage designation 600/1000 Volts.

Conductors shall be stranded copper as indicated on the drawings.

Armouring shall be steel wire as indicated on the drawings.

20.16 INSTALLATION OF ARMOURED CABLES

Armoured cables shall be laid on cable ladders or tray, racked on hangers, run in cleats, laid in service ducts, drawn through stoneware ducts or buried direct in the ground as specified or indicated.

These Works shall include the supply of all such cable ladders, hangers and cleats.

Every cleat, hanger or cable ladder or other fixing shall be of adequate size and securely fixed to the structure as indicated.

All hangers and similar metal accessories used externally shall be galvanised. In other situations they shall be protected with one coat of metal primer red lead paint, and one coat of black bituminous paint.

20.17 JOINTING AND TERMINATING ARMOURED CABLES

Joints in armoured cables shall be avoided as far as possible and joints will only be allowed with the prior written approval of the Contract Administrator.

Joints shall be of the cast resin type and shall be made utilising only components and techniques recommended by the Cable Manufacturers for the particular application, and strictly following the manufacturer's published instructions.

The jointed cores shall be insulated over the ferrules with LSF tapes coated with LSF paste and arranged inside a split mould. The mould shall then be filled with resin which, on setting, produces sufficient heat to cure the LSF paste and provides an impervious LSF covering over the ferrules, firmly 'vulcanised' to the core insulation.

The cable armouring bond shall be made electrically continuous by means of two continuity clamps on each side of the joint and a copper bond shall be provided across the joint such that the final continuity of the completed joint is at least twice that of the equivalent conductivity of the armouring removed.

Cables shall not be cut jointed or terminated in the open during inclement weather, unless adequate precautions to the satisfaction of the Contract Administrator are taken, to prevent the ingress of moisture into the joint or cable end.

Every joint made shall be witnessed and approved by the Contract Administrator before the joint is encapsulated.

A minimum of seventy-two hours notice shall be given to the Contract Administrator prior to the commencement of any joint.

Each joint shall be completed on the day started. Armoured cables shall be terminated using proprietary cable dividing boxes and glands.

Cable glands shall be to BS.6121.

All glands shall be fitted with polychloroprene (PCP) gland shrouds.

Armoured cable conductors shall be terminated or jointed strictly in accordance with the cable manufacturer's recommendations, using components and tools manufactured by them and following their published instructions.

Armoured cable connections to component terminals where the rated current carrying capacity is more than 60A shall be fitted with cable sockets, appropriate to the system of termination adopted.
Cable terminations shall be made using either compression crimped ferrules or sockets.

20.18 CABLES MINERAL INSULATED COPPER SHEATHED (MICS)

Cables shall have solid copper conductors and copper sheath, and shall be manufactured to BS. 6207.

Cables shall normally be 500V Class (light duty). Where the nominal cross-sectional area of conductor or the number of cores required is outside the range of 500V Class (light duty), then 750V Class (heavy duty) cables shall be used. Cables shall be of one manufacturing origin.

Mineral insulated cables shall be served with an orange LSF sheath of low smoke and halogen free plastic specified and/or indicated on the drawings for a particular service. The fire performance of cables shall comply with BS 6387, Category CWZ.

20.19 INSTALLATION OF MICS CABLES

Mineral insulated cables shall be run on the surface and/or supported on cable tray.

Multiple cable runs shall be in flat formation and single core cables shall always be run alongside each other. Where groups of more than four cables follow the same route, they shall be supported on cable trays.

Cables shall be fixed by means of LSF coated copper saddles of the correct size for the cables and one, two, three or four-way as required. All saddles shall be two screw fixing and shall be fixed by means of brass round head screws. Where fixed to cable trays, brass nuts with washers shall be used. The spacing of the saddles shall not exceed the dimensions indicated below:-

Vertical Runs	-	Diameter of Cable x 60
Horizontal Runs	-	Diameter of Cable x 40

Any bend in a cable shall have an inside radius of not less than six times the overall diameter of the cable.

No through joints will be permitted in any cable, without the Contract Administrator's prior approval.

20.20 TERMINATING MICS CABLES

Conductors up to 4mm² cross-sectional area shall be doubled over before insertion into terminal barrels, wherever possible.

All MICS cable terminations shall be protected and sealed with screw-on pot type seals, utilising cold plastic compound. The seals shall be of the earth tail type, approved by the Cable Manufacturer.

For connections to conduit boxes, accessories or equipment, brass compression type fittings shall be used with compression nut, ring and universal gland, fitted with locknut and bush. To eliminate gland and seal protrusion into plain hole accessory boxes, glands incorporating male bushes shall be used.

Terminations to motors and/or equipment subject to vibration should have an anti-vibration loop installed.

Earth tails shall be connected to earthing terminals within the box or component connected.

For general applications the seals shall incorporate resin bonded stub caps and LSF insulators and extension sleeving using appropriate compounds as recommended by the Cable Manufacturer for operation up to 105°C.

For terminations at outlet boxes to which enclosed tungsten luminaires are to be fixed, and elsewhere as specified or directed by the Contract Administrator, the seals shall incorporate a ceramic cap, PTFE sleeving, utilising appropriate compounds as recommended by the Cable Manufacturer for operation up to 185°C.

Where PVC sheathed MICS cables are terminated an LSF of the same colour as the sheathing and of the correct size shall be fitted over the cable from the sheath end to the entry point of the accessory or component to form a neat and effective seal.

The sleeved conductors of MICS cables terminated in panels, distribution boards, etc., shall be run in a neat and uniform manner to the appropriate terminals and a small loop left adjacent to each termination. Terminations local to the point of entry to the panel with link cables to the panel terminals will not be permitted.

A 500V instrument shall be used to check the insulation resistance of completed seals. The reading shall be infinity in all instances.

Repairs to a cable copper sheath, regardless of the extent of the damage, will not be accepted.

All MICS cable connections to component terminals where the rated current carrying capacity is more than 60 A, shall be fitted with soldered cable sockets.

20.21 CABLE TRAYS

Cable trays shall be manufactured from sheet steel. The thickness of the sheet steel shall be 1.25 metric gauge (18 swg) up to 225mm (9") sizes and 1.65 metric gauge (16 swg) for sizes from 225mm (9") to 450mm (18").

Cable trays shall have solid flanges at right angles to the tray to provide rigidity.

Cable trays shall have a galvanised finish.
Where multiple runs of small cables are required, particularly when mineral insulated cables are in use, they shall be run on perforated cable tray.

Cables shall be fixed to tray work with saddles of the type and spacing set out in the sections covering the respective cables.

20.22 ELECTRIC SUPPLY

Electric equipment shall be suitable for the electricity supply, the characteristics of which are: 400 volts, 3 phase, 50 Hz or 230 volts, 1 phase, 50 Hz

20.23 ELECTRIC MOTORS

All electric motors, apparatus and equipment supplied as part of these Works shall, except where otherwise specified or specifically permitted by the Contract Administrator, be completely in accordance with the latest relevant British Standard.

All equipment and apparatus shall be of sound construction both mechanically and electrically. All internal connections shall be in a type, size and grade of conductor and insulation suitable for the conditions of temperature within the equipment or apparatus and for the electrical duty for which such connections are made. Such

connecting wires and cables shall be so run and secured as to prevent mechanical damage. Terminals shall be suitably sized and so positioned or shrouded so as to prevent accidental contact or damage.

Except where otherwise specifically permitted no equipment or apparatus shall be accepted which has mechanical or electrical characteristics which lead directly or indirectly to non-compliance with the Regulations of the Institution of Electrical Engineers.

All interconnecting circuit wiring indicated as part of these Works shall be completely in accordance with the Regulations for Electrical Installations issued by the Institute of Electrical Engineers.

Wiring connection diagrams and all other similar relevant data necessary to carry out all wiring and interconnections shall be submitted to the Contract Administrator for approval prior to the commencement of the installation.

The type of motor, enclosure, duty, speed and electrical characteristics shall be as stated in the detailed sections of the Specification. Each motor shall be supplied with a rating plate to the appropriate B.S.S. and shall be fitted with a substantial terminal box arranged for the reception of conduits or metal sheathed cables.

Should any motors with a rating of 5.5 kW and above be specified these shall have assisted start, star delta starters, or other form of assisted starting as specified elsewhere in this specification. Therefore, motors of these ratings shall have 6 terminals. All motors shall be corrected to 0.9 pf lagging, but never greater than 85% of the no load magnetism of the motor and this shall be carried out by the manufacturers. Should the Contractor fail to comply with this requirement, he shall be obliged to modify the motors on site entirely at his own expense.

Connections to motors shall be made by the use of flexible conduit from the motors local isolator.

The flexible conduits to be sheathed overall with black LSF compound.

20.24 LOCAL ISOLATION

All items of plant shall have local isolators for maintenance purposes. All isolators shall be 7-pole, TP&N, 3-pole or SP&N as indicated. The isolators shall be manufactured and tested to BS EN 60947 - 1.

20.25 LABELS AND IDENTIFICATION

Non-inflammable labels shall be supplied and fixed by brass headed instrument screws or by other means approved by the Contract Administrator to the outside of all items of electrical apparatus supplied as part of these Works.

Labels shall be clear Perspex, engraved on the back with cyphers of general height 5mm but proportionately larger where appropriate. The cyphers, after engraving, shall be filled in black or such other colour as the Contract Administrator may direct.

Alternatively, the labels may be of the sandwich type such that the engraving and filling are totally enclosed by the front, clear Perspex element of the sandwich.

The labels shall adequately describe the function of the equipment or unit in accordance with the details on the record drawings.

Motors which are automatically controlled shall be provided with a prominent label of durable material, bearing in clearly inscribed characters the following legend:

DANGER - THIS MOTOR IS AUTOMATICALLY CONTROLLED AND MAY START WITHOUT WARNING - ISOLATE BEFORE INSPECTION.

20.26 EARTHING AND BONDING

The Contractor shall include for earthing the whole of the installation.

The frame of the sub-main switchgear, all conduits, trunking and metal enclosures, the sheath of all metallic covered cables, the cases and enclosure of all switchgear, fusegears and all apparatus of an electrical nature shall be so connected as to effectively form a continuous bonded earthing system, directly connected at the earth point. All non-metallic joints in pipes and ductwork shall be bridged with a 4.0mm² bonding connection.

All metalwork which may provide a path to earth such as components of hot and cold water systems shall be effectively bonded to the electrical earthing system.

The resistance between any point on the bonded system and the main earth shall not, under any circumstances exceed 0.5 ohms when tested in accordance with the current IEE Regulations.

Every copper tape connection shall be made with not less than 10mm diameter cadmium plates bolts and nuts.

Full tests are to be made on the completion of the installation and these tests shall be carried out in accordance with the latest appropriate B.S. and reports on the tests submitted to the Contract Administrator.

20.27 PROTECTION AGAINST EARTH LEAKAGE CURRENTS

In addition to the earthing and bonding as specified the Contractor shall include and arrange for protection against earth leakage currents in accordance with the current edition of the I.E.E. Regulations for the Electrical Equipment of Buildings.

20.28 TESTING OF ELECTRICAL CIRCUITS

i. The Contractor shall be responsible for providing four copies of all tests carried out and forwarding the test sheets to the Contract Administrator.

ii. Tests shall be carried out in accordance with British Standards, I.E.E. Regulations and manufacturers' requirements.

iii. Three days' notice shall be given by the Contractor to the Contract Administrator so that should the Contract Administrator wish to do so, he may witness the tests.

iv. Electrical wiring to mechanical plant equipment and controls shall be the responsibility of the Contractor and he shall include for a complete operational installation, tested and fully commissioned.

20.29 DEMARCATION

These works shall include for a new sub-main by the Electrical Contractor to the control panels. These cables shall terminate into a 100A TPN switch, to be confirmed with the Electrical Contractor, by the Mechanical Contractor upon receipt of order. Final connection from this switch to the control panels shall be carried out by the Mechanical contractor.

All power and control wiring and containment within the plantrooms shall be by the Mechanical Contractor.

All control wiring and containment outside the plantrooms shall be by the Mechanical Contractor.

Fused spurs for all power supplies to main mechanical plant items required outside the plantrooms for plant items not powered from the Mechanical Control Panels shall be provided by the Electrical Contractor adjacent items of Mechanical plant. The Mechanical contractor shall connect the Mechanical plant to these isolators. All required power supply locations and sizes are to be confirmed with the Electrical Contractor, by the Mechanical Contractor upon receipt of order.

Minor items of mechanical plant such and valve actuators, controllers, sensors etc shall be powered from the local mechanical control panel.

SECTION 21

21 ABOVE-GROUND DRAINAGE/SANITARY PLUMBING AND RAINWATER

21.1 PRELIMINARIES

This specification shall be read in conjunction with the Preliminary Clauses for the engineering services.

21.2 SCOPE OF WORKS

This specification document is for the sanitary plumbing works and shall be read in conjunction with all other relevant contract documents.

The work is to include the complete supply, installation, testing and commissioning of all materials, equipment and plant for the installation of the soil, waste and rainwater drainage works above the sub-basement floor slab level in the building.

The installation shall be to the satisfaction of the Contract Administrator and in accordance with the requirements of the current version of the Building Regulations, including that of giving the necessary statutory notices.

In addition, the following British and European Standards shall apply:

- BS EN 12056 Parts 1-5, and 8000.
- Building Regulations 2000 Approved document 'H'.

The works generally comprise the installation of new systems for the safe and efficient discharge of foul, waste and rainwater to the underground drainage systems.

Rainwater from all roof/terrace areas of the building shall be collected through a system of internal and external rainwater pipes and carried down to the below-ground surface water drainage external to the building. All externally located pipework shall be painted black (primer and finish coat).

The discharge from sanitary fittings in the bathrooms, toilets, kitchens and utility rooms shall be collected through a fully ventilated system of soil waste and ventilating pipes.

Condense drainage from the boilers, fan coil units and humidifiers shall be taken to the nearest soil vent pipe or floor gully, as shown on the drawings. Where the condensate drain connects to a soil vent pipe, the connection shall be made via a water-less trap.

Similarly, pressure/temperature relief drains from hot water cylinders shall be drained via the appliance tundish and water-less trap direct to the nearest SVP as indicated on the scheme drawings.

The Contractor shall be responsible for the production of detailed working drawings as required for the proper installation of the works. The Contractor is to liaise and coordinate the works with other trades and services as necessary.

Pipework passing through or across living accommodation, i.e. bedrooms, living rooms, other areas sensitive to noise, shall have acoustic insulation applied.

Pipe brackets shall have an insert of a neoprene/rubber gasket between pipe surface and inside face of joint ring to prevent noise transfer to structure. Pipe insulation shall be as EEC Acousti-Clad 5 system, comprising a 25mm thickness mineral wool, a layer of "lead-lined core" and then a further layer of mineral wool to give a max. thickness of approx. 55mm.
Gaps between the insulation shall be sealed with an aluminium foil tape.

There shall be no annular space between the pipe+lagging O.D. to the internal surfaces of the boxing, i.e. no touching surfaces.

21.3 SCHEDULE OF MATERIALS

21.3.1 General

Soil vent and rainwater pipes shall be cast iron, WC branch connections and waste pipes shall be cast iron or copper.

Connections from sanitary ware shall connect to stacks in plastic, all other drainage pipework, including condensate and safety relief drains shall be cast or copper

Pipework materials shall be in accordance with the following requirements.

21.3.2 Soil and Vent Pipes, Rainwater pipes and Stub Stacks (Internal)

Pipe	Fittings
Socketless cast iron to BS EN 877 from Saint Gobain Ensign range.	Flexible mechanical joints to BS EN 877.

21.3.3 Rainwater Pipes (External)

Externally located cast iron soil and rainwater pipes and fittings shall be manufactured in compliance with BS 416 Part 1, 1990. Spigot and socketted traditional LCC pipes and fittings finished painted black, as or similar to “Harmer LCC socketted soil and waste systems” for external use only.

The manufacturer’s installation, jointing, testing and support procedures shall be strictly adhered to.

Cast iron Heritage style rainwater hoppers shall be as per Architect’s requirements.

21.3.4 Branch Soil Pipes

Pipe	Fittings
Socketless cast iron to BS 416 (internal use only)	Flexible mechanical joints to BS 6087
Socketless cast iron to BS EN 877 (internal use only)	Flexible mechanical joints to BS 6087
Socketed cast iron to BS 416	Caulked lead joints
PVC-u to BS 4514	Push-fit or solvent welded joints to BS 4514

21.3.5 Waste Stacks and Stub Stacks

Pipe	Fittings
Socketless cast iron to BS 416 (internal use only)	Flexible mechanical joints to BS 6087
Socketless cast iron to BS EN 877 (internal use only)	Flexible mechanical joints to BS 6087

Socketed cast iron to BS 416	Caulked lead joints
Copper tube to BS EN 1057 – R250 54 x 1.2 66.7 x 1.2 76.1 x 1.5 108 x 1.5	Copper or copper alloy non-dezincifiable capillary fittings to BS EN 1254-1

21.3.6 Branch Waste Pipes and Condensate/P.T.R. Drains

	Pipe	Fittings
	Copper tube to BS EN 1057 – R250 35 x 1.2 42 x 1.2 54 x 1.2 66.7 x 1.2 76.1 x 1.5	Non-dezincifiable capillary type to BS EN 1254-1

21.4 INSTALLATION

All supervisory site staff shall be qualified and hold a Final City and Guilds Certificate in plumbing and/or be Registered Plumbers.

Unless more stringent requirements are stated in this Specification, all site works shall be in accordance with BS EN 12056.

21.5 PIPEWORK GENERAL

All pipes and pipe fittings shall be carefully examined before fixing. Defective items shall be replaced.

Jointing rings, couplings and adaptors shall be of types recommended and supplied by the manufacturer of the pipes to be jointed. Joint rings shall be carefully stored in bags as delivered and not exposed to sunlight.

Particular care shall be taken that all pipework is erected and secured truly parallel and plumb with vertical surfaces. All horizontal pipework shall be arranged with falls as specified in BS EN 12056 to ensure a self-cleansing system.

All branch connections to horizontal pipework shall be swept in the direction of flow. Long runs of pipework shall be erected so that stresses of expansion and contraction, due to temperature variation, are taken up by expansion joints.

Where expansion devices are used they shall be of similar material to the pipe, installed in line with the axis of the pipe and shall be free from compression, tension or torsion. Expansion devices shall be installed in accordance with the manufacturer's recommendations.

Where pipes pass through fire compartments, walls, floors and in-fill slabs, sleeves shall be fitted to allow free axial movement of the pipes. Sleeves shall be of a material compatible with the pipes they protect, non-combustible and of a minimum bore to allow such movement The length of sleeve shall be sufficient to finish flush with the finished wall or, where passing through floors, to protrude 6mm above and below the finished floor thickness and any gaps between the structure and pipe penetration shall be filled with a fire rated material.

Generally, the location of soil and waste services pipework shall take account of all new services contained in the ducts, voids and false ceiling spaces, which form part of this project, and a co-ordinated arrangement agreed prior to installation work. Due allowance must be made for future access to soil and waste pipes. Where mechanical joints are used on pipework they shall remain accessible for future maintenance purposes.

Split slip-on wall and floor cover plates shall be provided as a finish to pipework, up to and including 50mm diameter in occupied areas other than plant rooms and service voids. Samples shall be submitted to the Contract Administrator.

Union type fittings shall be provided to make up to sanitary fitting waste outlets on pipework up to and including 50mm diameter.

Joints in pipework shall not be made within the thickness of walls and floor, or where they would later be built in, wherever this can be avoided.

Jointing material shall not project into the bore of pipes, fittings or appliances.

Access doors shall be fitted at the foot of each vertical stack, at all floor levels and also at junctions to horizontal branches of 50mm diameter and over, with the exception of pipework in false ceilings, floor voids and within floor screeds/finishes, to enable the complete piping system to be internally cleaned and rodded.

Access caps/doors shall be fitted at ends of all horizontal pipework, at junctions, and at changes of direction on branch pipework, with the exception of pipework in false ceilings, floor voids and within floor screeds/finishes.

Soil, waste and vent stacks above each highest branch shall be continued upwards at the full diameter to terminate to atmosphere as indicated on the drawings.

Joints between branch soil pipes and WC pan spigots shall be made by the use of a suitable flexible WC connector.

All pipework in ceiling or floor voids shall be fitted with 25mm thick foil-backed acoustic lagging, as well as vertical pipework running through bedrooms, living/dining rooms, sitting rooms and all other areas where noise is to be kept to a minimum. Pipework I.D. shall be fitted.

Where baths and WCs connect to SVPs at the same level, a cast iron manifold fitting shall be employed to facilitate this connection.

21.6 PIPEWORK

21.6.1 Cast Iron Pipework

Cast iron pipework and fittings shall be to BS EN 877. Pipework will be from the Saint Gobain Ensign range.

Bends, branches and other accessories shall be from the same supplier.

Before jointing pipework any cut ends shall be coated with an epoxy paint.

Access doors shall be provided to all soil stacks at all levels, in a location to be agreed and coordinated with other services/joinery etc.

All joints shall be made in accordance with the pipework manufacturer's recommendations.

21.6.2 Ductile Iron

Ductile iron pipework and fittings shall be to BS EN 598. Pipework shall be from the Saint Gobain Ensign range.

Bends, branches and other accessories shall be from the same supplier.

Before jointing pipework any cut ends shall be coated with an epoxy paint approved by the pipework manufacturer

Pipework shall be pointed using one of the following methods:-

Ductile Iron Flanges to PN16:
Rapid Push Fit with anchor gaskets:
Rapid Mechanical joints:

All joints shall be made, restrained and supported in accordance with the pipework manufacturer's recommendations.

21.6.3 Copper Pipework

Bends, springs and sets in R250 (half hard) tubing, up to and including 42mm diameter, may be made where standard fittings cannot be used or where this method will give a neater appearance. Pulled bends or offsets which show flattening, rippling or restriction of the bore will not be accepted.

Fittings incorporating screwed threads to BS 21 shall be jointed by systems using materials and compounds complying with BS 5292, or with PTFE tape.

Joints between copper tubes and capillary type fittings shall be made in accordance with the manufacturer's recommendations. Self cleaning fluxes shall not be used.

Joints between copper tubes and compression type fittings shall be made in accordance with the manufacturer's recommendations.

Joints between copper tubes and cast iron pipes shall be made by the use of a cast iron boss pipe and a copper to BSP adaptor.

21.7 PIPEWORK SUPPORTS

21.7.1 General Requirements

Pipework supports shall be provided in accordance with the following table and either side of bends.

Pipe Material	**Pipe Size (mm)**	**Vertical Pipes (mm)**	**Low Gradient Pipes (m)**
Cast iron to BS 416	All sizes	3.0	3.0
Cast iron to BS EN 877 Ductile Iron to BS EN 598	All sizes	3.0	1.5
Copper	28 35 – 40 54 66 – 108	2.4 3.0 3.0 3.6	1.8 2.4 2.7 3.0

Multiple pipe supports for pipes of differing sizes shall be spaced at intervals required for the smallest pipe.

Suspended type pipe hangers and accessories shall be constructed and assembled in accordance with BS 3974 Part 1.

The type of pipe hanger clip or hoop used shall be selected according to the application, special provision being made in instances where the piping or tubing is subject to axial movement due to thermal expansion and/or contraction.

Where the Contractor proposes to support pipes on cantilevers of fabricated mild steel section, either bolted or welded, he shall submit full details of his proposals to the Contract Administrator for acceptance prior to ordering or fabrication.

Where individual fixings require cutting for and building into the building structure, the Contractor shall arrange for positions to be marked out on the building for acceptance by the Contract Administrator before cutting out and fixing.

Contact between dissimilar metals must be prevented.

Socketless pipe systems shall be supported adjacent to every joint using brackets supplied by the pipe manufacturer at centres and fixings in accordance with manufacturer's fixing instructions. 3m lengths shall have a minimum of two brackets. Long sections of drain shall be laterally braced to the structure with angle section mild steel brackets to prevent horizontal movement.

Angle section mild steel thrust brackets shall be fitted at vertical bends to prevent axial movement of suspended pipes.

Pipes in shafts shall be fixed with two-piece eared type holderbats bolted together with cadmium plated mild steel bolts and nuts and screwed to shaft walls using 50mm No. 10 cadmium plated mild steel screws and plastic wall plugs.

All steel brackets shall be wire brushed clean of rust and then painted with one coat of red oxide paint prior to erection. Following erection and installation of the piping, the brackets shall be painted with one additional coat of red oxide paint.

Exposed pipework fixed to walls in occupied areas shall be supported on brass or mild steel pipe rings as appropriate with screw on backplates.

21.8 TESTING

21.8.1 Pipework

Gravity

The methods to be adopted for the testing of gravity pipework shall be those set out in Section 4 (Inspection and Testing) of BS 8000-13. Smoke shall not be used for the detection of leaks.

The methods to be adopted for performance tests shall those set out in BS EN 12056.

21.8.2 Initial Test

All internal pipework and jointed external pipework, shall be tested with air as soon as practicable after installation and before enclosing with shaft walls and suspended ceilings etc.

21.8.3 Final Test

On completion of installation and connection of all sanitary appliances, a further air test shall be carried out.

Pipes shall be tested by air pressure at 50mm wg (494Pa) held constant for 5 minutes.

21.9 SANITARY APPLIANCES

21.9.1 General

The sanitary appliances shall be fixed only as specified on the Sanitary Fittings Schedules.

21.9.2 Protection

Protective coverings shall be retained, when practical, during and after fixing.

All packing and protective wrapping etc. shall be completely removed from inside and outside of all appliances prior to Practical Completion.

21.9.3 Installation General

Where masonry walls are faced with ceramic tiling, wall plugs shall be pushed beyond the back face of the tiling.

Floor standing appliances shall be bedded in suitable mastic and secured with screws and not bedded in cement mortar unless so specified.

Only brass or stainless steel screws shall be used throughout.

Taps and waste fittings shall be bedded using washers or suitable mastic. Any surplus mastic shall be cleaned off immediately after installation.

When an appliance is fed with both hot and cold supplies the hot tap shall be fixed on the left hand side and the cold on the right when viewed from the front, unless otherwise specified.

Appliance traps shall be of the anti-vacuum type to prevent noise upon appliance discharge.

SECTION 22

22 MISCELLANEOUS

22.1 DIAL THERMOMETERS

These shall be as manufactured by S. Brannan & Sons Ltd. A thermometer shall be fitted on each heating flow in the boiler room.

Each thermometer shall be 100mm diameter dial index type mercury in steel having a temperature range and method of mounting as scheduled. Each case shall be chromium plated with the dial calibrated in □C and shall be complete with an indicating black pointer and red line set to indicate the normal operating temperature. Each thermometer shall be fitted integral with a plain bulb and capillary tubing and separable stainless steel pocket.

Each thermometer shall be positioned so that the tail is truly subjected to the temperature of the water to be measured. The position of all sensing bulbs shall be approved by the Contract Administrator before ordering and installation. Provision for checking temperature in air ducting shall be as specified elsewhere.

22.2 PRESSURE /ALTITUDE GAUGES

These shall be manufactured by Brannan & Sons Limited.

Pressure gauges shall be fitted to major equipment as scheduled and they shall be 100mm diameter dial type having a pressure range and method of mounting as scheduled. Each case shall be chromium plated with the dial calibrated in metres and bar and shall be complete with an indicating black pointer and an adjustable red pointer set to indicate the normal working pressure or head of the system.

22.3 TEMPERATURE AND PRESSURE TEST POINTS

Self sealing test plugs shall be fitted where indicated on the drawings and in addition the positions listed below. Refer also to the clause on 'Provisions for testing and commissioning'. The plugs shall be fitted into screwed bosses welded into the pipeline at bends or other locations to ensure full penetration of the gauge probe and shall be suitably rated for each application.

The test points shall be of gun metal construction and shall have long life ethylene-propylene diaphragms and be complete with a screwed sealing cap with renewable washer. The test points shall be of the extended type, such that connection extends above the finished level of any insulation.

Two insertion pressure gauges and two thermometers shall be provided for each range of conditions. Pressure gauges shall be of the 60mm diameter bourden tube type and thermometer gauges shall be of the 45mm diameter bi-metallic type.

Test plugs shall be installed at the following positions:-

1. On each port of every automatic control valve.

2. On flow and return connections to the heating coil.

3. On the suction and discharge of each circulating pump.

In addition to the above the Contractor shall install during commissioning ten further test points in locations to be determined by the Contract Administrator. The Contractor shall take into account all necessary draining down and refilling, welding, repainting, making good insulation etc.

Test points shall be as manufactured by Test Plugs Ltd., TEL: 01440 763167 or equal and approved.

Each gauge shall be fitted with level handle cocks, and where appropriate, syphon pipes.

22.4 DOMESTIC HOT AND COLD WATER MIXING VALVES AND FITTING

Thermostatically operated mixing valves shall be of gunmetal or brass construction with chromium-plated finish. Each mixing valve shall have a control thermostat capable of providing a constant mixed water temperature under the available hot and cold water pressures and of closing down the hot water inlet in the event of the cold water failing. All joints shall be of the compression type. A stop tap and strainer shall be provided on the hot and cold supply to each mixing valve.

Each mixing valve shall be provided with a temperature regulating handle or knob permitting regulation of the mixed water temperature up to a maximum of 40□C. Means shall be provided for varying the maximum setting. The valve shall also have provision for controlling the maximum rate of outlet flow.

22.5 INCOMING WATER SERVICE

The Contractor will raise the order with Thames Water for the installation of a new incoming cold water main. The Contractor shall include for liaising with Thames Water and coordinating their installation to suit the programme and site installation requirements.

The Contractor shall extend pipework from the Supply Authority's termination complete with means of isolation, all as indicated on the drawings, together with a drain cock.

22.6 INCOMING GAS SERVICE

The Contractor will raise the order for the installation of a new incoming gas main provided by National Grid. The Contractor shall include for liaising with National Grid and coordinating their installation to suit the programme and site installation requirements.

The Contractor shall extend pipework from the Supply Authority's termination, complete with means of isolation, all as indicated on the drawings.

Pressure testing nipples shall be fitted at the outlet side of the gas meter, and where the pipework is 25mm or larger on the pipework at positions required by the Gas Safety Regulations (GSIUR) 1998.

22.7 PAINTING IN PLANT ROOMS

The Contractor shall include for surface preparation, i.e. clean down to remove all dirt, grease, etc. Chip, scrape and wirebrush to remove all defective paint, rust, loose millscale, etc., and the painting of all plant, machinery, gantries, pipework, supports, vessels and thermal insulation, etc., forming part of his Works in all locations such as:

- Boiler Room
- Plant Room

Painting and preparation other than in Plant Rooms shall be as specified later.

All paint shall be suitable for the surface to which it is to be applied and shall be applied strictly in accordance with the manufacturer's instructions. The Contractor shall familiarise himself with these materials and obtain the Contract Administrator's approval before ordering.

No paint is to applied to surfaces which are structurally or superficially damp. All surfaces must be free from condensation, dirt, etc.

Primed or undercoated metalwork must not be left in an exposed or otherwise unsuitable situation for more than one week before applying finishing coats. Prepared metalwork must be primed as soon as possible on the day of preparation.

Cold Water Storage Tanks : The painting, internally and externally of metal cold water storage tanks shall be carried out with a non-tainting bituminous coating.

Paint colours shall be in accordance with BS 4800.

Exterior or exposed painting must not be carried out under extreme weather conditions such as extremes of temperature or during rain, fog, etc.

The following paint types shall be used in connection with the items listed as appropriate:

(a)	Boiler and flue surfaces above 121°C	Two coats of Furnace Grade Bitumastic Black
b)	Uninsulated pipework and all surfaces up to a temperature of 100°C.	One coat Metal Primer Zinc Chromate followed by two coats long-oil modified Alkyd Gloss (pipeline identification colours).
c)	Uninsulated pipework and all surfaces above 100°C up to 200°C (except boilers etc. as specified above)	Two coats oil-based Aluminium paint.
d)	External gantries, chequer plating, ironwork etc.	One coat Red Metal Primer followed by one coat of an oil-based undercoat and two coats of a long-oil modified Alkyd Gloss.
e)	External gantries, ironwork, etc.	One coat Red Metal Primer, followed by two coats Micaceous Iron Oxide Linseed Oil/Phenolic.
f)	Pipework to be insulated up to a temperature of 100°C.	One coat Metal Primer Zinc Chromate
g)	Pipework to be insulated above 100°C	One coat of oil-based aluminium paint.
h)	Internal thermal insulation and external thermal insulation	One coat oil-based Alkali resisting primer, followed by one coat of an oil-based paint and two coats of a long-oil modified Alkyd gloss.
i)	Electric motors, etc.	One coat Metal Primer followed by one coat of oil-based undercoat and two coats of a long-oil modified Alkyd gloss.

22.8 PAINTING AND PREPARATION OTHER THAN IN PLANT ROOMS

Other than in plant rooms, weatherproofing and protective painting specified elsewhere, including the painting on completion and the painting of all other thermal insulation will be carried out by the Contractor.

The Contractor shall include for manual surface preparation of all in situ exposed pipework, supports, radiators and radiant panels.

All black steel pipework shall after erection be prepared and painted as follows:

Clean down to remove all dirt, grease, etc. Chip, scrape and wirebrush to remove all defective material and rust. Prime all bare metal with one coat of Metal Primer.

22.9 WATER LEAK DETECTION SYSTEM

A water leak detection system shall be installed in each bathroom comprising of a leak detection tape below the floor around the perimeter of the bathroom connected to a control panel to isolate the water supplies to the bathroom upon detection of a leak, via motorised valves located in a local joinery unit, or where served from a manifold arrangement, by motorised valves located on the manifold.

The system shall comprise of the following per bathroom, all as manufactured by Aquilar Ltd (01403 216 100)

- TT1000 TraceTek Water-Sensing Cable (length to suit the bathroom)
- AT-LDM Leak Detection Module
- 3 No motorised valves on the water supply to the bathrooms
- Relay interface device to close the isolation valves upon detection of a leak.

A water leak detection system shall also be provided to each fan coil unit, utility areas, service trench and areas where there is a water appliance comprising a water detection probe hidden in the plinth of joinery or plant void connected to a control panel.

The system shall comprise the following per fan coil unit and utility area:

- A T-Probe Water Detection.
- A T-LDM Leak Detection Module.

The leak detection system shall be interlinked with the fire alarm system and raise alarm when activated.

22.10 VALVES AND PIPEWORK

The rising main shall have a nominal bore of 100 mm and the system shall be installed to withstand a pressure of one and half times its predicted maximum operating pressure. All dry riser pipework shall be to BSEN1387 / EN10255

Pipework shall be heavy quality galvanized Steel manufactured to BS EN 10255: Non-alloy steel tubes suitable for welding and threading 2004

Pipe fittings shall be Victaulic Gruvlok. Straight sections of the rising main shall be joined with mechanical grooved couplings with a long radius tee at each floor level and connect to the landing valve with a flanged joint.

To the top of riser shall be fitted with an air release valve which shall close automatically under pressure of water. The valve shall be manufactured from solid brass with a maximum test pressure 20 bar and a maximum working pressure 12 Bar to BS 2874 with a ¾" or 1" BSP male inlet.
A 1" drain valve shall be installed at the bottom of the riser to BS 5154.

22.11 FLOW RESTRICTORS TO SANITARY WARE

Flow restrictors shall be provided to every shower, bath, WHB and sink to comply with Part G of the Building Regulations and BREEAM 'very good' rating.

Flow restrictors shall be fitted in line to the sanitary ware fitting combined with isolation valve.

These shall be model RP/ACC supplied by Robert Pearson & Company Ltd., Post Office House, Post Office Lane, Stockton, Warminster, Wiltshire BA12 0SE. Tel: 01985 850954.

The flow restrictor shall be WRAS compliant.

SECTION 23

23 INSPECTION, COMMISSIONING, TESTING, RECORD DOCUMENTATION

23.1 ACCEPTANCE TESTS

All systems, plant and controls must be tested, adjusted, regulated, labelled and put into commission by the Contractor in accordance with the programme and the tender sum shall cover all the costs of providing the services of suitably qualified test engineers and certified test equipment and fuel to carry out these activities.

The test engineers and equipment shall be employed on the site continuously during the period and until completion of the tests to the satisfaction of the Contract Administrator. No claim whatsoever for extra costs in these connections will be allowed and the Contractor shall repeat any or all tests, adjustments, regulation operations and control functions, as required by the Contract Administrator until all the systems, plant and controls are to his satisfaction.

The tests shall be arranged by the Contractor and must be carried out before occupation, giving at least two working days notice to the Contract Administrator.

The Main Contractor is aware that a test period has to be included in the overall programme for such testing and commissioning.

The building must be glazed, partitioned, sealed, etc. before tests are commenced and the Contractor must programme his works with the Main Contractor to this end. Likewise pre-commissioning checks shall be carried out and the details of the items of equipment, make, type, rotation, settings, etc. recorded.

The tests shall include demonstration of the operation and function of the complete systems, and of the operation and function of all items of plant and their ability to perform and maintain the full design requirements as specified.

The tests shall be carried out in accordance with the appropriate British Standard Specification and Codes of Practice, the CIBSE Commissioning Codes, and the "Regulations for the Electrical Equipment of Buildings issued by the Institution of Electrical Engineers. The Contractor shall complete detailed commissioning sheets and the Contract Administrator will not attend the site for purposes of witnessing acceptance tests and commissioning until these sheets are submitted to the Contract Administrator for his approval.

All plant, pipes and fittings shall be hydraulically tested for a period of not less than one hour, to twice the working pressure, testing being carried out before the application of any thermal insulation.

In addition, where applicable, all pipes, fittings and appliances that will become inaccessible shall be tested on site before being covered in, each section as completed being subjected to a water pressure, or air pressure as appropriate, of not less than twice the maximum operating pressure, such pressure to be maintained in the presence of the Contract Administrator or his representative, without further pumping, for a duration of one hour.

All pipes embedded in building fabric shall be hydraulically tested to not less than 14 bar or twice the working pressure if higher for a duration of not less than six hours.

On completion of the gas service, the pipework shall be subjected to an air pressure of 70 mbar for a period of 30 minutes, with the test pump disconnected, during which period the system shall remain airtight. Any suspect joint shall be tested by the application of soapy water solution to ensure that the system is airtight and no bubbles are formed. The gas meter must be disconnected before this test takes place.

All tanks, calorifiers, cylinders and pressure vessels shall be tested in accordance with the relevant British Standard Specification, and a test certificate shall be provided.

All the tests on site shall be carried out in the presence of the Contract Administrator or his representative and, if required, a representative of the Insurance Company.

23.2 PERFORMANCE TESTS

All major plant items, such as fan coil units, shall be tested at works, at the specified duty, and a certificate forwarded to the Contract Administrator for approval before installation.

The Contractor shall submit to the Contract Administrator for approval the schedules to be used for both the pre-commissioning and commissioning checks. Sample checks are included in this Specification.

If, following submission of the complete commissioning sheets, the Contract Administrator visits site for the purpose of evaluation and in the opinion of the Contract Administrator the systems have not been properly set up, tested and commissioned, the Contract Administrator will charge the Contractor for the abortive visit, and furthermore will make alternative arrangements for the systems to be set up, tested and commissioned, the cost of which shall be defrayed from the Contract.

A schedule of drawings indicated the recorded maintained temperature conditions in each of the rooms shall be submitted as soon as possible after the commencement of the installation.

The Contractor shall, in addition to allowing in his tender for the service of the test Engineers and all instruments, include for all costs to cover the necessary equipment to enable him to carry out and demonstrate the test, viz., scaffolding, ladders and the like.

The Works shall not be regarded as complete for the purpose of issuing a Certificate of Practical Completion until all tests have been carried out and the systems properly performing to the satisfaction of the Contract Administrator.

23.3 SECTIONAL TESTING

The Works shall be pressure tested and the Contractor shall arrange for these tests to be carried out at the appropriate time and no claims for additional costs will be considered.

Where pipes are to be buried in inaccessible positions, the Contractor shall arrange for pressure testing before covering in takes place. Buried joints will not be permitted.

23.4 ELECTRICAL INSTALLATION TESTS

The following tests shall be applied to the installation before the installation is certified as satisfactory.

Insulation resistance tests for MICS cables shall be required to show results of at least 50 megohms:

- Insulation Resistance Tests
- Polarity Tests
- Continuity Tests
- Phase proving Tests, to ensure that phases are connected in the specified manner and proper sequence throughout
- Earth fault loop impedance Test

23.5 HANDOVER TO CONTRACT ADMINISTRATOR

Handover of the Works shall include:-

1. Supply of all test certificates of plant items from manufacturer.

2. Supply of all test certificates covering the Works, during the installation, hydraulic and heat tests, or any special tests certified by an Insurance Company.

3. Supply of all test certificates on hydraulic systems and air flow systems.

4. Supply of inspection certificate for electrical installation.

5. Supply of record drawings, wiring diagrams and valve charts.

6. Supply of operating and maintenance instructions in manual form for all the plant items.

7. Supply of operating and maintenance instructions for the proper working of the whole installation, service by service.

8. Supply of instructions on safety precautions under fault conditions.

9. List of names, addresses and telephone numbers of all contracting firms, and manufacturing firms responsible for the installation or supply of equipment items comprising the Works.

10. Supply of spares.

11. Completion of all painting including identification painting, lettering and numbering.

12. Making sure all plant items clearly show actual manufacturer's nameplate giving plant details, reference numbers, test pressures and dates of manufacture.

13. Ensuring all notices and labels are fitted.

14. General finishing of installation.

15. Agreeing with the Contract Administrator a list of any outstanding items or defects on basis that the items so listed shall be dealt with and cleared within 28 days unless otherwise agreed with the Contract Administrator.

16.
    i. Training the Client's staff, by holding a teach-in.
    ii. Testing the thermal environment
    iii. Testing the water and air flow capacities
    iv. Testing the plant capacity and efficiency
    v. Checking the automatic control systems including extract fan controllers and controls.

Subject to the satisfactory completion of the foregoing the Contract Administrator will then issue a Certificate of Interim Completion.

23.6 RESPONSIBILITY DURING DEFECTS LIABILITY PERIOD

The Contractor's responsibility during the Defects Liability Period shall include the following, notwithstanding that stated in the Contract conditions.

1. Adapting the technical and physical performance of the complete installations to the actual operating needs of the Contract Administrator and carrying out any adjustments necessary.

2. Further checking the automatic controls systems and correcting any malfunctioning.

3. Final clearance of any outstanding defects under Defects Liability Period, just prior to issue by the Contract Administrator of final certificate of acceptance and final certificate releasing balance of retention monies due to under the Conditions of Contract.

23.7 MAINTENANCE CONTRACTS

The contractor shall include in his summary of tender a maintenance supply contract for 12 months from the date of Practical Completion. The contractor shall be responsible for the following, notwithstanding that stated in the contract conditions:

1. Ensure that the maintenance set out in the appropriate standard can be achieved.

2. Carry out the maintenance in the appropriate standard and in according to manufacturers instructions and recommendations, for all items of plant and equipment supplied as part of these works.

3. Maintaining the services installation in efficient working order.

4. Routine checks, adjustments, lubrication and replacement of consumable parts.

5. Provide a level of maintenance services to a standard including appropriate dress code etc.

6. Maintain Emergency maintenance response to be no more than 3 hours.

SECTION 24

24 RECORD DRAWINGS

24.1 PROVISION OF RECORD DRAWINGS

The Contractor shall supply to the Contract Administrator as a pre-requisite to Practical Completion of the Works, comprehensive record documents finalised in detail and subject to the approval of the Contract Administrator.

The Contractor is advised that great importance will be placed upon the quality, accuracy and completeness of the record documents and upon their being made available promptly.

The Contractor shall demonstrate from time to time, as required by the Contract Administrator throughout the execution of the Works, that adequate and accurate records are being kept such as will ensure the ultimate completeness and accuracy of the record documents and that the record documents are themselves being progressively compiled as the Work on Site proceeds.

24.2 SCOPE OF RECORD DOCUMENTS

Record documents shall comprise all as described in this Specification, with the following:-

i. Record Drawings and Schedules, including Valve Charts.

ii. Operating and Maintenance Instructions.

All record documents shall be provided in electronic and hard copy form. The Contractor is to provide three sets of disk copies and one hard copy of all such record and O&M documentation.

The record documents shall:-

i. Record clearly the arrangements of the various sections of the Works as actually installed and identify by unique number and locate all component parts thereof.

ii. Make it possible to comprehend the extent and purpose of the Works and the method of operation thereof.

iii. Set out clearly the extent to which maintenance and servicing is required.

iv. Provide sufficient and readily accessible information, properly to facilitate the ordering of spares and replacements.

24.3 RECORD DRAWINGS

The record documents shall be correlated so that the terminology and the numerical and/or other references used are consistent with that used for Tender drawings, which shall show the following as installed:-

i. The location, including level if buried, of public service connections provided within this Contract whether carried out by the Contractor or by the appropriate Authority, together with the points of origin and termination, size and material of pipes, line pressure and/or other relevant information.

ii. The layout, location and extent of all piped services showing pipe sizes throughout, together with all valves for regulation, isolating and other purposes.

iii. Location, identification, size and details of all apparatus served by, or associated with, each of the various services. The information with respect to size and details may be presented in schedule form subject to the prior agreement of the Contract Administrator.

iv. The layout, location and extent of all air ducts, showing all dampers, test holes, grilles and fans/controllers.

Each duct and each terminal component shall be marked with its size and the air quantity flowing, as actually measured after approved regulation of the system, or as computed by the addition of such measured quantities.

v. The location and identify of each room or space housing plant, machinery or apparatus.

Drawings or sets of drawings to a scale consistent with that used for Tender drawings, i.e. ONE TWENTIETH full size which shall show the following as installed:

i. The detailed general arrangement of ducts and sections of works, where in the opinion of the Contract Administrator, the smaller scale drawings cannot provide an adequate record.

ii. Flow diagrams which shall show the principles of the arrangement and operation of each of the various services as related to the central plant, other principal components and zoning of distribution.

iii. Diagrams which shall show the principles of application of automatic controls and of instrumentation, presented in combination with items foregoing, or separately as agreed with the Contract Administrator.

iv. Manufacturer's drawings shall show the internal wiring of each piece of electrical equipment supplied under the Contract, together with arrangement drawings, where necessary, to locate and identify the component parts.

v. Comprehensive diagrams which shall show in detail all power wiring and all control wiring and/or other control piping carried out within the Contract, including size, type of conductor or piping used and identifying the terminal points of each.

vi. Record of pressure drops in all circuits throughout.

24.4 OPERATING AND MAINTENANCE INSTRUCTIONS

Operating and maintenance instructions shall comprise the following (one set contained in volumes strongly bound in flexible covers and suitable for heavy usage over a long period) written to be read in conjunction with the Record Drawings:

i. A general description of the scope, purpose and manner of working of each system and the apparatus forming part of the Works.

ii. A detailed description of the scope, purpose and manner of working of each system of automatic controls.

iii. Data on general design parameters and associated normal operating temperatures, pressures etc., based on the commissioning tests.

iv. Clear and comprehensive instructions for the starting up, running and shut down of each system or apparatus.

v. Clear and comprehensive instructions for dealing with emergency conditions for each system or apparatus.

vi. Instructions in respect of any precautionary measure from time to time necessary (e.g. against corrosion or freezing).

vii. Instructions in respect of the care of apparatus normally subject to seasonal disuse.

viii. Instructions as to the nature, extent and frequency of servicing necessary, properly to maintain the Works in good condition, and also as to the material to be used for the purpose. This information shall be supported by maintenance instructions provided by the suppliers of particular component apparatus.

ix. The names and addresses of suppliers of all major components of the Works, as may potentially be required to obtain space parts or replacements.

x. List of recommended spares.

xi. Manufacturers' literature.

Copies of manufacturer's data shall be supplied with regard to the nature, type and method of operation of individual maintenance instructions. Such data, in the form of individual booklets and the like, shall be indexed and cross-referenced to the operating and maintenance instructions and presented suitably protected in stout binders with D shaped rings.

Draft copies of all record drawings and instruction manuals shall be made available in advance of the completion date in order that the Contract Administrator has the opportunity to comment, and the corrections/amendments recorded, thereby allowing sufficient time for the approved documents to be available.

24.5 HEALTH & SAFETY FILE

In accordance with CDM Regulations, the Contractor shall include a Health and Safety File within the Record Documents.

The file shall set out any operational hazards inherent in the systems installed and how they should be dealt with and any special precautions required during maintenance set out.

SUMMARY OF TENDER

All items to be priced, no item shall be priced as 'included'.

		Amount
Mechanical and Public Health Services		
1.	Preliminaries	£
2.	Provisional sum for strip-out and removal of redundant services	£5,000
3.	Provisional sum for new incoming gas and water services	£10,000
4.	Above ground foul water drainage system	£
5.	Above ground surface water drainage system	£
6.	Cold water break tank and booster set	£
7.	Cold water softener plant	£
8.	2nd floor boiler room installations: centralised gas-fired boiler plant, pressurisation set, expansion vessels, valves, insulation, etc.	£
9.	Specialist boiler flue and boiler room ventilation systems	£
10.	Basement plant room installations: centralised DHWS calorifiers, secondary F&R distribution, pumps, expansion vessels, valves, insulation, etc.	£
11.	Internal gas distribution (incl. manifold and gas shut-off system)	£
12.	Internal domestic hot and cold water services distribution	£
13.	Internal heating services distribution (incl. radiators, trench heaters, wet and electric underfloor heating systems)	£
14.	Ventilation systems (incl. MVHR, fans, ducting, controls, grilles, louvres, terminations, fittings and accessories).	£
15.	VRF comfort cooling system including condensers, controls, ductwork, diffusers, etc.	£
16.	Provision of Acoustic Elements, i.e. Attenuators, Spring Mounted Hangers for Plant etc.	£
17.	Heating controls (Heatmiser NeoStats, neoKit, all associated wiring, fittings and accessories)	£
18.	Plantroom and boiler room control panels (incl. all associated wiring, fittings and accessories)	£
19.	Fix only sanitary ware	£
20.	Refrigerant and water leak detection systems	£
21.	Provision of working / installation drawings	£

		Amount
22.	Testing and commissioning	£
23.	Working drawings	£
24.	Demonstration of installed systems to end user	£
25.	Operation and Maintenance manual with record drawings	£
26.	Any items not listed by the foregoing ……..…… ……..…… ……..……	£
	Total	£

Amount in words …….....

Contractor …….....

Address …….....

…….....

…….....

Signed for and
on behalf of …….....

Date …….....

SCHEDULE OF ALTERNATIVES

The Tenderer is required to complete this form at the time of submitting his tender, in respect of all items of plant or equipment for which he is offering an alternative to that specified, for consideration by the Employer's Agent. It is understood that the submitted tender includes for the supply and installation of all items of plant or equipment of the type and manufacturer specified. The Contract Administrator is under no obligation to accept any alternatives put forward by the Tenderer and shall expect all items of plant and equipment specified in this document to be incorporated into the final works. Any unauthorised deviations from the specified equipment shall be replaced with the specified equipment at the Contractors cost.

SPECIFIED CLAUSE NO.	ITEM OF PLANT OR EQUIPMENT	SUGGESTED ALTERNATIVE AND REASON FOR CHANGE	EFFECT ON TENDER PRICE.

SCHEDULE OF DAYWORK CHARGES
MECHANICAL INSTALLATION

Percentage additions to cover Supervision, Overheads and Profit

Labour ……

Materials/Plant ……

Fares & Allowances ……

LABOUR		**BASIC HOURLY RATE**
Technician	……..	…….
Approved Fitter/Plumber acting as Chargehand	……..	…….
Approved Fitter/Plumber	……..	…….
Fitter	……..	…….
Labourer/Fitter's Mate	……..	…….
Apprentice (state age)	……..	…….

Contractor ……..

Address ……..

……..

……..

Date ……..