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CLIENT

London Borough of Hillingdon

PROJECT

Performance Specification for the Mechanical and Public Health Engineering Services for the refurbishment and extension of MHS Harefield Northwood Way Harefield Uxbridge UB9 6ET

Project No.: 21/168
Date: August 2022
Revision: 01

CONTENTS

REVISION HISTORY

July 2022 Revision 00	Initial Issue
August 2022 Revision 01	1.2.2.1 – Description updated to included water meter & water leak detection. 1.19.1 – Description updated to included water meter & water leak detection. 18.5- Clause added for domestic water services items to be pick up on central control system. 19.7.2 – Description updated regarding water meter. 19.8 – Clause added for water leak detection system. Appendix A - Hybrid systems added to 3 rooms.

SECTION 1

1 INTRODUCTION

1.1 GENERAL DESCRIPTION

This performance specification is for the design, supply, installation, commissioning and setting to work for the Mechanical and Public Health Engineering Services new installation for Refurbishment and Extension at MHS Harefield Northwood Road Harefield UB9 6ET

This 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. Mechanical and Public Health Services will be designed and installed by the Main Contractor's Domestic Sub-Contractor.

The Residential Boarding Block, is situated on the North East of the Academy site and was built in 2010. Hence the building services provisions are to reasonably modern standards and in their present condition are serviceable and appear to have been well maintained.

The building design complied with Building Regulations Part L as was in force at the time, and aspired to meet a BREEAM "very good" rating. The most notable sustainability element incorporated within the scheme was the provision of a Biomass Boiler.

The existing building has a cross laminated timber panel structure frame solution with white rendered walls over dark grey glazed brick base plinth. The windows and doors are dark grey, powered coated aluminium/timber frames with double glazed units and trickle vents. The roof is a flat roof with single ply membrane roof covering in grey.

The proposal is to extensively alter the internal partitions to create teaching spaces from the sleep accommodations with various ancillary rooms and spaces for use by both the pupils and staff.

The new extension will contain 6 Classrooms and 2 Group rooms other two floors. New openings will be created in the existing external fabric to allow movement between the extension and the existing building.

The new extension building will be built in similar style to the existing using cross laminated timber panel structure frame solution with white rendered walls over dark grey glazed brick base plinth. The windows and doors are dark grey, powered coated aluminium/timber frames with triple glazed units with louvres to suit the hybrid ventilation strategy. The roof is a flat roof with single ply membrane roof and covered with a sedum/wildflower to increase the site's urban greening.

1.2 MECHANICAL AND PUBLIC HEALTH ENGINEERING SERVICES

1.2.1 EXISTING

The current building is now nearly 12 years old and whilst the equipment is in a reasonably condition, internal refurbishment means that the services no longer suit the

layout and with a more sustainable approach to heating the building, all of the existing services will be stripped out.

The current mechanical installation comprises of the following elements:

1.2.1.1 Utility Supplies

A dedicated U25 gas meter within an external box in a landscaped area provides a natural gas supply to the two gas boilers in the external boiler plant room. There is a branch that provides gas to the laundry room. This will be cut back to the existing gas meter to allow for new installation.

A buried water main rises from the floor of the mechanical plant room to provide a metered water supply to the building. We understand that water supply is taken from the water supply to the Harefield Academy and feeds the fire hydrants as well. Given the change of ownership and the need for a sprinkler tank, a new incoming cold water supply shall be provided. The existing supply shall be removed back to the nearest fire hydrant.

An electromagnetic water conditioner and filter is installed on the incoming water main.

1.2.1.2 Heat Source

A separate, external boiler plant container houses a biomass (wood pellet) boiler and two wall-mounted natural gas-fired boilers.

The two boilers provide low temperature hot water (LTHW) via a buried pipe circuit to an internal mechanical plant room on the ground floor of the residential boarding block.

The external plant room houses pumps and ancillary equipment to provide two pressurised, pumped primary LTHW heating circuits which feeds the mechanical plant room.

The biomass boiler appears unused and there is no wood pellet storage or automatic feeder. The mechanical plant room contains a low lever heater that has two pump circuits which feed the underfloor heating system and the 2No hot water cylinders.

The external plant container and the mechanical plant room is to be stripped out and removed from site.

1.2.1.3 Heating Distribution

The main heating is a wet under-floor heating, fed from multiple manifolds on each floor. For the ground floor and the main areas of the 1st and 2nd floors. The ensuites have electric Under Floor Heating (UFH). Each pipe loop from the manifold has an electric actuator linked to a room thermostat to provide thermostatic control.

According to the record drawings, the copper heating circuit pipes feeding these manifolds from the ground floor plant room rise to the first floor in a riser next to the lift shaft, but the second floor is served by multiple local risers from the first floor.

On the ground floor the UFH pipework is laid in the screen whilst the 1st and 2nd floors UFH pipework is laid out on metal plates, between the joists.

Due to the significant rearranging of the internal wall, the Contractor shall allow for the removal of all the existing UFH pipework, manifolds, controllers, etc.

1.2.1.4 Ventilation

Bedrooms and other habitable areas appear to be naturally ventilated by opening windows. The exception is on the ground floor with extract systems in the family rooms, 6th form social, laundry and kitchen. There are also supply systems to the kitchen, duty office, laundry and visitor's room.

Ducted mechanical extract ventilation is provided from all bathrooms, ensuites and WCs.

The ground floor supply and extract system have connected to the louvre at High Level ground floor to intake or discharge to atmosphere. On the 1st floor, the staff accommodation has individual extract systems from the bathroom. The ensuites and pupils' communal bathrooms have 4No central extract systems with twin fans in the corridor ceiling void at 2nd floor. These system discharges through louvres on the roof.

Natural smoke and night cooling ventilation to the atrium is provided by automatically-controlled windows and doors at ground and roof levels.

All the ductwork, fans, etc. shall be stripped out and removed from site.

1.2.1.5 Domestic Water

The existing system consists of a break tank and booster pump set, located in the ground floor mechanical plant room, provides a boosted, potable cold-water service to the cold water outlets within the building, as well as a cold feed to the hot water.

Two unvented, indirect hot water storage cylinders (in the same plant room) provide domestic hot water to the sanitary fittings via copper distribution pipes which incorporate pumped return circulation.

The distribution pipework configuration appears to be broadly similar to the heating distribution.

There is a significant reduction in the cold and hot water requirement, changing from boarding accommodation to a day school hence, the cold water will be directly fed from the new incoming water supply and, the hot water will be from local electric water heaters.

All of the existing pipework, tanks, cylinders pumps, etc. are to be stripped out and removed from site.

1.2.1.6 Soil and Waste

From the record drawings, it appears that the above-ground soil and waste installation follows single-stack principles, with multiple soil vent pipes running vertically through the bathroom risers on the first and second floors. Due to the different room and sanitary layout on the ground floor, many of the soil pipes from the first floor offset at high level ground floor to reach the underground drain locations.

Given all the significant changes to the soil and waste requirements, all of the existing pipework shall be stripped out and removed from site.

1.2.1.7 Comfort Cooling

The server cupboard on the ground floor is a split pump system to provide cooling to the server racks. The server racks are to remain and the Contractor needs to ensure that the split system remain functional throughout the Works.

1.2.2 PROPOSED

The new extension will increase the heating requirements, but reduce the domestic water needs which requires a complete re-think of the Mechanical Services strategy using low energy sources and the reduced need for domestic hot and cold-water supplies.

In addition, given the change of use of space in the existing building and the requirements of BB101 for ventilation and, avoidance of overheating, consideration needs to be given to the ventilation strategy of the classrooms, particularly due to the proximity of the Northwood Road and the play area.

1.2.2.1 Utility Supplies

The Contractor shall allow for bring a new gas supply, sized to suit, the requirements of the Catering Kitchen (0.06), Domestic Kitchen in the independent Living (0.01) and the Food Tech Classroom (2.01). The new main shall entry the building in the Mechanical Plantroom (0.04) with ACEV in the plantroom. Then from a manifold serve the three rooms using TRAC Pipe CC. Depend upon the gas capacity required the Contractor shall liaise with the relevant gas company for the removal of the existing gas meter and replace with a smaller meter to suit the required capacity

The Contractor shall liaise with Affinity Water to supply a new suitable sized cold water main to directly into the existing plantroom from Northwood Road. The new incoming water supply will serve all of the new water outlets in the existing building and extension. The new water supply will need to supply a new sprinkler system. The Contractor is to liaise with the sprinkler system designer to obtain the correct water supply requirements.

There will be a water meter fitted in the plantroom on the incoming cold water main along with an automatic water leak detection system fitted in the plantroom to shut off the water supply if excessive water flow rate is detected.

1.2.2.2 Heat Source

The new heat source will be low energy Heat Source Pumps (ASHP's); in our outline design will have assumed there will be 5No units and this will be located on the roof of

the existing building as also indicated on the drawings. The Contractor shall include for anti-vibration mounts and liaise with the Structural Engineer and Acoustic Consultant over steel supports, or big foot system and acoustic screening.

The ASHP's will feed the buffer vessel in the existing mechanical plant room 0.04. The system will include a circulation pump, pressurisation unit, air/dirt separator, etc.

1.2.2.3 Heating Distribution

The space heating will generally be provided by a new wet underfloor heating system with several manifolds on each floor. The system will be fed from a pumped secondary heating circuit from the buffer vessels.

There will be individual room controllers in each room to modulate the room temperature. This will be linked back to a central control system via a wiring centre, adjacent to the local manifold.

The new pipework will be routed at high level in the ground floor and dropped to serve the ground floor manifold and risen up to serve the manifold on the first and second floors. All the distribution pipework shall be insulated.

The new underfloor heating will run in the screed on the ground floor and on plates between the joists on the upper floors.

1.2.2.4 Ventilation

The classroom and teaching space requires ventilation to comply with BB101 to avoid high concentration of CO^2 and overheating. Whilst natural ventilation is preferred as the low energy solution in this case but, due to the external acoustic requirements of Special Educational Needs Pupils and the external noise level, the Acoustic Consultants has recommended the windows are sealed shut, hence, hybrid ventilation units will be used.

New louvres will be provided to allow for connection form mixed flow hybrid ventilation fixed to the ceiling. The louvres will be at high level in the extension and just above the windows in the existing buildings were required.

The catering kitchen on the ground floor will have a new extract system to pick up from the cooker hood with a new fresh air make-up system with heater battery and filter to replace the existing system.

The Office, Medical Room and the 2 Hygiene rooms are all internal spaces with no windows and hence will be provided mechanical heat recovery units to provide both fresh air and extract the air.

There will be a requirement for additional louvres on the external façade of the existing building.

The rest of the spaces with openable windows will be natural ventilated.

1.2.2.5 Domestic Water

The Contractor will organise a new incoming cold water main from Affinity Water to serve all the sanitary ware and provide a supply for the heating system and sprinkler system.

The new cold-water pipe will return at high level ground floor with branches to feed all of the sanitary ware and, local electric water heaters. The pipework will rise up to serve the 1st and 2nd floors vertically from the ground floor.

The hot water will be provided by local electric water heaters, sized to suit the sanitary ware they are serving.

1.2.2.6 Soil, Waste and Rainwater Pipework

The Contractor will design a new gravity soil and waste water pipework installation that is fully ventilated and will take the waste water for all the new sanitary ware to connect to the existing drain points, on the underground drainage system.

There will be new underground drainage, designed by the Structural Engineer for the soil, waste and rainwater pipework from the new extension. The Contractor shall allow for modification of the rainwater pipework from the existing pipework where the extension attaches to. The new extension will have a Sedum roof covering.

The Mechanical and Public Health installation is required to be of the highest quality and shall be flush throughout with the exception of the plant spaces.

1.2.2.7 Comfort Cooling

The existing split heat pump system will be retained for the current server. The Contractor shall include for a new server room for the new school with a new split heat pump system as a provisional sum.

1.3 SCOPE

The Contractor shall be responsible for all the design and installation works detailed in this Engineering Specification and in particular, but not limited to, the following items:-

- Undertaking specific detailed designs for all Engineering Services as indicated herein, providing design drawings at 1:50 scale (for general floor plans) and 1:20 (for all plant rooms), and detailed calculations to the Contract Administrator for inspection.

- Liaise with the Structural Engineer regarding any concerns of a structural nature, such as drilling holes through joists.

- Liaise with Acoustic Consultant and Fire Engineer regarding the noise requirements for the external plant and within the internal space particularly those considered as teaching spaces.

- Liaise with Fire Engineer regarding the Sprinkler system and water requirements for system whether there is a storage tank or direct from the incoming cold water mains.

- Coordinating with other members of the Design and Contractor's Team during the works to ensure the Engineering Services do not clash with any other service or the building structure, including architectural or decorative finishes, and that the scheme is acceptable to all concerned especially the Contract Administrator.

- Providing Designers' Risk Assessments and all other information required by the CDM Regulations.

- Notifying the works to the Health & Safety Executive (in accordance with the Construction Design & Management Regulations), and providing all requisite assistance and details required of the Principal Contractor to the Employer, Planning Supervisor, and other members of the project team.

- Providing fabrication drawings, installation/working drawings for all services and detailed wiring diagrams for all equipment and panels.

- Before works start on site, the Contractor must obtain the Water Undertaker's consent by prior notification.

- Inspecting all plant, equipment and materials when delivered or at the manufacturer's works and providing suitable protection, and safe secure storage.

- Liaison with the Gas and Water Utilities in respect of the project and new incoming services to the property.

- The design, supply and installation of the following systems: -

  GENERAL MECHANICAL AND PUBLIC HEALTH SERVICES LIST
  Main Heating Plant and pipework etc.
  Space Heating System
  Hot Water Supply System
  Cold Water Supply System including water meter and water leak detection
  Natural Gas Service
  Automatic Controls and wiring - including BMS
  Water Treatment and Filtration
  Mechanical Ventilation System including Hybrid systems
  Extract Ventilation System
  Thermal Insulation
  Before works start on site, the Contractor must obtain the Water Undertaker's consent by prior notification.
  Above-Ground Soil and Waste Plumbing Installation
  Above-Ground Rainwater Installation

- Provide method statement prior to disconnection of any existing system.

- Liaison with the relevant Local Authority Planning department for approval of all external plant and equipment, including boiler flue penetrations, ventilation duct penetrations and obtaining relevant approval for each system.

- Liaison with the relevant Local Authority Building Control department for approval of all Mechanical plant and equipment, including obtaining relevant Building Regulations approval for each system.

- Compliance with all Building Regulation requirements.

- Provision of SBEM and Overheating Calculations for the Refurbished & New Extension to the School at the start of the installation and at the end of the project.

- Production of as built EPC Certifications and submission to the relevant registration scheme

- Demonstrating that the equipment is capable of the performance and method of operation specified to the satisfaction and acceptance of the Contract Administrator.

- Provide information for Building Logbook.

- Providing Record Drawings of the Complete Installation.

- Providing Operating and Maintenance Instructions for the Complete Installation.

- To ensure that all Product Warranties are completed in the name of the Employer, with the address of the site, and consequently registered with the respective manufacturers, and as may be the case with certain manufacturers to implement the Extended Warranties as proffered. All completed warranties details to be maintained in the O&M manual.

- Instructing the Employer's Staff in the use, operation and maintenance of the complete installation.

- Instructing in the use, operation and maintenance of the complete installation to the Contract Administrator.

- Builder's work associated to services installation.

- Submission of samples such as proposed room thermostats/sensors for approval by the Contract Administrator and Client.

- Fixing or installing correctly all plant, equipment and materials.

- Ensuring all associated work such as electrical wiring, connecting pipework, builder's work, etc., are properly executed.

- Testing and commissioning the complete installation including making adjustments and balancing as necessary.

- Provision of necessary and appropriate signs in accordance with the legislation complying with the Health & Safety (Safety Signs) etc.

- Visual and written identification of plant and component parts and installation

- Demonstrating that the overall and complete systems perform correctly in the required manner and as intended by the Specification to the satisfaction and acceptance of the Contract Administrator.

- Provide the full set of test results in an approved format for all tests, commissioning and balancing operations.

- Handing over all specified tools, keys, spares, oils, chemicals, etc.

The Contractor shall be responsible for all works detailed in this specification and in particular the following items:-

a) Submission of samples of all proposed items on view for approval by the Architect and Client. Such approval will not be unreasonably withheld.

b) Obtaining statutory approvals, Building Regulation Supervisor approval and Fire Officer's approval as necessary.

c) Demonstrating to the Contract Administrator following full commissioning random tests and full functionality.

1.4 CONTRACTOR'S DESIGN RESPONSIBILITY

The Contractor shall be responsible for the design of the complete Mechanical, and PHE engineering services installation as detailed in this engineering performance specification. This document shall be read in conjunction with all other volumes of the Tender documents, Architectural and Structural design information, and the Interior Designer's layouts.

The Contractor shall be responsible for ensuring that the design of the engineering services complies with all statutory requirements, together with the requirements of the engineering specification, and design shown by the Architect, Structural Engineer, Acoustic Consultant, Fire Engineer and others.

The design of all engineering services shall demonstrate that the following factors have been adequately considered and incorporated into the services design:-

- Economy of running.
- Ease and economy of maintenance.
- Ease of operation.
- Use of proven technology.
- Limitation of noise within criteria specified.
- Compliance with CDM Regulations.
- Compliance with Building Regulations.
- Environmentally, the best possible to suit the circumstances in line with current regulations.
- Sustainability of materials in manufacture and disposal.

The Contractor shall ensure that he has adequately co-ordinated and liaised with all the individual installers within his control, and shall ensure that he has included for all items necessary to provide a fully complete installation. Any additional costs resulting from failure to comply with this clause shall be borne by the Contractor.

1.5 DRAWING LIST

No.	Title	Scale
21/168-M01	Mechanical Engineering Services Legend of Symbols	N.T.S.
21/168-M10	Proposed Site Plan Mechanical Engineering Services Layout	1:200
21/168-M11	Proposed Outline Mechanical Ventilation Services Layout Ground Floor	1:100
21/168-M12	Proposed Outline Mechanical Ventilation Services Layout First Floor	1:100
21/168-M13	Proposed Outline Mechanical Ventilation Services Layout Second Floor	1:100
21/168-M14	Proposed Outline Mechanical Pipework Services Layout Roof Plan	1:100

21/168-M15	Proposed Outline Mechanical Pipework Services Layout Ground Floor	1:100
21/168-M16	Proposed Outline Mechanical Pipework Services Layout First Floor	1:100
21/168-M17	Proposed Outline Mechanical Pipework Services Layout Second Floor	1:100

1.6 OPERATING CONDITIONS

1.6.1 Temperatures to be Maintained

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

Accommodation	Room Temperature ℃
Classrooms/Teaching spaces	22℃ db +/- 1℃
Break out space	23℃ db +/- 3℃
Offices/Library	21℃ db
Medical Room	22℃ db
Dining/Assembly	21℃ db
Toilet Accommodation	20℃ db
Corridor/Ancillary Areas	20℃ db
Storage	18℃ db

These conditions are to be read in conjunction with the room data sheets.

Summer Conditions

Accommodation as scheduled below has been designed to be cooled and maintained at the temperature listed during the summer when the external temperature of 30℃ DB and 20℃ WB is not exceeded.

Existing Server Room (IT Comms 0.16) 21℃ db +/- 2℃

1.6.2 Cold Water Main

Pressure at Supply Authority's inlet valve 1 bar

1.6.3 Gas

Supply gas pressure (minimum) 21 mbar

1.7 INTERNAL NOISE LEVELS

The installations have been designed to limit the noise level to meet the requirements of BB93 and Part E of the Building Regulation. As cover in BB93 consideration needs to be given to students with special educational needs.

The requirements are given in the Sharps Redmore Acoustic Design Report.

1.8 EXTERNAL NOISE LEVELS

The noise from the installations shall not exceed the limits specified in the planning requirements of the Local Authority.

A background noise survey has been undertaken by Sharps Redmore and covered in their Acoustic Design Report. The design of any acoustic enclosure or attenuation for any external plant or equipment with intake/discharge louvres needs to be based on the noise survey and agreed with Sharpe Redmore

1.9 DESIGN CRITERIA

1.9.1 HEATING SYSTEM

1.9.1.1 Performance Objective
To provide the existing building and extension with heating using design data from the Chartered Institution of Building Services Engineers (CIBSE) and to the room temperatures listed for specific applications. The aim is to have an Energy Efficient and Sustainable building.

1.9.2 Design Parameters
To comply with current Building Regulations, CIBSE Guides, BS 7671, all relevant British Standards and Codes of Practice, Department of Education's Building Bulletins and Technical Annexes, Gas Safety Regulations and Water Regulations.

1.18.3 Heat Losses and Gains
These shall be calculated using the method detailed in the Chartered Institution of Building Services Engineers Guide, including Intermittent Heating Margin (assuming very irregular and intermittent use of the facility) and Design Margin. Calculations shall indicate heat losses and gains through the individual components of the room, i.e., walls, windows, etc. Calculation methods providing approximate heat losses, such as Mears calculator will not be accepted.

1.18.4 Winter Conditions
Infiltration for heat losses:

Classrooms/Teaching Spaces	= 1 ach/hr
Office/Library	= 1 ach/hr
Medical Room	= ½ ach/hr
Dining /Assembly	= 1 ach/hr
Toilets/Changing Rooms	= 2 ach/hr
Corridors/Hallways	= 1½ ach/hr

For Internal and External temperatures refer to clause 1.6.1

For Building Fabric information refer to clause 1.15.

Maximum Pipework Pressure Drop
Heating pipework shall be sized with a maximum pressure drop of 200 Pa/m and 1.0 m/s maximum velocity up to 42mm and 1.5 m/s above

1.19 COLD WATER SERVICES

1.19.1 Performance Objective
To provide Cold water to all sanitary appliances, Hot water Storage heaters, cold feed make-up water for low temperature hot water system and a water supply to the new sprinkler system. The aim is to have an Energy Efficient and Sustainable building.

The new installation to all be feed from a new incoming cold water supply.

To assist compliance with BREEAM Water category to encourage sustainable water. The Contractor shall include for a water meter and an automatic water leak detection system.

1.19.2 Design Parameters

To comply with the following Regulations/Guides: -

- Current Building Regulations.
- Water Regulations Guide.
- Public Health Engineering CIBSE Guide.
- CIBSE TM13 – Minimising Risk of Legionnaire's Disease.
- Department of Education's Building Bulletins and Technical Annexes

Maximum pressure drop 200 Pa/m and 1.5 m/s maximum velocity.

Minimum static pressure at Water Authority's stopcock 1 Bar

Water Supplies

Supplies shall be connected to the heating system quick-fill connection, hot water system cold feed and all cold-water fittings including external taps.

1.20 HOT WATER SERVICES

1.20.1 Performance Objectives

To serve hot outlets on sanitary ware and appliances.

1.20.2 Design Parameters

To comply with the following Regulations/Guides: -

- Current Building Regulations.
- Water Regulations Guide.
- Public Health Engineering CIBSE Guide.
- CIBSE TM13 – Minimising Risk of Legionnaire's Disease.
- Hot Water Storage and Flow Temperatures: 65℃
- Mixed Water Flow Temperature: 43℃
- Maximum Velocity 1.5m/s
- Maximum Pressure Drop 200 Pa/m

1.21 VENTILATION

1.21.1 Performance Objective

To provide supply and/or extract ventilation to Classrooms, bathrooms, WCs, Basement, Utility and Kitchens, based on room volume. The aim is to have an Energy Efficient and Sustainable building.

1.21.2 Design Parameters

Classrooms and Teaching Space:	In accordance with BB101 to avoid CO2 build up and overheating with a minimum of 10 L/Sec per Person
Office Medical Room, Hygiene Room	8 L/S per Person with min. 2.5 AC/Hr
Kitchen Supply Ventilation	To match the Cooker Extract.
Extract Air Rates:	
Bathroom, WC, Changing rooms:	Min. 10 air changes per hour.
Cleaners Room:	6 air changes per hour.
Food Tech Store:	5 air changes per hour.

Catering Kitchen	To suit equipment to be installed
Ductwork in false ceilings:	3 m/s max velocity.
Ductwork in service risers:	5 m/s Max velocity.
Branch ducts and final connections to grille:	3 m/s max velocity.
Extract grille face velocity:	1.5 m/s max.
Attenuators face velocity	2 m/s max.

The system is to comply with current Building Regulations and the Ventilation and Air Conditioning CIBSE Guide B2, Department of Education's Building Bulletins and Technical Annexes and DW172 specification for kitchen Ventilation systems

1.22 CONTROLS

1.22.1 Performance Objective

To enable the system to function economically and efficiently to the satisfaction of the Client. The controls need to be designed with the relevant Building Regulations requirements in place.

1.23 ABOVE-GROUND DRAINAGE

This shall include the installation of safe and efficient discharge system to take the foul water, waste water and rainwater from the various sanitary ware items and gutters etc. down to the underground system.

The system shall be fully ventilated.

1.23.1 Performance Objective

To comply with the following Regulations/Guides:

1. Current Building Regulations.
2. BS EN 12056.
3. BS 8000.
4. Public Health Engineering Guide CIBSE.

1.24 BUILDING ELEMENTS

Prior to commencing the final design of the systems, the Contractor is to obtain the construction details from the Architect for each building element. From these details he shall calculate the correct U-values for each component (walls, windows, roof, etc.).

These values shall be used to determine the heat losses/gains for the design. All such values and their full make up shall be submitted by the Contractor to the Contract Administrator for approval.

As part of the design verification process the Contractor is to submit to the Contract Administrator copies of full and detailed calculations for each system, these being submitted along with details of each unit selection proposal, to fully demonstrate compliance with load/selection.

The Contract Administrator may choose to instruct for appropriate changes to be incorporated into the Contractor's proposal, should be decide this to be necessary to comply with the requirements of the Specification.

The Contractor is to fully incorporate all such directives into his final design proposals and demonstrate his compliance with the same prior to the commencement of any installation work.

SECTION 2

2 CONDITIONS OF TENDER AND PRELIMINARIES

2.1 PRELIMINARIES - GENERAL

The Conditions of Tender shall be as stated in the Contract Conditions and Bill of Quantities. Detailed requirements for the design & 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.

The contract documentation is to be read as a whole. It is the responsibility of any party issuing any part of the documentation to others to ensure they provide recipients with all parts of the contract documentation, (including but not limited to the specification clauses and drawings) relevant to their scope or involvement and that they comply with the contract requirements in all respects. The issuing party will be responsible for any discrepancies caused by a failure to comply with this clause.

2.2 DEFINITIONS

"The Employer"	This shall mean: London Borough of Hillingdon
"The Project Manager" (and/or) "The Contractor Administrator"	This shall mean: Pellings, 24 Widmore Road, Bromley, Kent, BR1 1RY
"The Engineer"	This shall mean Edward Pearce LLP, Old School House, 35 Ewell Road, Surbiton, Surrey KT6 6AF
"The Architect"	This shall mean: Chadwick Dyer Clarke, Studio 17, Comberton Road, Barton Cambridge CB23 7BA
"The Structural Engineer"	This shall mean: Michael Hadi Associates, First Floor, 14-18 Old Street, London, EC1V 9BH
"The Quantity Surveyor"	This shall mean: Pellings, 24 Widmore Road, Bromley, Kent, BR1 1RY
"The Principal Designer"	This shall mean: Pellings, 24 Widmore Road, Bromley, Kent, BR1 1RY
"The Acoustic Consultant"	This shall mean: Sharps Redmore, The White House, London Road Copdock, Ipswich, IP8 3JH
"The Fire Engineer"	This shall mean: Hoare Lee, Western Transit Shed, 12-13 Stable Street, London, N1c 4AB

"The Landscape Architect"	This shall mean: HED UK, One Wessex Way, Colden Common, Winchester, Hampshire, SO21 1WG
"The Contractor"	This shall mean the Contractor employed to carry out the Works described in this specification.
"The Main Contractor"	This shall mean the Contractor employed to carry out the building works.
"Tender Documentation"	The performance specification and outline drawings and other documentation as appropriate to the agreed procurement method prepared to enable those tendering to interpret the proposal for the works and to submit a tender for executing all or any part of the works.
Installation Drawings"	Drawings based on the Contractor's design drawings shall show details of proposals by Contractors or Sub-Contractors for the execution of the Works and Co-ordination. 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.

2.3 TENDERS

Tenders shall be submitted on the forms provided. The Tenderer shall complete the Summary of Tender at the rear of this Specification as part of the tender submission.

Tenders shall comply with the requirements of this Specification. Where the Tenderer wishes to submit an alternative for consideration it shall be submitted in an accompanying letter with a full description, including details of the variation from the Specification and the cost effect of the proposal.

Tenders which do not comply with the above requirements will be rejected.

2.4 PRE-TENDER QUOTATIONS

The Engineer 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.

Where equipment from specialist suppliers has been selected and specified within this Contract, the Contractor and Mechanical Services Installer shall be responsible for ensuring that the equipment provided complies with the Specification in terms of services requirements and space.

Where the Contractor or Mechanical Services Installer offer alternative equipment and the above requirements require modification to the services or requirements, they shall be responsible for the costs of design changes and for the cost of providing any additional services required as a result of the proposed change. They shall also be responsible for the effects of such changes to the programme.

2.5 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 Main Contractor/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 Main Contractor/Clerk of Works, having been previously submitted to him weekly by the Contractor as the work proceeds. The Contract Administrator 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.

2.6 DESIGN TEAM MEETINGS

Regular meetings at agreed intervals shall be held at an agreed location or over video link to develop the Services design. The Contractor be present at all such meetings and shall present preliminary scheme design drawings for discussion and shall incorporate any reasonable comments as required to develop the final design.

2.7 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.

2.8 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.

2.9 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.

2.10 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.

2.11 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.

2.12 INTERIM AND FINAL OPAYMENT CLAIMS

Payments shall be made to the Contractor in accordance with the Conditions of Contract and the requirements of the Construction Act 2011.

After agreeing claims made by the Contractor, the Contract Administrator will issue this recommendation to the Contract Administrator, so that the Contract Administrator may include the correct amounts, at his discretion, in the official certification issued to the Main Contractor.

All interim claims will be submitted as showing a percentage of work complete against the Summary of Tender items.

Retentions will apply as the Contract at 5% until Practical Completion when 2.5% will apply for the duration of the Rectification Period.

2.13 COMPLETION – DESIGN OBJECTIVES

At completion the Contractor shall fully demonstrate that the system has achieved the design objectives.

2.14 CALCULATIONS AND SCHEMATICS

The Contractor shall provide:

- Schematic drawings showing the outline design of the services proposals, including design loads, pipe sizes, air / water velocities, pressure drops etc.
- Winter heat loss calculations, Air Source Heat Pump sizing calculations, Underfloor heating calculations, pipe sizing calculations, pump duty calculations, expansion vessel calculations.
- Calculation showing Classrooms and Teaching Spaces ventilation, thermal comfort and indoor air quality requirements as described in Building Bulletin 101
- Calculation for Cold water sizing, hot water sizing and distribution pipework sizing calculations.

- Ventilation plant and equipment sizing calculations, ductwork and grille sizing calculations. Noise attenuation calculations.
- Gas pipework sizing calculations
- Heating, gas, domestic water and cooling schematics.
- Controls schematics, wiring diagrams and description of operations.
- 1:50 drawings showing the design of the services proposals, including design loads, pipe sizes, etc.
-

2.15 COMMENTS ON CALCULATIONS AND DRAWINGS

Where comment on calculation and 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.

2.16 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 and Engineer written notice when any portion of the plant is ready for test.

2.17 TESTS AT SITE

The Contractor shall carry out such pressure, insulation and other tests and commissioning of the systems and taking over tests on site as may be required by the Contract Administrator and/or Engineer, and unless otherwise indicated in the Specification. The Contractor shall 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 or Engineer.
In the event of the plant not passing the tests, all reasonable expenses incurred by the Contract Administrator or Engineer, 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.

2.18 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.

2.19 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.

2.20 RESTRICTIONS

There shall be a No Smoking policy enforced throughout the works, in all areas of the Site. No radios will be permitted.

The Contractor’s staff shall restrict themselves to the Site at all times and shall not loiter within the immediate environs outside the building.

Foul and offensive language and gestures will not be tolerated within the immediate environs of the building.

All debris and refuse from the works shall be removed off site to a waiting van, lorry or vehicle. Collections of materials on the public footpath will not be accepted unless part of a continuous offload.

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 and Public Health 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.

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.

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) Electricity at Work Regulations.

(6) Health and Safety at Work Regulations.

(7) All relevant British Standards

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

(9) The Electricity Safety, Quality and Continuity Regulations.

(10) The Building Regulations Approved Documents.

(11) Gas Safety (Installation & Use) Regulations 1998 (GSIUR).

(12) Requirements of Gas Safe.

(13) Manufacturers' Instructions.

(14) Gas Safe Technical Bulletins including TB008 (Edition 3).

(15) Department of Education Building Bulletins.

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 Engineer 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 Engineer at no cost to the Works.

In the event of neglect or refusal to carry out replacement or remedial works, the Engineer 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 RECTIFICATION PERIOD

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 DRAWINGS, PROGRAMME AND RISK ASSESSMENTS & METHOD STATEMENT (RAMS)

The Contractor shall provide for the Contract Administrator's comment, not less than SIX WEEKS prior to commencement on site, Detailed Design Drawings and Calculations.

Upon comments being received on the design drawings and the scheme shall be amended to suit the comments. The scheme shall be re-submitted before commencement of the installation

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 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 also provide, prior to manufacture or installation, detailed installation and coordination drawings for the entire installation, purpose-made equipment including pipe, ductwork, conduit, trunkings 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 all builder's work drawings and detailed installation 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 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.

3.9 DRAWINGS TO BE SUBMITTED BY THE CONTRACTOR

The Contractor shall provide as part of these works the following drawings as defined in Clause 2.2: -

- Design Drawings and Calculations
- Coordination Drawings.
- Installation Drawings.
- Installation Wiring Diagrams.
- Control Logic Diagrams, Switchgear, Start and Control Panel Drawings.
- Shop Drawings.
- Record Drawings.
- Builders' Work Drawings.
- As Installed Drawings shall be maintained on site.

The definitions for each of the above are set out below and shall be allowed for in the Tenderer's quotation. The definitions are set out in line with BSRIA BG 06/2018 Appendix A.

3.9.1 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 are as follows: -

- Plan layouts to a scale of at least 1:50 or 1:100. Plant areas to a scale of at least 1:20 or 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.

3.9.2 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 coordination drawing are as follows: -

•Plantroom layouts to a scale of at least 1:20, accompanied by cross-sections and elevations to a scale of at least 1:20.

•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.

3.9.3 Installation Drawing

These Installation Drawings shall be prepared from the Engineer's "Construction Issue" given at the commencement of the project.

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:

•Plantroom layouts to a scale of at least 1:20, accompanied by cross-sections and elevations to a scale of at least 1:20.

•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 designer's specified option.

•Provide dimensions where the positioning of services is considered to be important enough not to leave to the tradesmen on site.

3.9.4 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.

3.9.5 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.

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

3.9.7 Shop Drawing
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.

3.9.8 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.

3.9.9 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.

3.9.10 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.

3.9.11 Builder's Work Drawings

Design Stage
A drawing provided by the Contractor to the Quantity Surveyor and Structural Engineer to show the provisions required to accommodate the services which significantly affect the design of the building structure, fabric and external works, issued solely for costing and Planning.

These drawings will be superseded by the Contractor's Installation Builders Work Drawings.

Installation Stage
To be prepared and issued by the Contractor.
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). The Contractor is to show on BWIC drawings all access panels required for maintenance.

The Contractor shall provide for the Contract Administrator's comment dimensioned drawings giving details of all builders' 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 supply a comprehensive wiring diagram for the following systems
- Automatic Controls System.
- Wet Underfloor heating.
- Local Mechanical Ventilation Systems.

and submit these for the approval of the Contract Administrator before the installation of the Works.

3.9.12 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.

These drawings shall be used to prepare Record Drawings at completion.

3.10 SETTING OUT WORKS

The Contractor shall set out the whole of the Works in strict compliance with the Architect's setting out drawings, and shall be responsible for the correctness of the derived 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 accepting 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 Contract 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:-

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

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

iii. 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.

iv. 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.

v. 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.

vi. Arrangements have been made to provide extended plant warranties to ensure the Client has full benefit of the Manufactures standard warranty periods.

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:

i) The excavation of trenches for pipes, cables, etc., backfilling and reinstatement.

ii) 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.

iii) The formation of concrete bases, plinths, foundations, etc.

iv) The cutting and forming of chases, recesses and holes in or through walls, floors, ceilings, partitions, roof etc., and making good.

v) 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 UNDERGROUND SERVICES

All underground services shall be laid with due regard to existing services, drains, culverts, etc.

In laying any underground services, the Contractor shall be responsible for establishing and checking the exact positions of existing services.

Pipes, ducts, cables, etc., shall be laid at least 1m from any existing underground service, drain, etc., crossovers excepted. Where this is not practicable, the Contract Administrator's ruling shall be obtained before proceeding with excavation.

The Contractor shall be held responsible for any damage caused to existing underground services, drains, etc., that is deemed due to negligence or bad workmanship on his part or due to his failure to work to this Specification.

3.24 CONNECTIONS TO EXISTING CIRCUITS

Connections shall be made to the existing mains where indicated, and these works shall include draining down as necessary and re-filling, re-regulating and venting all existing circuits to suit the new operating conditions.

The Contractor shall also include for making and repairing the existing thermal insulation where damaged or disturbed and as further indicated on the drawings.

No alterations to the existing boiler, service piping, or valves shall be undertaken without first obtaining the approval of the Contract Administrator.

If temporary or other work is required outside normal hours this must be specified and detailed).

The Work shall be executed in such a manner and at such times as may be necessary in order to cause the minimum of interference with existing services.

Where it may be necessary to interrupt existing services, notice of such intention shall be given by the Contractor to the Contract Administrator one month in advance to enable any necessary re-arrangements to be made.

FORTY-EIGHT hours' notice shall be given to the parties above prior to actual commencement of this work.

3.25 DISPOSAL OF FLUORESCENT LAMPS

Where these Works involve the disposal of fluorescent lamps the waste from these shall be regarded as hazardous waste and shall be disposed of in accordance with the Control of Pollution Act, Latest Edition.

The waste lamp(s) shall either be crushed in proprietary lamp crushers and bagged in special bags marked "hazardous waste", or the Local Authority shall be contacted and their advice sought on the proper disposal of these lamps.

3.26 DISPOSAL OF PCBs (POLY CHLORINATED BIPHENYLS)

Where these Works include the stripping out and disposal of electrical equipment containing PCBs:- e.g., capacitors in fluorescent luminaires, power factor correction capacitors and oil insulated switchgear and transformers, these shall be regarded as hazardous waste and shall be disposed of in accordance with the Control of Pollution Act, Latest Edition.

This type of waste shall not be disposed of into skips unless the waste contractor is fully aware of the contents and has obtained the correct licences for the disposal of PCB materials.

3.27 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, trunkings, 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.

3.28 LOOSE MATERIALS

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

3.29 ELECTRIC SHOCK NOTICE

In every Plant Room/Switch Room, a Notice shall be hung giving details of the methods to be employed when treating persons suffering from Electric Shock (published by IPC Business Press Ltd. - Mouth to Mouth Resuscitation).

3.30 RUBBER MAT

In front of all main switch panels a 600mm wide rubber mat the length of the switch panel shall be provided.

3.31 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.

3.31.1 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

3.31.2 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.

3.31.3 Supplies to Fire Alarm Equipment

The mains supply to an item of fire alarm equipment shall be on a dedicated circuit, its protective device shall be coloured red and it shall bear the label:

FIRE ALARM: DO NOT SWITCH OFF

3.31.4 Drinking Water

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

3.32 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.

3.33 CABLES COMPLIANCY

The European Union's Construction Productions Regulation (CPR), EN 50575 (incorporating the new fire test EN 50399), requires that all construction cable that is fire reactive and intended to fit permanently into the structure of a building, including power distribution, final circuit wiring, control and instrumentation and data communications cables, shall meet specific cable testing and certification set out in EN

50575 and must be CE marked. These works shall include for all such certified cables where used. The Contractor shall provide all documentation within the O&M manual prior to handover.

3.34 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

This section of the Specification sets out the general standards, methods and processes to be adopted for the supply and erection of pipework and fittings.

Pipework systems shall comply with the British Standard Code of Practice appropriate to the system. Water services shall, in addition, comply with the Water Supply Regulations appropriate to the Works. Gas pipework installations shall comply with the requirements of The Institution of Gas Engineers Utilisation Procedures IGE/UP/2. Refrigerant pipework shall comply with the Guide to Good Practice for Commercial and Industrial Refrigeration published by the BESA. Soil and Waste systems shall comply with the Building Regulations and Local Authority Byelaws.

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

4.2 PIPE AND FITTINGS

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

Steel up to and including 125mm bore	BS EN 10255 (formerly BS 1387)
Steel above 125mm bore	BS EN 10216-1 & BS EN 10217-2
Half hard copper	BS EN 1057 (Formerly BS 2871 Part 1, Table X)
Corrugated Stainless Steel - Rigid (known as Trac Pipe CC)	BS EN 15266 (BS 7838)
Cast Iron Ductile Iron	BS EN 877 BS EN 545, 598 and 969
Unplasticised PVC (PVC-U)	BS 3505 (BS EN ISO 1452-1 & BS EN ISO 1452-2
Polyethylene (PE) blue and black (for potable water below ground) 20mm - 63mm 90mm & above	 BS EN 12201-1, -2, -5 WRC Spec. No. 4.32.03
Polyethylene (PE) yellow (for gaseous fuels)	BS EN 1555-1, -2, -5

Fittings shall conform to the following British Standards:

Steel	(Threaded Cast Iron & Copper)	BS 143-1256
	(Butt-Welded)	BS EN 10253
	(Threaded Steel)	BS EN 10241

Copper (Capillary)	BS EN 1254-1
(Compression End)	BS EN 1254-2
(Press Fit)	BS 8537
Corrugated Stainless Steel - Rigid (known as Trac Pipe CC)	BS EN 15266 (BS 7838)
Cast Iron	BS EN 877
Ductile Iron	BS EN 545, 598 & 969
Unplasticised PVC (PVC-U)	BS EN ISO 1452-1 & BS EN ISO 1452-3
Polyethylene (PE) blue and black (for potable water) 20mm - 63mm	BS EN 12201-1, -2, -5
90mm to above	WRC Spec. No. 4.32.94
Polyethylene (PE) yellow for natural gas	BS EN 1555-3

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.

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

Gas pipework shall not be installed in wall cavities but may pass through if sleeved and sealed.

On water and gas services running below floorboards, the floorboards shall be marked to show the routes.

Gas pipework shall not pass through another dwelling to serve a property.

Denso tape wrapped gas pipework running within the screed shall have a minimum 25mm screed cover, but to be avoided if possible.

Ensure all flux residue is removed from soldered fittings.

4.3 PIPE JOINTS

For steel pipework: Joints on all permanently concealed pipework and all pipework of 65mm and above shall be welded. All other pipework shall have screwed joints with threads to BS 21 with tapers on pipes and adaptors.

For copper pipework: Joints on copper pipework 67mm dia. and above shall be by gunmetal brazing, flanges or, where specified elsewhere, mechanical grooved joints suitable for copper pipe or brazed joints providing flanged or mechanical joints installed in locations not exceeding 12m apart.

Joints on copper pipework 54mm dia. and below shall be by means of pre-soldered capillary or compression fittings. Compression fittings shall be used for valves and final connections to equipment or where necessary to facilitate removal and/or dismantling. Push-Fit or Press-Fit shall be allowed if specified elsewhere.

All pipework in positions not readily accessible in wall chases, cavities and floor trenches shall have brazed joints.

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

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. All unions shall be conical seated pattern.

Connectors or long screws shall not be used.

4.3.1 Screwed Joints

Screwed joints shall be provided on steel pipework, up to and including 50mm nominal bore, where the pipework will be accessible on completion. They shall also be provided in other areas where specified and at screwed valves and fittings.

Screwed joints on pipework shall have taper threads to BS EN 10226 Part 1, made with PTFE jointing tape, or with best quality hemp and jointing paste. The amount of hemp and paste used shall be kept to a minimum and excess removed. Where excessive use of hemp is observed the length of pipe and fittings involved shall be replaced with new materials.

On screwed joints at least one of the two engaging components shall be taper threaded and the jointing between them shall be made with approved jointing material. Screwed fittings shall be manufactured to BS 143 / BS EN 10241.

White jointing compound and hemp shall not be used on domestic water services where the jointing material shall comply with the requirements of the Water Supply Regulations.

Joints on oil pipework shall comply with BS 799 : Part 4. They shall be unaffected by the action of the oil and remain in a slightly plastic condition when set. Hemp and other fibrous materials shall not be used.

4.3.2 Copper Pipework Joints

Joints in copper pipework shall be by means of factory made non-dezincifiable couplings or by brazing using the correct forming tools. Couplings shall be fitted strictly in accordance with the manufacturer's recommendations. Particular attention shall be given to cleanliness and lack of distortion of the tube and fitting and to ensuring full insertion depth in fitting.

Capillary joints shall be made by thoroughly cleaning sockets of fittings and ends of pipes, and by using a suitable flux as described below. Capillary fittings shall have integral solder rings. No additional solder shall be added to the joint and all surplus flux shall be removed.

Brazing shall be carried out in accordance with HVCA publication TR3 'Brazing and Bronze Welding of Copper Pipework and Sheet'. Couplings shall be used where joints are visible. Elsewhere they may be made by properly belling or swaging one pipe to allow insertion of the other. Brazed joints shall be made using filler rods and appropriate fluxes.

Soldered joints shall be made in accordance with HVCA publication TR7 'Guidance on Soft Soldering for Pipe Jointing of Copper' using lead free solders. Excessive use of flux or self-cleaning flux will not be permitted. The Mechanical Services Installer shall obtain agreement from the Local Water Authority for any flux and solder proposed. The Engineer reserves the right to have any pipework not complying with this clause removed.

4.3.3 Welded Joints

Welded joints shall be provided on mild steel pipework of 65mm nominal bore and above and on all concealed and inaccessible pipework including structural, ducts, trenches and chases.

All forms of welding shall be in accordance with the conditions, techniques and methods laid down in the appropriate British Standard, Code of Practice and the BESA Technical Documents for Welding.

The method used shall be appropriate for applications where welding is required.

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

Welds shall be of clean metal, free from porosity or slag inclusions and of even thickness and contour. They shall be well fused with the parent metal, annealed and finished smooth. Welding metal shall not project into the bore of the pipe.

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. They shall only execute work appropriate to their grade and competency.

The Contractor is to demonstrate the quality of the welder's work in accordance with BS 4872:Part 1

Each welder shall be provided with weld tags and shall tag each joint with an individual identification symbol. A random 10% sample of each size of weld carried out by each welder shall be selected by the Engineer and, if directed, tested in situ, at the Mechanical Services Installer's expense.

4.4 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 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.

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.

4.5 PIPEWORK SPACING

The Contractor shall ensure that pipework or pipe insulation is installed with the following minimum clearance between them or the adjacent surface as follows:-

From	Minimum Clearance (mm)
Wall	25
Ceiling	50
Floor - finished	150
Floor - top of skirting	50
Other pipes - insulated	25
Other pipes - bare	150
Electrical cables, conduit, switchgear, etc.	150

Notwithstanding the above minimum clearances, sufficient space shall be allowed to permit easy application of insulating materials. Pipes shall not be enclosed in a common covering.

Spacing of gas and water services below ground shall comply with the requirements of British Gas and the Local Water Authority.

4.6 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.

4.7 EXPANSION RELIEF

4.7.1 Expansion Loops

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

These 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.

Where bends and loops are not a practicable solution provision for expansion shall be by the insertion of axial expansion joints, bellows as described in the following clause.

4.7.2 Axial Expansion Joint

The Contractor shall design, supply and install a thermal expansion joint, as manufactured and supplied by Stourflex Ltd., Tel: 01384 393329, included for on the heating distribution mains. The bellows shall be line size.

The expansion joints shall be suitable for the material and services they are being installed to serve.

Expansion joint convolutions for 65mm NB upwards shall be of a thick wall spirally wound multi-ply construction with a corrosion-resistant inner ply in AISI 316Ti stainless steel. Units 65mm NB and above should be fitted with stainless steel inner sleeves where necessary.

Expansion joint convolutions for up to 50mm NB carbon steel pipework shall be single-ply construction. They must be fitted with inner and outer sleeves and be manufactured

with an integral first guide within the body at each end. Units to be pre-cold-drawn with a retaining clip which must be removed after installation.

Expansion joint convolutions for up to 42mm NB copper pipework shall be single-ply bronze construction to avoid flux corrosion. They must be fitted with inner and outer sleeves and be manufactured with an integral first guide within the body at each end. Units to be pre-cold-drawn with a retaining clip which must be removed after installation.

Expansion joints shall be capable of withstanding a pressure 1.5 times their design pressure without deformation.

Prior to commencement of the installation, the Contractor must agree with Stourflex Ltd., to visit site to ensure their guidelines for selection and installation are adhered to, and that the anchors and guides are correctly positioned to ensure that the expansion joints function as intended. Prior to application of heat onto the systems, Stourflex Ltd., is to visit site to check the expansion joint installation and issue a Certificate of Inspection, which is to be sent Contract Administer

The expansion joints shall be installed to the manufacturer's requirements and have anchors and guides installed to the manufacturer's requirements.

4.7.3 Rubber Bellows

The Contractor shall design, supply and install rubber bellows on pump inlets and outlets, The bellows shall be pipeline size not the pump inlet size.

The pump and the first pipe supports shall be taken to the floor with a tico pad between the floor and support.

The rubber bellows shall be Stourflex Ltd., Tel: 01384 393329, type to manufacturer's specification.

The bellows shall have noise reduction capabilities of 20 dB and have a current TUV approval certificate.

4.7.4 Rubber Hoses

The Contractor shall design, supply and install rubber hoses as manufactured by Stourflex Ltd., Tel: 01394 393329..

The rubber hoses shall be manufactured from EPDM rubber with stainless steel outer braiding and brass nickel plated ends with BSPT male taper Hex or BSPT full male unions to suit the pipework.

4.8 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.

In addition, where pipework passes through fire barriers, and after the installation of the piping the space between the pipe and sleeve shall be packed with intumescent material and sealed with Mann McGowan Ltd. Pyrosleeve Pyrocool, to give a 2-hour fire resistance to affect a fire seal. Sealant penetration shall be in accordance with the manufacturer's instructions.

4.9 PIPES, ENTRIES OR DEPARTURES

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

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 Mann McGowan Ltd., Tel: 01252 333601.

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

4.10 DRAIN AND EMPTYING POINTS

Each system shall be provided with suitable drain connection at all low points. They shall also be provided to allow plant, equipment and connections to sanitary fittings to be drained.

On low or medium pressure systems drain cocks shall comprise standard hose union gland type drain cocks with detachable keys manufactured from cast gunmetal or bronze. On high pressure hot water systems, they shall comprise a needle-seated key operated globe valve. On open circuit systems they shall be screw-down pattern to BS 2879. The size to be confirmed by the Engineer before installation.

Drain and drip points at pumps, cooler coils, safety valves, safety cocks and other equipment shall be provided with drain lines discharging into tundishes adjacent to the equipment. Where necessary to prevent back suction, drains from equipment shall be fitted with cleanable traps of a depth such that the system pressure does not break the water seal.

Tundishes shall be sized for the expected discharge and shall be constructed from copper or stainless-steel sheet. A rolled top rim shall be formed to stiffen the tundish and a hinged lid provided to allow for examination of the drip pipes without disturbing the drain lines. Tundishes shall discharge into copper pipes, run to convenient floor gullies or sumps.

4.11 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.

4.12 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.

4.13 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.

4.14 POCKETS FOR TEST THERMOMETERS/BINDER TEST POINTS

Unless otherwise agreed by the Contract Administrator 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.

4.15 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

All branches to sanitary fittings, kitchen appliances, drinking fountains, etc. shall terminate within 300mm of the fitting or range of fittings with a copper stainless steel adaptor

Unless otherwise indicated, the Contractor shall connect up to all items of kitchen equipment, etc.

On shower assemblies the Contractor shall run right up to the nozzle, rose or mixer fitting as indicated with chromium plated pipe and fittings.

4.17 TERMINATION OF BRANCHES ON GAS SERVICES

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

When connecting to a workshop bench outlet and the like, and where it is possible that the outlet will be coupled to a compressed air appliance, a non-return valve shall be fitted on the gas connection.

Each appliance shall be provided with a gas cock.

4.18 UNDERGROUND SERVICES, WATER MAINS, ETC.

Pipes buried in the ground shall have a minimum of 900mm cover and shall be evenly graded throughout with drains and washouts provided at the lowest points and at changes in level.

Each drain shall comprise a tee on the underside of the main, with isolating valve as scheduled and 50mm diameter waste pipe to the nearest suitable site drain.

Air release arrangements shall be fitted on the crown of the main at all points where air is likely to accumulate. These shall be of the size as scheduled and complete with isolating valve and air release valve screwed 20mm BSPT.

Suitable surface boxes shall be supplied for drains, washouts, valves and air release points.

All water mains shall be cleaned and chlorinated before being commissioned, as specified elsewhere.

Pressure tests, cleansing and chlorination shall be carried out before backfilling, but after all changes of direction on socket and spigot pipes have been concreted, blank ends strutted and each pipe barrel earthed over, leaving the joints exposed.

Polyethylene pipe shall be used.

4.19 BRANCHES TO SERVE FUTURE EXTENSIONS

Branches shall be left where indicated on the drawings to serve future extensions and each branch main shall be terminated with a valve which shall be sealed with either a screwed plug or joint ring and blank flange bolted on.

4.20 CLEANING AND CHLORINATION

All hot and cold water services pipework including tanks, cylinders, etc. shall be cleaned and chlorinated as required by the local Water Supply Authority, HTM Standards and BS EN 806 & BS 8558:2015 immediately prior to Practical Completion. A Certificate of Chlorination shall be provided to the Contract Administrator and included in the Record Documents.

The Contractor shall employ a Specialist Water Treatment Company, as Goodwater Ltd. (Tel: 0118 973 5003), to chlorinate the new installation.

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 contains 50mg/l 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 1 hour, whereupon a test be made for residual chlorine. If the concentration is found to contain less than 30mg/l the chlorination procedure and testing shall be repeated.

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

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

method statements and all necessary safety notices on all outlets warning that disinfection is being undertaken. In addition, all necessary local water authority permits to discharge chemical to drain are to be acquired.

On completion of the disinfection works, samples are to be taken from representative locations and tested to TVC (22 and 37 degrees Celsius), Coliforms and Pseudomonas Aeruginosa.

4.21 PRE-COMMISSIONING CHEMICAL CLEANING - HEATING SYSTEMS

Upon completion of the installation of the heating [and chilled water] systems the Contractor shall ensure the entire installation is thoroughly and efficiently cleaned by a water treatment specialist. The Contractor shall employ a Specialist Water Treatment Company, Goodwater Ltd (Tel: 0118 973 5003), to carry out these works.

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 water supply has been provided as detailed in Table 3 of BSRIA BG 29/2021 and a water supply having a pressure of 30psi in excess of the static head of the system shall be provided to ensure that flushing velocities are achievable. 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.

4.22 PRE-COMMISSIONING CLEANING METHOD - HEATING SYSTEMS

Prior to commencing the pressure testing, filling and flushing process, the Contractor shall put in place the inspection and witnessing programme detailed in Section 3 of BSRIA BG 29/2021.

The pre-commission cleaning programme shall be carried out in accordance with BSRIA Guidance BG 29/2021 and the water sampling requirements of BS 8552 and include at least the following:

1) Prior to the start of any introduction of the chemical, each installation shall be subjected to a dynamic flush' with circulation pumps in operation as detailed in Section 5 of BSRIA BG 29/2021. The flushing shall continue until all parts of the system have been adequately flushed. Each branch is to be flushed to achieve at least 110% of the design flow or the flows stated in Table 7 within BSRIA BG 29/2021, whichever is the greater. The primary circuit is to be flushed first, with flow being measured at the time. Particular attention shall be

paid to venting and the operation of drain valves at low points and potential dirt pockets/dead legs.

During this flushing programme measurements shall be made to ensure adequate flow rates throughout the system and flow rates shall be maximised where applicable.

2) Measured quantities of cleaning agent designed to remove deposits such as grease, oil, other hydro-carbons, loose scale and corrosion products shall be introduced into the system via a system dosing pot.

The chemical shall be circulated and tested throughout the systems. The systems shall remain dosed and circulating with the chemical for the period of time specified by the chemical cleaning specialist, likely to be 48 hours. The installation shall then be subjected to a balanced flush with the circulation pumps running, until all traces of chemical are removed. Drain valves at low points and dirt pockets/dead legs shall be operated to facilitate this.

3) All strainers shall be removed from the system, cleaned and replaced back into the system.

4) An appropriate and approved inhibitor and biocide shall be introduced into the system via the dosing pot. The introduction of inhibitor shall take place immediately on completion of the final flush. The chemical shall be as advised by the chemical cleaning specialist and the boiler manufacturer's recommendations.

5) The inhibitor/biocide shall be circulated and tested throughout the system.

On completion of the flushing and chemical cleaning works, sampling and ongoing monitoring as per Sections 3.1.5, 3.1.6 and 3.2 of BSRIA BG 29/2021 are to be implemented. All samples are to be interpreted using Tables 4, 5 & 6 of BSRIA BG 29/2021.

4.23 OBJECTIVE OF CLEANING PROGRAMME

The objective of the pre-commissioning cleaning processes applied to heating, cooling and other closed pipework systems, is the process of bringing the system to a satisfactory state for commissioning and on-going maintenance of water quality. This means that:

1) The system water should be free of construction debris, dirt and excessive particulate matter.

2) Internal surfaces should be free of millscale and appropriately treated to minimise on-going corrosion.

3) Pipework, fittings and terminal units should be free from settled solids that could increase the risk of corrosion.

4) Residual levels of suspended solids should be low enough not to cause difficulties with commissioning or significant accumulation in low flow areas.

5) Biofilm formation should be minimised by appropriate use of biocides and those bacteria associated with microbiologically induced corrosion should be controlled.

4.24 DOSING POT

The Contractor shall include in the system a dosing pot to be fitted across the pump suction and discharge pipes located within the plant room.

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

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

The capacity of the dosing pot shall be sized to suit the system.

As manufactured by Arrow Valves Ltd., Tel: 01442 823123

4.25 SHEDULE OF PIPE AND FITTINGS

SERVICE	LOCATION	MATERIALS	FITTING	REMARKS
Primary Heating Mains	Internal but accessible	Half hard copper (light gauge)	Capillary or Compression Push fit or Press Fit (Yorkshire)	Press Fit shall be the primary jointing method followed by Push Fit. To be installed to Manufacturer's requirements
	External and external ducts	Half hard copper (light gauge)	Capillary or Compression	To be installed to Manufacturer's requirements.
	Inaccessible	Black mild steel (heavy gauge)	Steel butt welding	Denso tape wrapping
Hot Water	Internal but accessible	Half hard copper (light gauge)	Capillary or Compression Push fit or Press Fit (Yorkshire)	Press Fit shall be the primary jointing method followed by Push Fit. To be installed to Manufacturer's requirements
Cold Water Services	Internal but accessible	Half hard copper (light gauge)	Capillary or Compression Push fit or Press Fit (Yorkshire)	Press Fit shall be the primary jointing method followed by Push Fit. To be installed to Manufacturer's requirements
	External and external ducts	Half hard copper (light gauge)	Capillary or Compression Push fit or Press Fit (Yorkshire)	To be installed to Manufacturer's requirements
	Repair of existing systems	Galvanised mild steel (heavy gauge)	Galvanised malleable iron	

SERVICE	LOCATION	MATERIALS	FITTING	REMARKS
	External and external ducts (not above ground)	Medium Density Polyethylene (MDPE Blue)	Compression, Fusion or butt welding	Laid in sand
	Buried underground	Medium Density Polyethylene (MDPE Blue)	Compression, Fusion or butt welding	Laid in sand
Gas	Internal but accessible	Half hard copper (light gauge)	Capillary or Compression or press fit system	Ventilated voids. **Push fit shall not be used on Gas installation**
	Internal (non-ventilated voids)	Corrugated stainless steel (semi-rigid)	Auto-flare	Pipe-in-pipe application known as Tracpipe CC, installed to manufacturer's requirements.
	External and external ducts	Half hard copper (light gauge)	Capillary or Compression	Ventilated duct
	Internal but accessible	Black mild steel (heavy gauge)	Malleable iron, subject to Supply Authority, steel butt welding	Ventilated voids
	External and external ducts	Black mild steel (heavy gauge)	Malleable iron, subject to Supply Authority, steel butt welding	
	Fire protected shafts	Black mild steel (heavy gauge)	steel butt welding	
	External and external ducts	Medium Density Polyethylene (MDPE Yellow)	Compression fusion or butt welding	Laid in sand
	Buried underground	Medium Density Polyethylene (MDPE Yellow)	Compression fusion or butt welding	Laid in sand

SERVICE	LOCATION	MATERIALS	FITTING	REMARKS
Condensate from Condensing Boilers & Flues	All	PVC Plastic	Glued Joints	To Boiler manufacturer's requirements
Safety Valve Drain	Copper Table X	Yorkshire Push Fit System Yorkshire Press Fit System Capillary/Compression	Press Fit shall be the primary jointing method followed by Push Fit.	
Sprinkler Services to Stop Valve	Internal External	Galvanised mild steel (heavy gauge) Galvanised mild steel (heavy gauge)	Galvanised malleable iron Galvanised malleable iron	 Denso tape wrapping
Sprinkler from outlet to Stop Valve	Internal	Black mild steel (heavy gauge) Galvanised mild steel (heavy gauge)	Cast Iron	

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 VALVES AND COCKS - GENERAL

These shall be from the preferred list of manufacturers in the Schedule of Valve Types at the end of this section. The Contractor shall use a single manufacturer to provide similar valve types throughout the project.

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.

The Contractor shall provide valves and cocks to permit the isolating of equipment or sections of the installation and for balancing of flow quantities. They shall be located to allow ease of operation and servicing. Where concealed behind access panels or similar they shall, wherever practical, be grouped for ease of access. The Contractor shall provide valves and cocks on the inlet and connection to all appliances such as:-

Air Source Heat Pumps
Heat Exchangers
Heater Batteries
Radiators
UFH Manifolds
Pumps
Water Heaters
Water Meters
Automatic Valves
Vessels
Tanks
Appliances

Where the heating medium is water one of the valves on 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.

Valves and cocks, located where unauthorised interference is possible, shall be fitted with key-operated spindles. Alternatively, on large valves they shall be securely locked in position by means of a padlock. Wheeled valves on hot services shall be fitted with ‘cool’ pattern wheels. Valves and cocks exposed in rooms shall be provided with easy-clean bonnets.

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.

Double regulating valves shall be provided on all hot water service return branches and main branches.

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

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 or ball-o-fix type valve shall be fitted on each branch serving a fitting or range of fittings of hot and cold water services.

Ball-o-fix type valves shall have full bore orifice not a restricted orifice.

A gas cock shall be fitted on each branch serving a fitting of gas services. Ensure handle is attached to valve. Handle must be vertically down in closed position if on horizontal pipework.

5.2 VALVE LABELS

Valve labels shall be provided for all main valves, except those on 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.

If gas emergency control valve is more than 2m from meter, or out of sight, a notice must be provided.

5.3 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.

5.4 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 AUTOMATIC AIR/DIRT SEPARATORS

The Contractor shall install line-sized air and dirt separators or a combined air/dirt separator as indicated on the drawings, on the hottest point of the system.

The separators shall be manufactured and supplied by Spirotech UK Ltd., Tel: 020 8451 3344. The separator shall have screwed connection up to and including 40mm and flange connection for 50mm and above.

5.6 PRESSURE REDUCING VALVE

The Contractor shall install on the domestic hot and cold pipework a pressure reducing valve to protect the installation against excessive pressure from boosted supplies.

The pressure reducing valves shall be diaphragm operated with an adjustable spring. The valves shall be WRAS approved and suitable for the inlet pressure and temperature.

The valves shall be manufactured by Reliance Water Controls Ltd., Tel: 0800 389 5931. The valve shall be complete with pressure gauge.

5.7 THERMOSTATIC CIRCULATION VALVES

Hot water self-balancing or thermostatic circulation valves shall be provided on all domestic hot water return pipework connections. These shall be DN15 or DN20 Aquastrom VT valves as manufactured by Oventrop UK Ltd, factory set at 57°C or TA-Therm valves as manufactured by Tour and Anderson. These shall be factory set at 55°C.

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

5.8 CONCEALED HOSE UNION TAP

Where indicated on the drawing, a concealed Hose Union Tap shall be installed – model HUC – as manufactured by Arrow Valves Ltd – Tel 01442 823123. The tap shall be flush when closed and be extended using the key supplied. This key shall also be used to turn the tap on/off. An installation kit shall be supplied, including a Double Check Valve assembly (type ED) suitable for Fluid Category 3 protection, which should be installed inside the thermal envelope of the building.

5.9 DOUBLE CHECK VALVE - OUTSIDE APPLIANCES

All services to outside appliances shall have a Double Check Valve assembly of the exceptionally low head loss type – model ED132 - as manufactured and distributed by Arrow Valves Ltd - Tel 01442 823123. The pressure drop across the assembly at 3 m/s pipe velocity shall be less than 0.13 bar. The body shall be DZR brass and include flat-faced connections suitable for solder union connections. A spherical drain tap shall be fitted downstream of the check valve cartridges.

5.10 THERMOSTATIC RADIATOR VALVES

These shall have 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 as manufactured and distributed by Oventrop UK Ltd.

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. 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 of not more than 300mm.

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.

5.11 MAGNABOOSTER

On smaller heating installations, where the main heating flow pipework from boiler is 22mm, a Spirocombi Magnabooster shall be installed instead of the Spirotech air and dirt separators.

The Magnabooster shall be as manufactured by Spirotech UK Ltd., either vertical or horizontal model, combined air and dirt separator complete with self-cleaning magnet.

5.12 VALVE SELECTION

A Schedule of Valve Types and the minimum required performance of such valves is included herein. Prior to commencing works the Contractor shall complete this Schedule, providing details of manufacturer and model references applicable. This completed schedule is to be submitted to the Employer's Agent for comment/ approval.

The Contractor is to select all valve types from a single manufacturer as far as is practically possible.

5.13 BRITISH STANDARDS

BS 864	Capillary and compression tube fittings and copper alloy.
BS 1010	Draw-off taps and stop valves for water services.
BS 1212	Float operated valves.
BS 2767	Valves and unions for hot water radiators.
BS 4504	Flanges and bolting for pipes, valves and fittings. Metric series.
BS 5150	Specification for cast iron gate valves.
BS 5152	Specification for cast iron globe and globe stop and check valves for general purposes.
BS 5153	Specification for cast iron check valves for general purposes.
BS 5154	Specification for copper alloy globe, globe stop and check valves and lift type check valves.
BS 5155	Specification for butterfly valves
BS 5158	Specification for cast iron plug valves
BS 5160	Specification for steel globe valves, globe stop and check valves and lift type check valves
BS 5163	Specification for predominantly key-operated cast iron gate valves for waterworks purposes
BS 5353	Specification for steel plug valves
BS EN ISO 9000	Quality Systems

BS 6755	Testing of Valves
BS 7350	Specification for double regulating globe valves and flow measurement devices for heating and chilled water systems
BS 7556	Thermostatic radiator valves – specification of dimensions and details on connection
BS EN 215-1	Thermostatic Radiator Valves Part 1 – Requirements and Test Methods

5.14 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	D	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 ℃	Maximum Pressure Bar
A	Bronze Gate	Oventrop Hepworth Hattersley Crane	15 to 50	168 30 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	Oventrop Hattersley Crane	65 to 300	10452 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	Oventrop Hattersley Crane	65 to 300	10484 (Lever) & 10492 (Gear Operated) 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	Oventrop Low Flow 0.01-0.035 LS. Low Flow 0.01–0.023 Commissioning Set	Oventrop Hattersley Crane	15	1060464 2473L D942	Water	120	20
C	Oventrop Med Flow 0.036-0.07 LS. Med Flow 0.23–0.05	Oventrop Hattersley Crane	15	1060434 2473M D942	Water	120	20

Ref.	Valve Description	Manufacturer	Size mm	Catalogue or Fig. No.	Medium	Maximum Temperature ℃	Maximum Pressure Bar
	Commissioning Set						
C	Bronze Commissioning Set	Oventrop Hattersley Crane	15 to 50	10604 2432 D940	Water	120	20
C1	Cast Iron Commissioning Set	Oventrop Hattersley Crane	65 to 300	10658 M2733PN16 DM940	Water	120	16
D	Oventrop Low Flow 0.01-0.035 LS. 0.01 – 0.05 l/s Double Regulating	Oventrop Hattersley Crane	15	10611641 473 D922	Water	120	20
D	Bronze Double Regulating	Oventrop Hattersley Crane	15 to 50	10601 1432 D920	Water	120	20
D1	Cast Iron Double Regulating	Oventrop Hattersley Crane	65 to 300	10626 733DRPN16 DM920	Water	120	16
E	Bronze Check	Hattersley Crane	15 to 50	1033347 D138	Water	120	25
E	A1 Bronze Check	Hattersley	65 to 200	5870	Water	120	16
E1	Cast Iron Check	Oventrop Hattersley Crane	65 to 300	10726 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	Oventrop Hattersley Crane	15 to 50	11200 807 D297	Water	120	32
G	Radiator Wheel Angle	Oventrop Hattersley Crane	15 to 25	11915 2386 D880CP	Water	120	10

Ref.	Valve Description	Manufacturer	Size mm	Catalogue or Fig. No.	Medium	Maximum Temperature ℃	Maximum Pressure Bar
G	Radiator Lockshield Angle	Oventrop Hattersley Crane	15 to 25	10906 2386LS D881CP	Water	120	10
G	Radiator Wheel Straight	Oventrop Hattersley Crane	15 to 25	11916 2407 D890CP	Water	120	10
G	Radiator Lockshield Straight	Oventrop Hattersley Crane	15 to 25	10906 2407LS D881CP	Water	120	10
H	Thermostatic Radiator Angle	Oventrop Hattersley Danfoss Drayton	15 & 20	11810 2086 RAVL-S TRV4	Water	120	10
H	Thermostatic Radiator Straight	Oventrop Hattersley Danfoss Drayton	15 & 20	11811 2087 RAVL-S TRV4	Water	120	10
J	Differential Pressure Relief	Oventrop Hattersley	20 to 32	10852 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	Oventrop Hattersley	15 to 25 32 to 50	44000 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	Oventrop Hattersley Crane	15 to 50	10320 81HU D344 1/2	Water	120	10

Ref.	Valve Description	Manufacturer	Size mm	Catalogue or Fig. No.	Medium	Maximum Temperature ℃	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 Crane	6 to 15 6 to 15	5N 5NLS D71	Water Water	120 100	32 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 Eliminator	Brownall (Winn)	15	Type B Type MPHW	Water	93 149	7 7
U	Automatic Air Valves	Oventrop Spirotech UK Ltd. Hattersley	15 15	10882 Spirotop 775	Water Water	110 120	10 10

5.15 SCHEDULE OF COMPRESSION END VALVES

Ref.	Valve Description	Manufacturer	Size mm	Catalogue or Fig. No.	Medium	Maximum Temperature ℃	Maximum Pressure Bar
A	DZR Gate	Oventrop Hattersley Crane	15 to 50	16830 30C D155C	Water	120	5
A	Ball	Oventrop Hattersley Crane	15 to 50	10790 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	1060464 2473LC D942	Water	120	5
C	Med Flow 0.23 – 0.05 Commissioning Set	Hattersley Crane	15	1060434 2473MC D942	Water	120	5
C	Bronze Commissioning Set	Hattersley Crane	15	10604 2432C D940	Water	120	5
D	0.01 – 0.05 l/s Double Regulating	Hattersley Crane	15	1061164 1473C D922	Water	120	5
D	Bronze Double Regulating	Hattersley Crane	15	1060104 1432C D920	Water	120	5
F	Bronze Strainer	Hattersley	15	11200 807C	Water	120	5
T	Ball	Oventrop Hattersley Crane	15 to 50	10790 100C D191	Water	120	5

SCHEDULE OF VALVES 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.

Manufacturers

Tour & Anderson Ltd. (TA)	Telephone No. 01582 876232
Crane Fluid Systems	Telephone No. 01473 277400
Hattersley (Pegler)	Telephone No. 01482 346461
Oventrop UK Ltd.	Telephone No. 01256 330441

5.16 SCHEDULE OF COMMISSIONING STATIONS

Commissioning Station Ref. No.	System	Pipe Size mm	Valve Size mm	M.S. Signal (kPa)	Mass Flow Rate (Kg/s)

Notes

1. All commissioning stations have been selected using Hattersley valves.

2. Not all commissioning stations are line size.

3. M – Denotes Medium Flow Valve and L – Denotes Low Flow Valve.

This table to be completed by the Contractor during the design stage and issued as part of the design package.

SECTION 6

6 HEATING SERVICES

6.1 GENERAL

The Contractor shall design, supply, install, test and commission a new heating system to the existing building and the new extension in accordance with the room data sheets.

The design of the heating shall take into current best practice to provide a energy efficient and sustainable scheme.

The primary heat source shall be Air Source Heat Pumps located on the roof of the existing building which feed a buffer vessel in the plant room. The plantroom shall include all the necessary ancillaries. The building will be heated by a wet underfloor heating system.

6.2 AIR SOURCE HEAT PUMPS

The Contractor shall calculate the heating load for the existing building and the new extension, to meet the requirements of the room data sheets and information provided in section 1 of this performance, to be able to correctly size the necessary Air Source Heat Pumps and associated buffer vessel.

The Contractor shall select from either the Mitsubishi Electric UK their CAHV range or Rhemeha their E-HP AW range. The outline scheme is based on the Mitsubishi CAHV 500 model. Each unit shall be provided with all necessary ancillaries.

The Contractor shall employ the services of the manufacturer to undertake the full commissioning of the heat pump installation.

The ASHP plant will be sequence controlled via the BMS, along with full BMS provision of monitoring as detailed in the appropriate section of this documents.

The Contractor's attention is particularly drawn to the requirements of the manufacturer with regard to ASHP system water quality and chemical content. The Contractor shall fully comply with the manufacturer's requirements such that the manufacturer's warranty period is not compromised.

The Air Source Heat Pumps shall be mounted upon frame, big foot or similar, complete with anti-vibration mounts and incorporating stainless steel condensate collection trays, etc. The frame and anti-vibration mounts shall be designed, detailed and installed by the acoustic specialist and agreed with the structural engineer and acoustic consultant., the Contractor allowing for all necessary co-ordination/liaison to ensure complete compatibility. The units will be located in an acoustic enclosure provided by others.

Upon completion of the installation the contractor will provide MCS certificate for Air Source Heat Pump installation.

The low temperature hot water system shall be the sealed type, complete with expansion vessel, circulation pump, air separator, dirt separator, automatic bypass, safety valve, pressurisation unit and commissioning station. The system shall be designed to operate at 50°C and 45°C flow and return temperature.

6.3 BUFFER VESSELS

The Contractor shall design, supply and install buffer vessels / thermal stores in the Mechanical Plantroom 0.03. The objective of the buffer vessel is to provide sufficient hot water for the heating system whilst the Air Source Heat Pumps (ASHP) are unavailable and to reduce the number of ASHP starts per hour.

The buffer vessels / thermal stores shall be manufactured by Flamco Ltd. Tel: 01744 744744 or Remeha Ltd and be compatible with ASHP manufacturer's equipment and meet the minimum circuit water content requirements of the manufacturer.

The vessels shall be constructed as a stainless-steel storage vessel with 100mm thermal insulation, all contained within a polystyrene fire resistant outer shell, There needs to be sufficient connection for the proposed installation.

6.4 PRESSURISATION UNIT

An automatic sealed system, wall mounted filling device shall be provided in the Mechanical Plantroom for the heating system in the form of a Mikrofill unit, as manufactured by Mikrofill Systems, Unit A, Buntsford Business Park, Buntsford Park Road, Bromsgrove B60 3DX. Tel: 01527 574574, type EFD.

The WRC approved unit shall comprise a 15mm compression mains cold water inlet with isolating valve, 15mm compression outlet to system with isolating valves, ¾" drain and tundish. The drain shall be run and carried into a local drain or open gully.

The unit shall also include hours-run indication, On/Off switch, mains pressure and system pressure indication, integral high pressure and low-pressure switches and alarms. Flood alarm (to shut system down), frequent use alarm, dry run protection, backflow protection.

The vessel shall be supplied and installed to the manufacturer's requirements. Only relevant equipment and assemblies certified as compliant will be permitted under this specification and any substitution put forward must also be compliant with the directive.

The unit shall be interlocked with the boiler to deactivate boiler on LP or HP.

The system condition and pressure setting are part of the Contractors design.

6.5 EXPANSION VESSELS

The Contractor shall determine the system water capacity and calculate the suitably sized expansion vessel model(s) to all adequate water expansion. The vessel(s) shall be installed to the ASHP return connection as part of the sealed pressurised system in addition to the heating expansion vessel.

Expansion vessels shall be as adequately, independently supported (not via the pipe line). The vessel shall be sized in accordance with the manufacturer's recommendations, and shall be provided by Mikrofill Systems and shall match the cold fill pressure of the Mikrofill device.

6.6 QUICK FILLING LOOPS

A quick filling loop shall be fitted.

A stop cock and double check valve shall be fitted onto the domestic cold water mains connections. An isolation valve and a single check valve shall be fitted onto the heating system cold feed connection. The two connections shall be jointed together via a metal shield flexible hose. The flexible hose shall be disconnected when not in use.

SECTION 7

7 SPACE HEATING

7.1 UNDER FLOOR HEATING SYSTEMS

7.1.1 General

Complete packaged manifolds shall be provided to each floor to serve all areas of the existing building and new extension as indicated on the Room Data Sheets. Each room and corridor shall be provided with a separate pumped loop from the manifold. The output of each underfloor heating zone shall be sized to provide at least the heat output required to overcome the calculated heat loss including 20% intermittent heating margin. Fully pumped mixing manifolds are to be provided.

The Contractor shall employ the services of WMS Underfloor Heating Limited, Tel: 01707 649922, to carry out the final design, detail drawings, supply, installation and commissioning as detailed in the following paragraphs. Note WMS systems were used in the original building installation.

The Contractor shall calculate the heat losses for each space including the 20% intermitted heating margin. The Contractor shall liaise with the underfloor heating specialist to provide initial design and ensure the room conditions can be met by the underfloor heating system.

The appointed Underfloor Heating Specialist is to allow for a full site inspection of all areas to be provided with underfloor heating, this prior to him producing detailed installation drawings.

The Underfloor Heating Specialist is to include for providing full sets of installation drawings, these indicating underfloor circuits, full manifold details, locations and sizes. The Contractor shall submit the same for comment and allow for revising the drawings in align with comments made.

The Underfloor Specialist shall be employed by the Contractor to provide/undertake the following duties:-

- Survey site and produce detailed drawings
- Revised drawings in accordance with any comments received via the Contract Administrator
- Supply and install all systems.
- Pressure test all systems and offer for witnessing prior to any elements being covered.
- Pressure test systems subsequent to laying of screeds/floor layers.
- Commission all elements of each system.
- Demonstrate full correct operation of each system.
- Provide full O&M and Record Drawings of each system.

7.1.2 Manifolds

Mixing type manifolds shall be provided. All such manifolds shall be inclusive of the provision of the following:-

- Manifold circulation pump - inverter driven.
- Temperature and pressure gauges.
- Automatic air eliminator.
- Lockshield valve.
- Flow temperature sensor and thermostat.
- Flow meters on individual underfloor circuits.
- Regulating valves and keys for individual underfloor circuits.
- Individual circuit actuators – on the return header manifold.
- High limit thermostat.

"Primary" heating circuit connections to each manifold are to include a line sized commissioning station on the return connection. This separately from the manifold assembly.

7.1.3 Manifolds 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.

7.1.4 Underfloor Distribution Pipework

All underfloor distribution pipework (downstream of manifolds) shall be of "PE-RT" multi-layered type, incorporating an aluminium layer acting as an anti-oxygen barrier.

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

7.1.5 Screeded Floor Systems

A wet underfloor heating system will be laid in solid screeded on the ground floor of the existing building and new extension. Insulation shall be provided on top of ground floor, with the underfloor heating pipework, fixed in place using a proprietary system agreed with the Architect. Prior to proceeding to screed the floors, all circuits are to be pressure tested as stated herein.

7.1.6 Joisted Floor Systems

Wet underfloor heating systems shall be provided to the first and second floor of the existing building and new extension. The floor construction is part of CLT frame and is wooden joist. The pipework shall be laid in a metal tray system suspended between the joist. Prior to proceeding with the floors finishes, all circuits are to be pressure tested as stated herein.

7.1.7 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.

7.1.8 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 each floor.

7.2 RADIATORS – LOW SURFACE TEMPERATURE (LST)

These shall be as manufactured by Stelrad Ltd; Tele 0800 876 6813 and be complete with heat emitter, casing, relevant fixings to support the emitter and casing, grilles and cut-outs etc.

All heat emitters and casings shall be provided free from rust and other corrosion and painted with one coat of priming paint [or standard finish if applicable].

All low surface temperature radiators shall be from the LST Standard range and tested to BS EN 422 and be fully compliant with surface temperature requirements achieving a maximum of 43℃.

The heat emitters shall be tested to a minimum of 7 bar and be suitable for a working pressure up to 4.6 bar.

All heat emitters shall be fitted with air vents of the flush pattern. Connection shall, where practicable be T.B.O.E. to enable the associated TRV to be located externally at the highest point.

The radiators may have been selected in conjunction with the Architect, either to have a flat or panel effect finish. The dimensions in the schedule are based on the length of wall space available. Before placing the order for the radiators, the Contractor shall be responsible for checking the length of wall space available by taking site dimensions and agreeing the exact length of radiators, and output required, with the Contract Administrator.

The Contractor shall make allowance in the tender for heating appliances to be disconnected and re-connected twice to allow for plastering, painting, etc.

The Contractor shall be responsible for the safe transport, storage and handling on site and shall agree with the Main Contractor a timed 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.

SECTION 8

8 PUMPING EQUIPMENT

8.1 GENERAL DESIGN

Pumps shall be arranged to provide circulation to the low temperature hot water heating system.

The pumps shall be sized to ensure the pumps selected are capable of delivering the necessary volume of water against the actual system resistance, in the mid range of the pumps' capacity.

Prior to placing orders for any pump set, the Contractor shall present copies of full pump duty calculations to the Contract Administrator. A copy of the proposed pump Performance Characteristic is also to be forward for comment.

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 met by the Contractor.

8.2 GENERAL - PUMPS

The pumps performance as designed by the Contractor shall be manufactured by Grundfos Pumps, Tele: 01525 850000 or Wilo (UK) Ltd., Tel: 01283 523000.

All pumps shall be installed in accordance with the manufacturer's recommendations and shall comply with the requirements of BS EN 60335, BS 4082: Part 1 and Part 2 and BS 5257 as applicable. They shall be type tested in accordance with BS EN ISO 9906.

Each pump shall be complete with an isolating valve and flexible connection on the suction and discharge connections, an air cock and drain cock, unless the pump is self-venting.

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 indicated, complete with non-return valves. The changeover shall be indicated by means of a warning light at the main control panel. These pumps sets shall be complete with test points on the inlet and outlet flanges and gauges shall be connected to the common suction and delivery mains.

Pump starters shall be panel mounted with separate isolators adjacent to the pump.

Connecting pipework shall be arranged so that no stresses are transmitted to the top casings. Anti-vibration hangers and flexibles shall be provided as necessary.

All pumps shall be resiliently mounted.

8.3 LEGISLATION

All pumps shall be compliant with European Directives for the eco-design of energy-related products (ErP) and energy-using products (EuP).

The pumps shall be CE marked.

The selection of pumps shall be made with due respect to the requirements of SBEM performance criteria that are necessary to achieve a good pass.

8.4 COMMISSIONING OF PUMPS

The Contractor shall include for the commissioning of each pump set on site.

8.5 VARIABLE SPEED PUMPS

These shall be provided as run and standby with each pump automatically infinitely fully variable in speed at the dictates of a differential pressure controller, or 3-speed control, controlling the speed of the pumps to suit the closure of the thermostatic, or electronic radiator valves.

The controller shall be mounted on the pump.
Heating pumps shall consist of a cast iron casing and impeller. The shaft shall be provided with a mechanical seal. Hot water pumps shall be glandless bronze or stainless steel.

The pumps shall be arranged so that the entire rotating assembly is easily removed from the casing without disturbing the pipework connections.

Where duplicate pumps are provided as a package a non-return flap valve shall be provided in the discharge manifold. Duplicate pump packages shall either be provided with a blanking plate and joint ring or separate isolating valves to allow removal and maintenance of the non-running pump whilst the running pump continues to operate.

The pumps shall be suitable for the pressures and temperatures of the system to which they are connected.

Connecting pipework shall be completely self-supporting.

The pump facia display shall include the following: constant and proportional pressure curve and constant speed settings, automatic night setback, auto-adapt and power rating in watts.

SECTION 9

9 DOMESTIC WATER SERVICES

9.1 COLD WATER

A new incoming cold-water main shall be provided by Affinity Water form Northwood Road. The Contractor shall liaise with Affinity water to ensure the correct water supply is provided and correct cold water is taken from the meter by the Contractor into the building in the plantroom.

The incoming cold water main, shall have stop cock and drain cock at the point of entry. There shall be an electromagnetic water conditioner and filter installed on the incoming water main.

The cold water shall serve all of the new sanitary ware within the existing building and new extension, electric hot water heaters, external taps and the Sprinkler tank.

The new pipework shall be insulated throughout.

9.2 DOMESTIC HOT WATER

The Contractor shall design, supply and install Electric Hot Water Heaters which will provide hot water to all the relevant sanitary ware. The contractor where practical i.e. short run for the hot water less than the guidance given water supply regulation, combine the hot water supply to more than one item of sanitary ware.

The Electric Water Heaters shall be the unvented storage type i.e. Heatrae Sadia tele 03448 711535 from their Multipoint range.

The water containers shall be heavy gauge copper vessels designed for 6 bar operation pressure (test pressure 20 bar).

The vessel shall be thermally insulated with CFC/HCFC-free (ODP zero) flame-retardant expanded polystyrene, all within a white stove enamelled steel casing.

The heating element shall be a replaceable sheathed rod type thermostat, externally adjustable from 10℃ to 70℃ with lockable positions. Safety features include manual re-settable over-temperature cut-out and factory-fitted temperature and pressure relief valves opening at 7 bar or 90℃.

The safety valve discharge shall be plumbed via a tundish to discharge in a safe visible location.

The water heaters shall be approved for UK Water Supply Regulations and CE marked.

Each unit shall have operation accessories to allow for expansion.

SECTION 10

10 VENTILATION

10.1 GENERAL

The Contractor shall design, supply, install, test and commission ventilation systems to meet the performance criteria detailed within the room data sheets.

The objective of the ventilation systems is to provide adequate air circulation to avoid the build-up of CO^2 and avoid overheating and, in addition, to also comply with the requirements of Part F of the Building Regulations.

To this end, there are several different types of ventilation systems employed on this project:

i) The classroom/teaching space: Requires specific acoustic conditions due to the proximity of Northwood Road, the MUGA area and general external noise. The windows will generally be closed hence, need some form of ventilation. Due to space restriction, a hybrid system has been considered and, indicated on the drawing. The Contractor shall ensure that they provide sufficient ventilation to avoid overheating and comply with BB101.

ii) Internal rooms: There are a few rooms that do not have any windows. These will require mechanical supply and extract in the form of room mounted heat recovery units.

iii) Toilets/Changing Rooms and Cleaner's cupboard: Meet the requirements of the Building Regulation's mechanical extraction and shall be used to remove odours and moisture from the rooms. Depending upon the location relative to each other, more than one room could be linked to one fan.

iv) Catering Kitchen 0.06: There is a cooker hood over the Hob and Ovens with an extract system designed to DW 172 which is removing sufficient air to require a mechanical supply system. This is a replacement of the current installation.

SECTION 11

11 DUCTWORK AND FITTINGS

11.1 GENERAL

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

The ductwork standard shall conform to the following classification as specified in BESA publication DW144, (item numbers refer to DW144).

2.1	Pressure Classification	-	Low
2.2	Leakage Classification	-	Low Class A
2.3	Positive Pressure	-	Positive upto 500
2.4	Materials	-	Mild steel (7.3)
2.5	Special Requirements	-	None
3.2	Cleaning Access Point (Appendix M – Table 25)	-	Level 3
4.2	Air Leakage Testing	-	None

Where possible ductwork shall be to the recommended BESA sizes.

All flexible ducting shall be as manufactured by Hotchkiss Air Supply and shall be their Flexible Ducting range, or to an equivalent standard, HASFLEX-M1 - Aluminium Insulated.

The terminal connection to grilles and diffusers shall be by use of propriety plenum boxes with non-metallic flexible ducts to each grille/diffuser.

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.

Access doors shall be provided in the new ductwork at regular intervals and up and downstream of obstructions such as control dampers, heater batteries, turning vanes, etc., to allow cleaning to take place. The position of these access doors shall be indicated by the Contractor on the manufacturing drawings for examination and approval by the Contract Administrator.

Control dampers for regulation shall be fitted in all positions necessary to facilitate a complete and successful balance to be achieved. 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 down stream and up stream 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 producing design and manufacturing drawings, the Contractor shall ensure complete co-ordination with other Mechanical, Electrical and Public Health Services.

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.

Tico pad strips, or neoprene pads shall be provided between the duct support and ductwork.

All ductwork from shower areas shall be insulated, sealed and sloped to drain trays so that any moisture forming in the ductwork is drained from the ductwork in a controlled manner. Each drain tray shall be provided with a trapped drain and connected to the building drainage system.

11.2 FIRE DAMPERS

Where ducts pass through Fire rated floors and walls etc., and shall be to the sizes to suit ductwork giving a maximum fire resistance of 2 hours. The exception shall be the kitchen extract system which shall be in fire rated ductwork throughout.

Fire dampers shall be manufactured by Advanced Air or Action Air, their shutter type, with the shutters held out of the airstream when open.

Fire dampers shall be tested in accordance with BS EN 1366.

The design and installation process shall be in accordance with BESA publication DW/145 ‘Guide to Good Practice for Installation of Fire Dampers’.

Each fire damper shall be fitted with a device to indicate that the damper has operated. The indicator shall be visible externally to the damper enclosure.

Fire dampers shall operate at 72℃ by means of a bimetallic element and at 180℃ by means of a fusible link. The whole operating assembly shall be replaceable without the need to remove the damper from the ductwork.

Fire damper shutters shall be stainless steel, mounted in an 18-gauge galvanised sheet metal frame and continuously welded corner construction, the complete fire damper assembly being corrosion-resistant.

Fire dampers shall be complete with galvanised steel installation frames, designed to allow thermal expansion of the damper within the building fabric in case of fire. In some instances a common frame for more than one damper will be required.

Fire dampers shall be provided with access doors adjacent.

The final location and size of fire dampers to be agreed with the Contract Administrator and is dependent upon design final ductwork routing and fire wall locations.

11.3 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.

11.4 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.

Dampers shall be provided on at least the supply and extract connections to fans and air handling units and all branch connections so that balancing is achieved without the use of the dampers provided with grilles and diffusers.

11.5 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.

SECTION 12

12 HYBRID PLANT

12.1 HYBRID VENTILATION PLANT

The Contractor shall design, supply and install a hybrid ventilation plant in the classrooms, teaching space, group room, etc., as noted on the drawings and room data sheets.

The hybrid ventilation plant shall be manufactured by either Monodraught Ltd. Tel: 01494 897700 from their HVR Zero X range or Breathing Buildings Tel: 01223 450060 from their NVHR range subject to them being able to fit into the Bulkhead provided by the Architect with 175 mm space for the supply diffuser

The equipment shall consist of low energy backward curve EC Motor Fans, an aluminium crossflow heat exchanger with a controls package that enables natural ventilation, night time purge and mixed mode ventilation to ensure optimum conditions in the room. The Contractor shall give due regard to the architectural package and proposed location of the hybrid ventilation plant in the section of a suitable model.

SECTION 13

13 AIR HANDLING/MECHANICAL VENTILATION HEAT RECOVERY UNITS

13.1 GENERAL

The Contractor shall design, supply and install various sizes of Air Handling Units (AHU's), and Mechanical Ventilation Heat Recovery Units to suit the Room Data Sheets.

All individual components of the air handling units/heat recovery units shall be built to comply with the appropriate clause of this Specification.

The air handling units/heat recovery units are to be fully assembled at the manufacturer's premises and tested.

Each air handling unit shall be tested in accordance with BS EN 1886 for casing leakage of Class L2 at the factory.

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.

Subsequent to satisfactory testing, the AHU is to be dis-assembled 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 casing air leakage and noise levels.

The air handling units/heat recovery units shall be tested as a complete unit at works to BS 6583 Volumetric testing.

13.2 LEGISLATION

The air handling units/heat recovery units shall be compliant with European Directives for the eco-design of Energy-related Products (ErP) and Energy-using Products (EuPD).

The air handling units/heat recovery units shall have Eurovent certification and be CE marked.

13.3 CONSTRUCTION

The air handling units and heat recovery units shall be manufactured by Nuaire Ltd. Tel: 02920 858200 or S&P UK Ventilation Systems Ltd. Tel: 08454 700074.

The unit casing shall consist of insulated panels built into a penta-post frame, each section having its own rigid 2mm thick (heavy gauge galvanised mild steel sheet) or (extruded aluminium alloy) framework material. Frame posts and cross members shall be constructed to incorporate 50mm thick thermal insulation.

Each panel shall be double skin construction with an infill of HCFC/CFC-free rigid heavy density thermal and acoustic insulation having a minimum density of 80kg/m^3 and a maximum thermal conductivity of 0.4 W/mk. 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. Where the unit is used for cooling, the framework shall be insulated and vapour sealed.

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 with either quick release snap fasteners or cam lock handles. . 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.

13.4 UNIT CONFIGURATION/INSTALLATION

The/each unit(s) shall comprise the components indicated in the schedule and detailed in the specification 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.

13.5 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.

13.6 FANS

13.6.1 General

The fans shall be selected by the manufacturer of the air handling unit/heat recovery unit to be compatible with the unit. The air volumes and pressure drops are stated in the schedules.

The fan motors, drives or impellers shall be arranged to allow a 10% variation in the final air flow/pressure drop due to site adjustments to the system.

The fans shall be tested at the manufacturer's works in accordance with BS EN ISO 5801, BS 848-1 (Air Volumes) and BS EN ISO 5136 and 13347 (Acoustics).

The fans' performance and selection shall ensure that the relevant limiting specific fan power levels stated in Approved Documents and stated in the schedules are achieved.

Fans and drives shall be resiliently mounted. Mountings and supports shall be arranged to prevent undue movement of fans relative to adjacent ductwork systems or building structure. Fans and drives shall be mounted on rigid base frames or support structures to ensure that proper alignment is maintained.

13.6.2 Centrifugal fans

The fan casings shall be manufactured from galvanised mild steel or PVC with angle stiffeners and base angles riveted or welded together to avoid drumming or excessive

vibration. The fan outlet shall be flanged and the air velocity shall avoid excessive noise.

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.

Centrifugal fans shall be high efficiency and low noise generation, either forward or backward curve, designed for long life.

13.6.3 "Plug" Type Fans

Plug fans shall be arranged for run, open radial, direct driven, backward curved, complete with a coupled internal run only motor and mounted upon a common base frame.

13.6.4 Mixed Flow Units

These shall be high efficiency mixed flow type. The units shall be low energy, high efficiency a.c. fan/motor assemblies with sealed-for-life bearings. Fans shall be complete with automatic high temperature cut-out protection and are speed controllable.

13.7 MOTORS AND DRIVES

13.7.1 General

All fan motors shall be direct driven unless otherwise described to suit hazardous substances.

All fan motors shall be supplied by the same manufacturer and shall be fully compatible for use with frequency inverter drives.

Motors shall be totally enclosed complying with BS 5000 and BS EN 60034. They shall be fan cooled with Class 'F' insulation unless operating conditions require a higher classification. Motors below 1 kW size shall be single phase and larger sizes three phase. Motors shall be provided with thermistor protection. Where mounted in external air, or in a highly moisture laden atmosphere, they shall be weatherproof or separately protected. Motors in hazardous atmospheres shall be flameproof, certified to BS EN 60079-18.

Where appropriate, motors shall be selected to suit "end of curve" conditions. Motors shall have a minimum spare capacity above the driven power of the fan, taking into account drive losses, as follows:

- Up to 7.5 kW 33%
- 7.6 kW to 15 kW 25%
- 15.1 to 30 kW 20%
- Above 30kW 15%

13.7.2 Inverter Drives

All frequency inverter drives shall be of the same manufacturer. Drives shall be compliant (as a minimum) to the following specification:-

- All inverters to be compliant with EN 61000-3-12 Harmonic Product Standard.
- All inverters to Integrated Category C2 (1st environment) filters to BS EN 61800-3.
- Protection of drive input by standard MCBs or MCCBs.

- 50℃ ambient temperature at fully rated output current at full speed and load without the need for derating or oversizing the unit up to 50℃.
- Coated boards on all PCBs to withstand contamination levels in IEC 60721-3-3 class 3C2/3S2.
- Verified tolerance to network interruptions in accordance with Semi 47.
- Complete access to drive parameter information when connected to a BACnet control network.
- Compatible for connection to any Building Management System (BMS).
- IP54 rated enclosure for wall or frame mounted applications.
- Real time clock.
- Keypad drive control panel with battery back-up (min life 10 years).
- kWh counter – metering consumed energy.

13.8 FILTERS

13.8.1 General

All filters shall be supplied by the same manufacturer.

Filter media shall be fire resistant and comply with BS 476-4 and BS 9999, rot proof and offer no sustenance to vermin. The media shall not be subject to erosion or deterioration or to the effects of temperature. Damp or saturated air steams shall not affect media. It shall comply with the requirements of the Health and Safety Executive and shall be manufactured from non-deleterious materials.

The filter performance shall be tested in accordance with BS EN 13779 and BS EN 779 with test certificates being available.

Face velocities across filters shall be limited to a maximum of 2.0 metres/second. Filter units or panels shall be selected to be of uniform size and pressure drop.

13.8.2 Panel Filters

Panel filter banks shall be incorporated as a means of pre-filtering the combined F.A./recirculatory air volume. Sized at maximum face velocity of 2m/s filters shall be selected in terms of providing high mechanical strength, pleated design, with filter media fully supported with bonded wire support grids, minimum grade to G4.

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.

A full set of spare replacement filter cartridges shall be provided for each panel filter bank incorporated into each AHU.

13.8.3 Bag Filters

Bag filters shall be made from non-breaking synthetic organic fibres and microfibres. Filter pockets shall be welded and formed into the front frame in a leak-proof configuration preventing dust leakage. Minimum grade to F7.

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.

A full set of spare replacement cartridges shall be provided for each bag filter bank incorporated into each AHU.

13.9 AIR HEATERS

13.9.1 General

All coils shall be supplied by the same manufacturer.

13.9.2 Heater Batteries

These shall be selected to match design criteria and performance requirements as scheduled.

Each battery shall be constructed from horizontal copper tubes with non-ferrous fins. The tubes shall be brazed into copper flow and return headers. The heating surface shall be housed in a galvanised sheet steel casing complete with flanged ends. The casing shall be sealed to prevent leakage.

Copper fins shall be aluminium plated to a MINIMUM THICKNESS of 0.5mm. The coil shall be rated for operation of 4 bar, 130℃ working conditions, and factory tested to a minimum of twice this pressure.

The headers shall be free to expand and contract and shall be designed to ensure equal water distribution through each tube. Each battery shall be self-venting and draining. Both air and drain cocks shall be incorporated.

Heating coil water pressure drops to be based upon a maximum of 12 kPa full flow.

13.10 HEAT RECOVERY

13.10.1 General

The heat recovery equipment shall be supplied by the same manufacturer and match the duties in the schedule.

Heat recovery equipment shall be used to collect heat in the extract discharge and deliver it into the supply air system.

Systems shall be selected for minimum air and water-side pressure drops. Where possible they shall be located to collect heat provided by the exhaust fans.

A panel filter shall be provided before any heat recovery device. Where condensation is likely in the duct, adequate drainage facilities as described for coils shall be provided.

13.10.2 Plate Heat Exchanger

The plate heat exchanger shall be arranged in counter-flow formation with a high efficiency of up to 90% and is almost maintenance free. The exchanger shall comprise aluminium/stainless steel heat exchanger matrix in a casing complete with adequate seals to ensure no cross contamination of moisture, smells, fumes or air leakage.

The face and bypass damper shall be fitted onto the exhaust of the plate exchanger with a 2-position actuator and pre-programme control logic.

13.11 FLEXIBLE CONNECTIONS

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

13.12 PRESSURE TESTS

The Sub-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 Sub-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 Sub-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.

SECTION 14

14 FAN PLANTS

14.1 GENERAL

The Contractor shall design, supply, install, test and commission ventilation systems to meeting the performance criteria detailed within the room data sheets

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

All fans shall be manufactured to BS 848 Class A Performance tolerance.

Prior to placing orders for a fan set the Contractor shall present a full set of detailed system pressure calculations to the Contract Administrator. A copy of the proposed fan Performance Characteristic is also to be forwarded for comment.

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 met by the Contractor.

Prior to submitting any Form of Tender offer the Contractor shall be deemed to have carried out the necessary design to satisfy himself that the fans included will form part of a package of mechanical plant that will fit into the plant room indicated on the Contract Administrator's Plans.

14.2 KITCHEN EXTRACT FANS

The fans for use on the kitchen extract systems shall be suitable for operation in high temperature, saturated air, and the ferrous surfaces exposed to the air shall be given two coats of heat and moisture resisting paint. A clean-out door and plugged drain point shall be fitted on centrifugal fans.

The fan motor is normally mounted outside the casing, i.e. a bifurcated type fan.

Bifurcated fans handle atmosphere normally detrimental to the life of the fan motor including saturated and dust laden atmospheres, heated air, hot gases and corrosive fumes.

The motors are isolated from the system air stream by being outside the air stream.

Each impeller shall be fitted with aerofoil type blades manufactured from solid PVC/mild steel.

The assembly shall be statically and dynamically balanced to ensure true and quiet running.

The fan casing shall be manufactured from mild steel plates welded together or solid PVC and flanged at each end.

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

14.3 TOILET EXTRACT FANS

Individual twin toilet extract fans shall be installed.

These shall consist of factory-assembled packaged unit incorporating duplicate exhaust fans to the duty required. The assembly shall be fitted with an easily removable plate for routine access, discharge louvres, bird guards, mounts and speed controller, and be of double skin acoustic construction.

Duct mounted inline fans shall be provided. Surface-mounted fans shall be approved by the Contract Administrator.

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.

Where the fan is a concealed duct-mounted type, it shall be provided with remote fan failure indicators and shall be accessible.

The fans shall operate via the local light switches or PIRs. To be agreed with the Contract Administrator and have adjustable run-on timers. Bathroom fans shall also have inbuilt humidistats.

14.4 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.

SECTION 15

15 ANTI-VIBRATION MOUNTINGS AND ATTENUATORS

15.1 GENERAL

Pumps and fans shall be isolated from the building structure by anti-vibration mountings. Anti-vibration mountings shall be selected by the Acoustic Specialist, EEC, Tel: 01932 230940, to suit the application and shall be supplied, positioned and fixed by the Contractor.

15.2 DUCT MOUNTED SILENCERS/ATTENUATORS, GENERAL

All attenuators/silencers shall be provided, to ensure that noise levels within all spaces do not exceed those set out in the Operating Conditions and the requirements of the acoustic consultant.

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.

Attenuators and silencers shall be as manufactured by Environmental Equipment Corporation Ltd. Tele 01932 230940, or by Caice Acoustic Air Movement Ltd. Tele

Ductwork between fans and attenuators shall be acoustically insulated.

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.

Cross-talk attenuators shall be provided on ductwork passing through rooms not served by the ductwork system or where the ductwork system serves two rooms.

15.3 ATTENUATOR CONSTRUCTION

The outer shall be constructed in accordance with DW144 and specifically as follows:

- Casings

Rectangular attenuators shall have an outer casing of not less than 0.8mm galvanised sheet steel.

All longitudinal joints shall be Pittsburgh Lock seamed, and mastic sealed during construction. Units shall be built as a one piece construction, unless space requirements dictate otherwise; when smaller modules are installed they shall be flanged together. Fixings should be via sealed rivets, the use of Tek screw type fixings will not be acceptable.

- Connections

The following standard jointing procedures shall be incorporated:

Plain Spigot/Slip Joint - 50mm overlap allowed during construction.

Profile Flanges - MEZ - for attenuators with longest side of duct:

0 mm - 1000 mm	Mez 20

1001 mm - 1250mm	Mez 30
1251 mm - 1600 mm	Mez 40
1601 mm - 2500 mm	RSA

The type used shall be identified on the schedule.

- Acoustic Splitters

The acoustic splitter elements shall be constructed from a minimum of 0.8mm perforated galvanised mild steel. Perforations to give a minimum of 30% free area. All splitters are to be supplied with fully radiused bull noses at each end to provide a bell mouth entry and exit. Side splitters must always be utilised and splitter elements must be mounted vertically.

- Acoustic Infill

The acoustic splitters are to be filled with an inert rot- and vermin-proof, non-hydroscopic and non-combustible long strand mineral wool (Rockwool). The infill shall be in slab form and must not be formed from off-cuts, nor blown in. It shall be packed under compression to a density of not less than 45 gm/m^3 to avoid settling and potential air voids. The infill should be protected from air erosion by glass cloth wrap retained behind the splitter element's perforated metal facing.

When attenuators are required to be installed in clean, moisture- and dust-free air conditions such as Hospital Operating Theatres, Clean Rooms or Food Production areas, the acoustic infill must be bagged in the glass cloth material and then fully sealed in a Melinex envelope retained behind the perforated metal facings.

- Labelling and Delivery

All attenuators must be clearly marked with their reference and location as listed on the equipment schedule and shall be despatched with polythene sheeting securely taped over the ends to prevent the ingress of dust and moisture during either transportation or storage on site.

Hospital/Clean Room specification requires the acoustic infill to be fully encased within the tissue and attenuators vacuumed out afterwards, with the units fully sealed with polythene.

All attenuators used on kitchen extract systems and changing room extract systems shall be lined with Melinex.

SECTION 14

16 GRILLES, DIFFUSERS & LOUVRES

16.1 GENERAL

The size, number and location of all grilles and louvres shall be determined in order to provide adequate draught-free and even distribution of supply extract air throughout treated areas. Supply grilles and diffusers shall be selected with regard to room dimensions, obstructions such as light fittings and with velocity of air stream not exceeding 0.25m/s at end of throw.

Prior to placing any orders for grilles/diffusers, the Contractor shall submit, to the Contract Administrator a ventilation layout, clearly detailing his proposed ventilation arrangements with details of Diffusers and Grilles to be used.

Grilles or diffusers supplied as extract points shall match in size, type and number those applied as supply air terminals. All grilles/diffusers shall be selected from a single manufacturer's range of products, and shall be manufactured by Swegon Air Management (Air Diffusion) Tele 01746 761 921 or Brooke Air Ltd. Tele 01268 572266.

The Contractors choice of manufacturer and styles of diffusers & grilles to be used shall be included in there Tender submission

16.2 GRILLES

Grilles shall be manufactured from aluminium, and powder coated white unless otherwise specified, to match adjacent finishes

All grilles shall incorporate a flange seal. Each supply air grille shall have two sets of separately adjustable louvres, one set horizontal and one set vertical and shall be complete with an opposed blade multi-leaf damper to control both the volume of air passing and the distribution of air across the grille face. The louvres and the damper shall be adjustable from the front of the grille. All supply air grilles are to be supplied with purpose made plenum boxes.

Return air grilles shall match supply grilles.

Each return air grille shall be complete with an opposed multi-leaf damper operable from the front.

3 sets of tools used to regulate the air volume and set the distribution pattern shall be handed to the Contract Administrator.

The colour finish of the grilles shall be agreed by the Contract Administrator before manufacture is commenced.

16.3 DIFFUSERS

Diffusers shall be as scheduled and shall be manufactured from aluminium and stove enamelled.

Diffusers mounted on ceilings shall have flange seals and incorporate anti-smudge rings.

Diffusers shall be complete with an equalising device and shall be provided with volume control dampers of the opposed blade type which shall be adjustable from the point of discharge of the diffuser.

Diffusers for Hybrid ventilation plant shall be the slot type and incorporate both vertical and horizontal adjustable blades, operated from the diffuser face if required

16.4 INLET/DISCHARGE TERMINATIONS

The Contractor shall design, supply and install external louvres shall be provided as indicated on the drawings.

These louvres shall be manufactured by Swegon Air Management (Air Diffusion) Tele 01746 761 921 or Brooke Air Ltd. Tele 01268 572266, manufactured from aluminium with a 50mm pitch. The louvre shall have a flanged frame with a powder coated finish, colour to be agreed with Contract Administrator before ordering. The louvre shall be complete with bird guard.

The colour finish of the louvres shall be agreed by the Contract Administrator before manufacture is commenced.

The louvres shall remain weatherproof up to a driving rain index of 7 m/s.

SECTION 17

17 THERMAL INSULATION

17.1 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, Tel: 01325 466704.

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	Method of specifying thermal insulation materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40℃ to +700℃.
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°C).
BS EN 13166	Thermal insulation products for buildings. Factory made Phenolic Foam (PF) products specification.
BS EN 14314	Thermal insulation products for building equipment and industrial installations. Factory made phenolic foam (PF) products. Specification
BS EN 12667	Thermal Performance of Building Materials and Products. Determination of thermal resistance by means of guarded hot plate and heat flow meter methods. Products of high and medium thermal resistance.
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	Thermal insulation of pipework, ductwork and associated equipment and other industrial installations in the temperature range of -100°C to +870°C Code of Practice.
BS 1710	Identification of pipelines and services.

For all mineral wool insulation products, test evidence must be available showing that the fibres from which the products are made are not classified as a possible human carcinogen, as detailed by European Directive 97/69/EC and the Approved Supply List of CHIP98. Test evidence must also be available showing that the fibres from which the products are made are bio-soluble.

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

Insulation materials should have a Euroclass of either A1, A2 or B, should not have a potential to flash over or should be FM Approved. The “K” value of the insulation must also be quoted, both manufactured and aged value.

All work shall be left smooth, clean and properly finished off 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 joints, 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.

17.2 FIRE PERFORMANCE

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

17.3 THERMAL INSULATION MATERIAL SELECTION

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

- 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.

- 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,.

- 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.

- 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.

- 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 Ltd.

17.4 INSULATION MATERIAL RESTRICTIONS

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

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

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

- 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.

17.5 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.

17.6 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 nonferrous bands fitted at each end of preformed sections 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.

17.7 EQUIPMENT INSULATION

Insulation to vessels and tanks and the like is to be factory applied.

17.8 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.

17.9 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)

17.10 INSULATION OF PIPELINE FITTINGS

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

In plantrooms 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 the 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°C to 260°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.

17.11 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.

17.12 DAMAGE TO INSULATION

Existing or new insulation damaged during the works shall be replaced by the Contractor. The Contractor shall take reasonable steps to protect all existing and new ductwork and pipework insulation etc.

17.13 ARMAFLEX INSULATION

Armaflex shall be used where scheduled and shall be manufactured by Armacell UK Ltd. Tel: 0161 287 7100.

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.

17.14 VENTURE CLAD FINISH

Venture tape VentureClad™1577CW® is a zero permeability, absolute vapour barrier for insulation cladding and jacketing applications. A 5-ply, self-adhesive material installs quickly and easily without special tools required, resulting in significant time, labour and cost savings.

VentureClad has the following features and benefits:-

- High performance jacketing product which performs well over a wide temperature range (-30°F to +248°F application surface temperature).

- VentureCW® cold weather acrylic adhesive which applies easily at temperatures as cold as -10°F.
- Zero permeability absolute vapour barrier.
- High puncture and tear resistance.
- Self-adhesive material which installs easily with no off-site fabrication required.

17.15 PVC SHEET INSULATION COVERING

This shall be manufactured by Hoechst. Sheeting shall be fitted in accordance with the manufacturer's published methods.

17.16 TRACE HEATING - GENERAL

Trace heating shall be applied to all pipework where there is a possibility of it freezing. Trace heating systems shall be complete with all necessary connection and end seal kits, splice kits, insulation entry kits, junction boxes, fixing tapes etc.

'ELECTRIC TRACED' labels shall be provided for each section of pipe served on at spacings not greater than 3m.

The whole installation shall conform to the manufacturer's recommendations and the manufacturer shall be required to check all details prior to installation.

All trace heating cables shall be of the energy efficient self regulating type.

The services to be protected shall include all external hot and cold water supply pipework and condensate lines, including cold feeds, down service and open vents etc. Maximum cold pipe contents temperature 10°C, hot water = 82°C.

All cold water services etc. shall be freeze protected and installed to a maximum circuit length of 150m.

All LPHW services shall be protected and installed to a maximum circuit length of 90m.

All trace heating circuits shall be controlled via an air sensing thermostat except those circuits where required by a line sensing thermostat, eg, potable water services.

17.17 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	0											
	Ducts/Cavities	0											
	External				0						0		X
CWS	Plant rooms				X							X	
	Ducts/Cavities	0											
	External				0					X			X
Comfort Cooling Ductwork	Plant rooms		0				0			X	0	0	
	Ducts/Cavities		0			0	0			X			
Refrigeration Pipework	All Areas	0								0	0	0	X

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: 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 25ºC and 80% relative humidity.

Pipe Size		Thickness of Insulation (mm)								
		Temperature of Water (ºC)								
NB (mm)	OD (mm)	0ºC			5ºC			10ºC		
		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 – Table 6, 8, 10 & 11 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 4 of this section.

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
Hidden Areas - Armaflex
External - Mastic finish or PIB

Material Restrictions

Mineral Fibres shall not be installed in areas as defined by Clause 4 of this Section (Insulation Material Restrictions).

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 15 (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
Hidden Areas	-	Armaflex
External	-	Mastic finish or PIB

Material Restrictions

Mineral Fibres shall not be installed in areas as defined by Clause 4 of this Section (Insulation Material Restrictions).

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%.

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, concealed areas	38mm	20mm
Shafts to plantrooms		
Externally exposed	65mm	30mm
In offices and occupied areas	None	None

Finishes

Plant Rooms	-	Stucco embossed aluminium sheeting
Hidden Areas	-	Armaflex
External	-	Mastic finish or PIB

Material Restrictions

Mineral Fibres shall not be installed in areas as defined by Clause 4 of this Section (Insulation Material Restrictions)

SECTION 18

18 CONTROLS AND ELECTRICAL SPECIFICATION

18.1 GENERAL DESCRIPTION OF CONTROLS AND SYSTEM OPERATION

A complete stand-alone controls system shall be installed for the existing building and new extension to control and monitor all Mechanical items of plant and equipment listed in this specification. There should be facilities to link the system to the main Meadow High School in Royal Lane Uxbridge.

The Contractor shall employ the services of a Specialist Controls Contractor to undertake the design, supply, installation and commissioning of the automatic controls system such as Imperium Building Services Ltd tele 020 3998 7125.

The design, supply, install and commission shall include all of the automatic controls components, cabinets, sensors, thermostats, user interfaces, field wiring (both control and power), isolators and starters required in order to deliver a fully automatic, intelligent HVAC controls system.

Local power supplies will be provided by the Electrical Contractor to serve all main mechanical systems. The Contractor shall connect power supplies and install all control components associated with these systems. The Mechanical Contractor shall, upon receipt of an order, liaise directly with the Electrical contractor to confirm the number, type, rating and locations of all spurs required for Mechanical services plant and equipment.

Circuit cables shall be run within false ceiling voids. Under no circumstances shall 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 scope of works shall include, but not be limited to, the following:-

1. Final design of the controls system shall be in accordance with this specification and the requirements of European Standard BS EN 15232 Energy Performance of Buildings - Impact of Building Automation Controls and Building Management, to achieve efficiency Class ‘C’. The Controls Specialist shall include for the provision of detailed System Operational Description Wiring and Panel Detail Drawings for review and comment by the Engineer. The Controls Specialist shall include for attending specific liaison meetings with the Engineer and Contract Administrator to discuss exact proposals and progress.

2. Design, manufacture, works testing, factory demonstration, packaging and delivery of items associated with the controls system including the main control panel and repeater panel in the Office. The repeater panel in the Office shall be hard wired and independent of software upgraded. Also, attendance during offloading and positioning of the control panel.

3. Provide all necessary hardware and software products to interface the BMS system with the building’s audio/visual Crestron system. This would be based on close liaison, and the complete cooperation from the “Crestron” system manufacturer and supplier.

4. Supply of all necessary Direct Digital Controllers (DDC) to meet the performance requirements of the control's specification, including intelligent outstations, software controls etc.

5. The system shall include a broadband VPN (Virtual Private Network) modem connection. The controller shall include for the BEMS to be monitored by the Controls Specialist for 12 months following Practical Completion via off-site maintenance and monitoring of the control's installation including 24-hour telephone support.

6. Design, manufacture, works test, demonstrate, package, deliver, off load, position and install all devices associated with the controls system such as controllers, relays etc. that are to be housed within purpose-built enclosures, e.g. fan coils etc.

7. Select, supply, deliver, distribute and install all field sensors, switches, control valves and actuators etc. as necessary to meet the requirements of the controls specification.

8. The main outstation within the MCC shall incorporate 10% spare input/output facility.

9. Supply all necessary controls logic descriptions, wiring diagrams and details to the Engineer for review of all controls/monitoring components etc, being supplied before manufacturer of the panels begins.

10. Supply all necessary wiring diagrams and details required for on-site field wiring of all controls/monitoring components etc, being supplied.

11. Supply, installation and testing of the entire electrical controls and central control system network wiring installation called for in this specification. The installation shall meet with all current IEE regulations, and will include, where necessary all containment i.e. tray, trunking and conduits

12. Supply all necessary wiring diagrams and details required for on-site field wiring of all power wiring associated with the mechanical plant served from the control panel.

13. Supply, installation, connection and testing of the entire power wiring installation associated with mechanical plant served from the control panel. The installation shall meet with all current IEE regulations, and will include all containment i.e. tray, trunking and conduits together with local isolators or switch disconnects. Following installation the wiring will be tested and the relevant test certification issued.

14. Supply, installation, connection and testing of a 240vac power supply to serve all locally mounted controllers. The installation shall meet with all current IEE regulations, and will include all containment i.e. tray, trunking and conduits together with all local unswitched fused spurs. Following installation the wiring will be tested and the relevant test certification issued.

15. Provide a Project Manager to manage the control design and installation, to meet the agreed requirements of this specification and the installation programme. In connection thereto liaise with the Engineer and Electrical Contractor and/or others as necessary.

16. Provide all central control system graphics. Graphics to be produced in draft for the Engineer's initial review and comment a minimum of two months

before commissioning. The graphics shall be presented as PDF format images of each graphics page available on the head end computer and shall clearly identify which items on the display page can be interrogated / adjusted.

17. Each isolator, panel, plant item, sensor, valve etc shall be clearly labelled to identify which panel / outstation the item is emanating from.

18. Following the installation works provide all necessary Commissioning and engineering full and proper resources to commission the controls installation and set the systems in working order.

19. Following satisfactory completion of the commissioning (and on separate days) demonstrate the complete commissioning procedures to the Engineer and/or Contract Administrator. The controls specialist shall allow for these demonstrations to take place for at least three full and non-consecutive days.

20. Demonstrate the user functions and instruction on changing time setting, holiday periods, set points etc. to the Client's Representative and Contract Administrator on the commissioned system. The Controls Specialist is to allow for two full working days for this process. This shall be on a separate day to the demonstration to the Engineer.

21. Provide two copies of CD/DVDs containing all necessary software and instructions to rebuild the computer operating system and control software to the commissioned plant state and set-points on a new computer.

22. Supply two hard copies and one electronic version of the complete Operating and Maintenance Document and Drawings for the completed system.

Timeclocks to be set up to the users' requirements.

18.2 HEATING CONTROLS

A central control system shall form the basis of the heating control system.

The Contractor shall supply the required number of hubs, thermostats, underfloor heating controllers and other associated components to provide a complete working heating controls system.

An interface panel shall be provided to control the boilers and associated equipment. The heating system shall be controlled to enable the Air Source Heat Pumps (ASHP) and internal circulation pumps when heating is called for in any of the rooms, systems or time schedules.

With a demand for heating the ASHPs and internal pumps will be enabled. The ASHPs shall operate under the dictates of their own control and limit thermostats, the control stat shall be set to 50℃ (adjustable), with a 5℃ temperature difference.

The ASHPs shall run under the flowing conditions :-

- Optimum start to ensure space conditions at occupancy.
- When any room is calling for heat and shall continue to run under the dictates of its control thermostat until the last room stops calling for heat.

Frost protection shall be afforded via the room thermostats and programmer to a determined internal set point set back temperature (adjustable) to start the ASHPs when reached.

Wall mounted temperature sensors shall be installed in locations to be agreed with the Contract Administrator, not the notional positions shown on the tender drawings.

Wall mounted temperature sensors/controller shall be connected to the relevant wiring centre/outstation to modulate the Room Temperatures. The controller shall be within each room/space in locations to be agreed with the Contract Administrator. Floor probes shall be provided in all rooms to act as a high floor temperature limit, also wired into the wiring centre/outstation.

18.3 UNDERFLOOR HEATING SYSTEMS

A high temperature thermostat shall, via hardwired interlocks, drive the mixing valve to the flow bypass position if an adjustable underfloor heating water flow temperature is exceeded.

Underfloor heating zones shall be provided with floor probes to monitor and control floor temperatures. In the case of timber floors the maximum floor temperature allowed shall be 27 ^{o}C (adjustable).

A UFH manufacturers controller shall be provided to control all underfloor heating zones. These controllers shall be linked back to the central controller to ensure the heating water is available to enable the rooms to be up to temperature at the start of the school day.

18.4 VENTILATION CONTROLS

18.4.1 Hybrid Ventilation Unit

All the classrooms, Teaching spaces, and group rooms which have hybrid ventilation, shall operate under the dictates of the manufacturer's controllers. The controller shall use the CO2 levels to run the unit in the most suitable mode avoid the room exceeding the permittable limits. This should include night-time cooling/purge ventilation.

The Wall Controllers location shall be agreed with the Contract Administrator. Where there is more than one unit in a room the units shall operate under a master/slave arrangement.

The room controllers shall include all necessary relays to link back to the central control panel and to include fire alarm connection.

18.4.2 Mechanical Ventilation Heat Recovery Units

The totally internal spaces shall be ventilated by local MVHR units. The heat recovery unit fans shall run continuously under the dictates of their time switches. Boost speed control shall be activated by the manual remote switches.

The combined supply and extract with heat recovery unit, shall supply filtered fresh air to each of the habitable rooms and vitiated air shall be extracted. The supply air shall be pre-heated by the warm extract air via the integrated counter-flow heat exchanger element. Should the ambient fresh air temperature fall below a predetermined temperature, the duct temperature sensor shall operate the frost heater until the supply air temperature reaches a predetermined set point (adjustable).

The room controllers shall include all necessary relays to link back to the central control panel and to include fire alarm connection.

18.4.3 Toilets & Changing Rooms

The extract fans shall run under the dictates of the local light switch or PIR, and built-in humidistat, complete with an adjustable integral overrun timer.

The Contractor shall be responsible for final commissioning of the unit and adjustment of fan speeds 1, 2 and 3 where applicable to achieve the specified duty points.

The fans shall twin fans with automatic change-over on fan failure and weekly through the central control system. There shall a local indicate as to the fan's status.

These fans are stand-alone units but shall be monitored for a Weekly change-over and fault condition by the Central Control System.

18.4.4 Catering Kitchen Ventilation

The ground floor catering kitchen 0.09 is of a commercial size with gas burner appliances. The room requires mechanical ventilation in accordance with DW 172.

The extraction is via a canopy (by others) over the appliances with the extract fan in the Kitchen Ceiling The make-up air is supplied via an AHU located in the mechanical Plantroom.

The Controls Specialist shall enable the operation of both systems in alignment with the following parameters:-

1) Upon enabling via a manual On/Off switch to be located in the kitchen, both supply and exhaust plants are to run. When the fans are turned OFF they will run on at full speed for 20 minutes (adjustable) before stopping.

2) The fans shall be interlocked with the kitchen gas proving system, so that if the fans fail and there is no air flow, the gas valve to the kitchen shuts. The kitchen safety system is described in Clause headed "Kitchen Safety System".

3) Fan failure for both supply and exhaust systems shall be monitored by fan differential pressure switches mounted across each fan. In the event of fan failure, a remote alarm is to be generated.

4) The supply system is to be arranged for minimum constant supply temperature. With provision of the Electric heater duct-mounted sensor, and minimum set point supply temperature. (21℃ adjustable)

5) The condition (dirty/clean) of the panel filters shall be monitored by use of air differential pressure switches. In the event of 'filter dirty' conditions, an alarm shall be generated.

18.5 DOMESTIC COLD WATER SERVICES

The incoming cold water main shall be fitted with both a pulse water meter and water leak detection system which will be linked to the Central Control Panel, to allow the client to monitor water usage and bring up an alarm if the there is excessive water usage.

18.6 DOMESTIC HOT WATER SERVICES

The hot water is provided by local electric water heaters. These water heaters are stand alone with no link to the Central Control Panel

18.7 GAS SYSTEMS

- Food Tech Classroom

The Contractor shall design, supply, install and commission an automatic gas pressure and CO2 Monitoring system for use in the Food Tech Classroom. The system shall be designed to operate in conjunction with the gas solenoid valve (automatic reset type) in the following fashion:-

a) Via digital pressure measuring, the system is to monitor the gas pressure in two fashions:-
   i) Measure the differential across the solenoid valve.
   ii) Constant monitoring of operational gas pressure.

If either criterion drops below a specified limit the system shall shut down.

To this end the Contractor shall supply, install and commission a ventilation gas proving system, as supplied by Medem, Tel: 0161 233 0600, model ref. No. SEC-L,

- Kitchen Safety System

The Contractor shall design, supply, install and commission an automatic gas pressure and ventilation safety system for use in the main basement kitchen. The system shall be designed to operate in conjunction with the kitchen gas (solenoid valve automatic reset type), and along with a ductwork pressure differential monitoring device to operate the solenoid in the following fashion:-

b) Via the ductwork differential device (inlet/outlet of exhaust fan), open the solenoid only upon achieving a satisfactory differential. At any time this differential falls below a set point, the valve is to shut.

c) Via digital pressure measuring, the system is to monitor the gas pressure in two fashions:-
   i) Measure the differential across the solenoid valve.
   ii) Constant monitoring of operational gas pressure.

If either criterion drop below a specified limit the system shall shut down.

To this end the Contractor shall supply, install and commission a ventilation gas proving system, as supplied by Medem, Tel: 0161 233 0600, model ref. No. SEC-K,

18.8 DEMARCATION

Electrical Contractor shall be responsible for:

- Power supply and final termination of power supply to control panels.
- Connecting into all local extract fans.
- Power supplies for all Hybrid Ventilation plants.
- Power supplies for ASHPs on roof..
- Power supplies for the underfloor heating manifolds.
- Power supplies for the radiator motorised valves.
- Power supplies for the Electric Water Heaters.
- Any item not listed above but included in specification.

Mechanical Contractor shall be responsible for:

- All control wiring, power wiring and terminations within the plantroom.
- Power wiring from the control panels and testing of the associated cable installation.
- Installation of relevant warning notices within the plantroom.
- All control wiring and terminations relating to the underfloor heating system.
- All control wiring and terminations relating to radiator motorised valves.
- Power and control supplies for kitchen ventilation system.
- Any item not listed above but included in specification.

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18.9 CONTROL SYSTEM COMPONENTS

- General

All system components shall be manufactured by Trend or Honeywell to match there Systems and shall be provided to ensure that the systems operate as described in this specification all components shall be from one manufacturer.

- Temperature Sensors

Temperature sensors shall be capable of an accuracy of operation of+/-0.25℃ and be capable of maintaining the system measured space temperature to an accuracy of +/- 0.5℃.

The sensors shall be manufactured by Sontay Ltd., Tel: 0845 345 7235, from their Thimble Temperature Sensor range. The type and finish of the sensors shall be agreed with the Architect before ordering, however for tender purposes the surround finish is PVC/White to be sprayed to appear antique brass.

- Remote Control Panel

The remote control panel shall be capable of controlling the operation of the whole HVAC system and includes time schedules, temperature set points, holiday periods, plant On/Off, alarms etc.

The final location of the panel to be confirmed by the Contract Administrator, for tender purposes the Repeater panel shall be located in the Office 0.14.

- Motorised Control Valves

Control valves shall be as scheduled and shall be of the plug and seal type. Maximum valve pressure drop at the maximum design flow rate shall be 15kPa, except in instances where good authority is required. Control valves used in heating compensation systems may be of the rotary shoe type. The Engineer shall be advised of the pressure drops for all valves before orders are placed.

- Motorised Radiator Valves

These shall be manufactured by Danfoss Randall Ltd., their Rotary-Shoe & Paddle type range, the 2-port valve configuration with actuator. Final selected to be made by the Controls Specialist to suit room controller and pipe size.

18.10 LINK TO FIRE ALARM

Via a pair of suitable volt-free contacts, the Contractor is to allow for an interlink between the fire alarm panel and the control system. In the event of a real fire condition (and not routine testing) all plant is to cease operation and the gas solenoid valves shut, (and automatically reset upon alarm clear).

18.11 POST-HANDOVER WORKS

The Controls Specialist shall include for TWO separate full day return visits to site within three months of handover to fine tune the controls system as required by the users.

The Controls Specialist shall also include ONE full day visit at the end of defects to attend site and modify the controls system as required by the users.

18.12 CONTROL PANEL FACIA

The panel fascia shall include the following with separate lamp/switch arrangements for each item of plant, and include the following but not limited to the list below:-

Door interlocked mains isolator
Panel live lamp – White
Control circuit fuse tripped lamp – Red
Fire alarm activated lamp – Red
Lamp Test Button

ASHPs enabled lamp – Green
ASHPs fault lamp – Red
ASHPs hand/off/auto switch

Pumps No. 1 run/trip lamps – Green/Red
No. 2 run/trip lamps – Green/Red
No.1/No.2 pumps – hand/off/auto switch

Main Gas Supply Healthy Lamp – Green
Main Gas Supply Fault Lamp – Red

Heating Pressurisation Unit Fault Lamp - Red

MVHR units - Supply Fan Run/Trip - Green/Red
MVHR units - Extract Fan Run/Trip - Green/Red

Supply Filter Dirty - Amber
Extract Filter Dirty - Amber

Kitchen Extract Fan - Run/Trip Green/Red
Kitchen Supply AHU - Run/Trip Green/Red

Each individual plant item shall have a separate set of lamps, switch etc.

Switches and indicator lamps, together with all other items within on the outside face of the panel shall be identified by means of engraved laminated plastic labels having black characters on white secured by screws or other methods approved by the Contract Administrator.

18.13 CONTROL PANEL, GENERAL

The control panel shall be designed, supplied, fixed and commissioned by the Controls Specialist.

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

The control panel to be “Wall Mounted type” to conform with Form 2 Type 2 construction, manufacturers standard finish. Note vault walls are waterproofed and there is no drilling allowed into or through the lining to support the panel. Alternative means of securing/fixing the panels shall be allowed by the Contractor.

The general siting of the control panel 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 shall be necessary.

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

Natural ventilation by means of louvred openings shall be provided.

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 EN 61558, 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 pincing 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 MCBs 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 Contract Administrator 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.

18.14 GENERAL

18.14.1 Wiring

The Contractor shall design, supply and install all wiring for all heating plant and controls. The works shall be carried out in accordance with the BS 7671 – IET Wiring Regulations.

All cables in walls shall be contained within steel conduit, and only vertical drops shall be allowed. All cables in floor voids and ceiling voids shall be at least 50mm from face of finished surface.

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 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 BS 7671 – IET Wiring 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. 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.

18.14.2 Wiring System to be adopted

Wiring Systems shall be as follows:-

i. Within Boiler Room - FP 100/XLLSF singles in HDZCS conduit and/or galvanised steel trunking.

ii. Within Plant Rooms - LSF singles in conduit (BE) and/or galvanised steel trunking.

iii. External to Boiler Rooms and Plant Rooms - LSF cables in BE conduit or HDZCS conduit external to the building.

iv. Network Cable shall be type CAT 5E FTPLSZH 305M

v. Within Building – LSF/LSF twin and CPC pulled through joist holes and chased in flush in the building fabric.

18.15 INSTALLATION OF LSF/XLPE INSULATED, ARMOURED CABLES

LSF/XLPE insulated, armoured cables shall be laid on cable ladders or trays, racked on hangers, run in cleats, laid in service ducts, drawn through stoneware ducts or buried direct in the ground or clipped direct to building fabric.

These Works shall include the supply of all such cable trays, hangers or cleats.

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

All trays 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.

Plastic type cable ties shall not be used.

18.16 CABLES LSF INSULATED

Single core low smoke wiring cables shall consist of stranded annealed copper conductors. LSF insulated only to BS 7211. No LSF insulated cables of nominal cross-sectional area less than 1.5mm² will be permitted. No through joints will be permitted without the Contract Administrator's prior approval. (Maximum conductor temperature 90°C)

18.17 INSTALLATION OF LSF INSULATED AND SHEATHED CABLES

LSF Insulated and Sheathed Cables shall be installed in ceiling spaces, in floor voids, or protected and buried in wall chases as specified (See Clause INSTALLATION METHODS).

Cable entries into all components shall be fitted with brass, neoprene or rubber bushes to protect the cables from damage.

Cables buried in wall chases shall be protected by steel conduit, or as otherwise specified or indicated for various situations (See Clause INSTALLATION METHODS).

LSF insulated and sheathed cables liable to come into contact with polystyrene insulation materials shall be protected by conduit or trunking.

All cable cores at live potential, i.e. switch lines shall be coloured red or marked with a red band of 25mm plastic insulation tape.

18.18 TERMINATION OF LSF CABLES

LSF insulated cable terminations at distributions boards, accessories, lighting fittings, 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.

18.19 CABLES AND CORDS - FLEXIBLE

No Flexible Cords having conductors of less than 0.75mm² shall be used.

Where an earthing conductor is required for the earthing of metalwork or apparatus, it shall be included in the flexible cord or cable.

Flexible Cords or Cables shall be PVC Insulated, PVC sheathed flexible cords shall be to BS. 6500, Table 16.

18.20 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.

18.21 CONDUIT FLEXIBLE

Flexible conduit shall comprise layered leaded steel and kraft paper and black PVC outer sheath. For normal use 'LS1 PVC Pliable'.

Where the temperature in use is likely to exceed 105℃ high temperature type 'LS1 - Pliable' shall be used.

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

18.22 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.

18.23 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.

18.24 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.

18.25 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 EN 50085-1 and BS EN 50085-2-1. 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 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.

18.26 ELECTRIC SUPPLY

Electric equipment shall be suitable for the electricity supply, the characteristics of which are:

415 volts, 3 phase, 50 Hz
240 volts, 1 phase, 50 Hz

18.27 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 BS 7671 – IET Wiring Regulations.

All interconnecting circuit wiring indicated as part of these Works shall be completely in accordance with BS 7671 – IET Wiring Regulations.

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.

18.28 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.

18.29 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.

18.30 EARTHING AND BONDING

The existing and new gas meters shall be earth bonded.

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 16th Edition Regulations of the I.E.E.

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.

18.31 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, 16th Edition.

18.32 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.

18.33 ELECTROMAGNETIC COMPATIBILITY

All new equipment installed as part of the final installation shall comply with the requirements of the European Directive on EMC 89/336/EEC.

Documentary evidence shall be provided in the form of certification from third party testing organisations.

In design of the electrical distribution system, due consideration shall be given to harmonic distortion created by switched mode power supplies contained in the end users equipment. The Contractor shall ascertain the necessary information from manufacturer of the existing and proposed equipment loads. Where information is not available on existing loads then the Contractor shall, if necessary, carry out harmonic monitoring.

SECTION 19

19 MISCELLANEOUS

19.1 DIAL THERMOMETERS

These shall be as manufactured by S. Brannan & Sons Ltd. A thermometer shall be fitted on all the heating flows in the plantroom.

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 ℃ 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 Engineer before ordering and installation.

19.2 PRESSURE /ALTITUDE GAUGES

These shall be manufactured by Brannan & Sons Limited.

Pressure gauges shall be fitted to major equipment, all pumps, suction and delivery connections and all ASHP.

They shall be 100mm diameter dial type having a Bourdon type pressure range to BS EN 837. 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.

Each gauge shall be fitted with level handle cocks, and where appropriate, siphon pipes.

19.3 TEMPERATURE AND PRESSURE TEST POINTS

Self-sealing test plugs shall be fitted in the positions listed: -

1. On each port of every automatic control valve, blending valves, pressure reducing sets.

2. On flow and return connections to the primary & secondary heating systems, Buffer vessel etc.

3. On the suction and discharge of each circulating pump.

4. cold water circuit branches/circuits in plant rooms.

Temperature and pressure test points shall be provided wherever required to enable satisfactory testing and balancing to be carried out. Test points shall be additional to any permanent thermometers or pressure gauges required.

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.
Test points shall be as manufactured by Test Plugs Ltd., Tel: 01440 763167.

19.4 DOMESTIC HOT AND COLD WATER MIXING VALVES AND FITTING

Domestic hot water mixing/blending valves shall be thermostatically controlled to provide a constant HWS outlet temperature.

In compliance with Building Regulation Approved Document Part 'G' the thermostatic mixing/blending valve needs to be a protective device to limit the hot water temperature to not exceed 48℃.

The valves shall conform to BS EN 1111 (supply pressure 1-5 bar) or BS EN 1287 (supply pressure 0.1 - 1 bar).

All valves shall be WRAS approved and have Build Cert approval as either TMV2 or TMV3 for valves designed for domestic and non-domestic use.

For use in hospitals and care establishments the valves shall conform to BS 7942, NHSD08 specification, be TMV3 approved and HTM04-01.

19.4.1 Thermostatic Valves
The thermostatic mixing/blending valves shall be manufactured by Home Engineering Ltd., Tel: 01505 321455.

The valve bodies shall be manufactured from gunmetal or brass with chrome plated finish. Valve bodies shall include strainers on the hot and cold supplies. The strainers shall have large area of fine mesh which is easily removable for cleaning without breaking any pipe connections.

To include Snap-On tamper-resistant plastic cover and integral check valves.

Hot/cold inlets shall be of elbow swivel inlet design with flat faced unions for ease of installation and to facilitate removal for periodic inspection/ maintenance as required. Integral isolating valves on hot and cold supplies must be Allen key-operated, full-bore quarter turn, ball valve.

The Contractor shall allow for the commissioning of valves and ensure that all pipework local to the valve is flushed using the Horne Flushing Kit, in accordance with BS EN 806 and the manufacturer's recommendations.

When using TMV3 valves the Contractor shall include Horne 4th connection on cold water supplies to provide protection to tap and isolation via integral ball valves.

The Mechanical Contractor shall ensure the manufacturer's flow regulator is fitted to the outlet pipe before making up compression fittings, ensuring an economical flow of 0.13 l/p/sec is achieved at all times.

The shower mixing valve type is specified by the Contract Administrator. The Contractor shall ensure that sufficient space is left (including tiling and marble) around the valve body and connections for its future removal.

19.5 INCOMING WATER SERVICE

The incoming service for the Cold-water main and the sprinkler service tank, will be provided by Affinity Water to a suggested position indicated on the drawings.
The Contractor shall size the new incoming water to serve the whole building and the sprinkler tank.

The Contractor shall arrange for Quotation for the work immediately upon being awarded the Contract and place an order in timely fashion to meet the programme. There is an item in the Form of Tender to allow for this provision.

The water meter shall be suitable for monitoring by the BMS.

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.

19.6 INCOMING GAS SERVICE

There is an existing incoming gas service with current meter position indicated on the drawings complete with a meter and governor assembly.

The Contractor shall size the new gas load to serve the Catering Kitchen Cooker, The independent living cooker and the Food Tech room requirements. Once the new gas load is known the Contractor shall liaise with the supply authority to review if the current meter needs to be changed.

The gas meter shall be suitable for monitoring by the BMS.

The Contractor shall extend pipework from the Supply Authority's termination, complete with means of isolation.

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.

19.7 METERING (SECONDARY)

The Building Regulations for non-domestic supplies effectively calls for sub-metering of gas, water and electricity to enable the building owner/operator to use no more fuel and power than is reasonably necessary.

The installation of meters and sub-meters is to ensure full compliance with Building Regulation Approved Document Part L.

19.7.1 Gas Meters

A rotary positive displacement meter should be used up to and including 50mm for a maximum gas flow rate of 20 cu.m/hr with a maximum pressure drop of 0.2 mbar.

The casing shall be manufactured from cast iron with aluminium piston. The meter shall be supplied with an inlet filter downstream of the meter to protect the moving components.

For installations over 50mm or for gas flow rates higher than 20 Cu.m/hr a turbine type gas meter shall be used. The maximum pressure drop shall be 0.25 mbar. The meters shall be manufactured from aluminium bodies. Downstream of the meter shall be a removable filter to protect the turbines.

The dials of the meter shall be easily readable or have remote reading facilities in difficult locations.

All gas meters shall be provided with a pulsed output for BMS monitoring and shall provide the option for a serial communications interface via an industry-standard protocol such as LON, M-Bus, Modbus, etc.

All gas meters shall be clearly labelled, stating the service and/or area which they are metering.

19.7.2 Water Meters

The Contractor shall install a pulse water meter on the incoming cold water main within the plantroom after the branch to the sprinkler tank.

The meter shall be sized to avoid a significant pressure drop on the incoming cold water main and be suitable for monitoring water usage and central control system connection. The installation shall be suitable for BREEAM WAT02 & WAT03 credits.

The meters shall be manufactured by Watersavers Ltd., Tel: 01603 725099 from there Mulit-Jet range.

All meters shall conform to BS EN 14154 and be of volumetric semi-displacement type. The meters shall be to the higher-Class C or D to provide accurate readings.

Internally meters shall be of the 'dry' dial type. Externally meter locations subject to climate change shall be of the 'wet' dial type.

All meters shall be WRAS approved.

All meters shall have isolation valve on the inlet and discharge and the meter shall be independently supported.

The dials of the meter shall be easily readable or have remote reading facilities in difficult locations.

All water meters shall be provided with a pulsed output for BMS monitoring and shall provide the option for a serial communications interface via an industry-standard protocol such as LON, M-Bus, Modbus, etc.

All water meters shall be clearly labelled, stating the service and/or area which they are metering.

19.8 WATER LEAK DETECTION SYSTEM

The Contractor shall install a water leak detection system on the incoming cold water main within the plantroom after water meter, including the control panel solenoid valve and all components necessary for the system to operate

The water leak detection system shall monitor the water flow into the building and if this flow rates exceeds pre-set parameters, then an alarm will be sounded and water supply shut-off. The system shall be connected to the central control system to monitor usage and alarms. The installation shall be suitable for BREEAM WAT03 credits.

The meters shall be manufactured by Watersavers Ltd., Tel: 01603 725099 from there WLDS and include a solenoid valve form there SVM range with 24V DC motor.

The Solenoid valve shall be sized to avoid excessive pressure through the cold water pipework system.

All component shall be WRAS approved.

19.9 PHSYICAL WATER CONDITIONER (SCALE CONTROL)

Physical Water conditioners shall be manufactured by Goodwater Ltd. Tele 0118923 5003 and be from there Phoenix Mediagon range

The Contractor shall design, supply and install. electro-magnetic water conditions, to fit on the incoming cold water supply.

The units shall comprise 2-segmented collars, which are attached round the pipe and secured with 'Alan' screws. The 2 segments are specially cast metal alloy designed to create numerous electrostatic fields along the length of the unit. Each unit is to be constructed so that it fits the external pipework diameter exactly.

The Mechanical Contractor must ensure there is adequate support for the pipework onto which the unit will be fitted.

The unit shall have a BMS output to detect power failure.

19.10 GAS SAFETY SYSTEMS

A gas safety system shall be provided to the Catering Kitchen and Food Tech classroom as gas pressure proving control system, carbon dioxide monitoring system and ventilation interlock in the case of the catering kitchen.

These systems are required to comply with current IGEM UP 11, UP 19 and UP 1

The Contractor shall design, supply and install a gas proving and CO2 monitoring system for the Classroom system as Medem SEC-L with AD MED-CO2 carbon dioxide detector and a gas solenoid valve. The manufacturer's requirements and for Medem to commission the systems.

The Contractor shall design, supply and install a ventilation and gas proving system for the Catering Kitchen system as Medem SEC-K and a gas solenoid valve the system shall comply with BS6173. The manufacturer's requirements and for Medem to commission the systems.

The SEC-L and SEC-K systems are manufactured by Medem, Tel: 0161 233 0600.

19.11 FLOOR DUCTS

Where concrete screed floors exist, floor ducts may be installed with the Contract Administrator's agreement for the services installation, finished flush to the adjoining surfaces. The Contractor shall make good damp-proof membranes disturbed by these works.

Floor ducts shall be as manufactured by Screeduct Ltd., model SFD with removable covers, sized to suit the screed depth and pipework installation and insulation. Tel: 01789 459211.

19.12 EXTERNAL TAPS

Gardens and balconies shall be provided with an external tap, final location to be agreed with the Contract Administrator. The tap shall be served via the mains cold water service and provided with a double check valve.

Where the external pipe run to the tap is longer than 300mm then the pipe shall be insulated and trace heated.

SECTION 20

20 ABOVE-GROUND DRAINAGE

20.1 GENERAL DESCRIPTION

The works referred to in this performance specification are for the design, installation and commissioning of the above-ground foul, wastewater and surface water drainage system.

An entirely new internal above ground drainage system shall be designed and installed for the existing building and new extension. There will be new rain water pipework on the new extension and modifications to the existing rain water pipework on the existing building particularly where it connects to the new extension.

20.2 PRELIMINARIES

This performance specification shall be read in conjunction with the Preliminary Clauses for the engineering services.

20.3 SCOPE OF DRAINAGE WORKS

This performance specification document for above ground drainage works should be read in conjunction with all other relevant contract documents.

The work is to include the complete design, supply, installation, testing and commissioning of all materials, equipment and plant for the completion of the above ground drainage works to the satisfaction of the Contract Administrator, and in accordance with the requirements of the current version of the British and European Standards and the Building Regulations including that of giving the necessary statutory notices.

The works generally comprise the removal of the existing foul and wastewater drainage system above ground level and the installation of new systems for the safe and efficient discharge of foul and wastewater to the below-ground drainage system, and the installation of new rainwater pipework.

The Contractor shall be responsible for the production of detailed design and working drawings as required for the proper installation of the works. The Contractor is to liaise and co-ordinate the works with other trades and services as necessary.

20.4 SCHEDULE OF PIPE MATERIALS

20.4.1 Soil and Rainwater 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

20.4.2 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

20.4.3 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

20.4.4 Branch Waste Pipes

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

20.4.5 Vent 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

20.4.6 Branch Vent Pipes including Anti-Siphon 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
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	Capillary type to BS EN 1254-1

20.5 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.

20.6 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 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 in accordance with the manufacturer's recommendations.

Where pipes pass through fire compartmentation, 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.

In toilet ducts the location of soil and waste services pipework shall take account of other services contained in the ducts and 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 cast iron pipework they shall remain accessible for future maintenance purposes.

Pipes passing through fire compartmentation, walls, floors, and in-fill slabs shall be sealed with an appropriate non-asbestos fire stop system.

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 outlets of basin and sink wastes on pipework up to and including 50mm diameter.

Joints in pipework shall not be made within the thickness of walls, floor or roof, 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 and also at junctions to horizontal branches of 50mm diameter and over 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.

Joints between branch soil pipes and WC pan spigots shall be made by the use of a suitable flexible WC connector.

20.7 CAST IRON PIPEWORK

Socketless pipe shall be jointed in accordance with the manufacturer's instructions. All pipe ends shall be cut square and kept free from dirt. The correct gasket shall be used, centrally located on both pipes with correct and even pressure exerted on bolts by torque wrench, in accordance with the manufacturer's instructions.

Vertical cast iron stacks shall be adequately supported with appropriate floor or stack supports as necessary to ensure that excessive weight is not transmitted through the system.

20.8 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 propertytening, 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.

20.9 PIPEWORK SUPPORTS

20.9.1 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	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. Cast iron and mild steel piping shall have steel supporting members in contact with the pipe.

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 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.

20.10 TESTING

20.10.1 Gravity Pipework

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.

20.10.2 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.

20.10.3 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.

SECTION 21

21 INSPECTION, COMMISSIONING, TESTING AND HANDOVER

21.1 TESTS, COMMISSIONING AND DEMONSTRATION - GENERAL

The Contractor is advised that great importance will be placed upon this section of the Specification which covers the inspection, testing and commissioning of the various mechanical services systems within the building.

The Contractor shall use a Specialist Commissioning Engineer who is a suitably qualified person either as a member of the Commissioning Specialists Association or Commissioning Group of BESA who shall undertake all the pre-commissioning and commissioning of the entire HVAC installation.

All systems, plant and controls must be tested, adjusted, regulated, labelled and commissioned by the Contractor in accordance with all relevant British Standards, Codes of Practice, BSRIA & CIBSE. The Contractor shall ensure that adequate time in the programme is allowed and the tender sum shall cover all the costs of providing the services of suitably qualified Commissioning Engineers and certified test equipment and fuel to carry out these activities.

The Testing and Commissioning Engineers and equipment shall be employed on the site continuously during the period and until completion of the work and the system have been demonstrated 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 demonstration of the commissioning shall be arranged by the Contractor and must be carried out before occupation, giving at least five working days' notice to the Contract Administrator, this notice shall be accompanied by a comprehensive commissioning report on all the systems before the Engineer will attend site to witness the operation and commissioning

The Main Contractor is aware that a test/commissioning period shall be included in the overall programme for such testing and commissioning. A specific commissioning programme incorporating times for the witnessing shall be issued before commissioning commences. The Contractor shall consider the use of a Commissioning Management Company to ensure smooth commissioning and demonstration progress.

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 testing and commissioning 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 testing and commissioning 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.

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.

21.2 FAILURE OF TESTS

Any defects occurring at any time during the test duration shall be made good and a complete re-test carried out.

Where failure during a test, inspection or commissioning process results in damage to the building fabric to any services not provided as part of the Contract, or requires subsequent building works in connection to be carried out, then the remedial works shall be the responsibility of the Mechanical Services Installer.

Leakages shall be repaired by properly remaking or replacing the defective component. Caulking will not be permitted.

21.3 WELDING TESTS

All welds shall be examined with the pipes, fittings and ducts heated to working conditions.

A hammer test shall be carried out on each weld during the hydraulic test of the pipe lines.

Specimens shall be cut from the work at the Contract Administrator's direction and subjected to visual examination and bending tests. Work, which in the opinion of the Contract Administrator is defective, shall be re-welded.

Defective work shall be considered to include work which, in the opinion of the Contract Administrator has not been satisfactorily prepared, nor achieved complete penetration, and is found to be unsatisfactory under bending tests, or unsatisfactory in any other way.

Should any leaks be detected during the specified testing, the defective portion of the weld shall be cut out and re-welded and further tested until found satisfactory.

All costs for welding tests shall be borne by the Contractor.

21.4 HYDRAULIC PRESSURE TESTING

21.4.1 General

Comply with procedures in BESA Guide to Good Practice for Site Pressure Testing of Pipework. Ensure safety precautions detailed in HSE Guidance Note GS3 Safety in Pressure Testing is adopted. Provide a blanked connection to accommodate a check gauge in addition to the accurate gauge fitted to section under test.

No section of pipework shall be concealed, buried or insulated prior to testing and inspection.

Advise appropriate personnel, at least two working days in advance, of the time pressure tests may be witnessed.

21.4.2 Water Circulating and Supply Systems

Carry out hydraulic pressure testing as described in BESA Guide to Good Practice for Site Pressure Testing of Pipework. Test section by section for one hour, as the work proceeds and prior to application of thermal insulation as follows:

- Operating gauge pressure less than 3.5 bar, test gauge pressure 7.0 bar
- Operating gauge pressure 3.5 – 7.0 bar, test gauge pressure twice operating pressure.
- Operating gauge pressure greater than 7.0 bar, test gauge pressure 14.0 bar or one and a half times operating pressure whichever is the greater.

21.4.3 Water Mains

Test to Local Authority requirements. Ensure the provisions laid down in BESA Guide to Good Practice for Site Pressure Testing of Pipework for testing underground CWS mains are carried out.

21.4.4 Gas Pipework

On completion of the gas service the pipework shall be subject to pneumatic leak test followed by a pneumatic pressure test as described in BESA Guide to Good Practice for Site Pressure Testing of Pipework.

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.

21.4.5 Tanks and Vessels

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.

21.5 COMMISSIONING

21.5.1 General

The commissioning shall be carried out in accordance with the procedures, checks and tolerances given in the BSRIA Application Guides for Water and Air Systems to achieve the standards set down in the CIBSE Commissioning Codes, the "Regulations for the Electrical Equipment of Buildings issued by the Institution of Electrical Engineers, and British Standards and Codes of Practice.

The ductwork systems shall be cleaned before the first run of any fan plant. The access requirements and cleaning shall conform to BESA Guide to good practice TR19 and CIBSE TM26 Hygienic Maintenance of Ventilation Ductwork.

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 review/comment.

The Commissioning 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 building must be watertight before commissioning is 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 witnessing 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.

21.5.2 Commissioning Water Distribution Systems including BSRIA Pre-Commissioning Checklist

Preliminary Checks:
Carry out checks and procedures as detailed in CIBSE Commissioning Code W, Section W1. Ensure system is statically complete as defined BSRIA BG 2/2010 Commissioning of water systems in buildings. Use pre-commissioning checklist.

Setting to work and regulation:
Set to work and regulate water distribution systems in accordance with CIBSE Commissioning Code W, Sections W2 and W3, and BSRIA BG 2/2010.

Measurement:
Use instruments for measurement detailed in BSRIA BG 2/2010 Commissioning of water systems in buildings.

The water flow through pumps shall be measured by relating the pressure drop across the pump to the manufacturer's test curves and by summation of relevant commissioning valve readings. A copy of the test curve indicating the final operating point shall be forwarded to the Engineer.

Flow through heaters shall be adjusted to give the design temperature difference and pressure drop across a pressure tapped orifice valve where specified.

Upon completion of balancing and testing operations, temperature measurements shall be taken in all rooms and readings tabulated in schedule form together with hourly ambient external temperature readings taken over the measuring period. Two copies of the schedules shall be forwarded to the Engineer.

The Controls Specialist shall be responsible for the positioning of motorised valves for the Commissioning Engineer.

21.5.3 Commissioning Air Distribution Systems including BSRIA Pre-Commissioning Checklist

Preliminary Checks:
Carry out checks and procedures as detailed in CIBSE Commissioning Code A, Section A1, Ensure system is statically complete as defined BSRIA BG 49/ 2015 Commissioning of air systems.

Setting to work and regulation:
Set to work and regulate air distribution systems in accordance with CIBSE Commissioning Code A, Section A2 and BSRIA BG 49/ 2015 Commissioning of Air Systems.

Measurement of air flow:

Use instruments for measurement and methods of measurement detailed in BSRIA BG 49/ 2013 Commissioning of air systems and CIBSE commissioning guide, section A3.

The commissioning results shall be forwarded to the Engineer and shall detail the recorded air volume and percentage deviation from design air volume, for each air supply and extract terminal.

The Controls Specialist shall be responsible for the positioning of motorised dampers for the Commissioning Engineer.

Wet and dry bulb temperature measurements shall be taken in all rooms served by air supply systems including fan coil units and the results indicated on the schedule of commissioning results, together with external ambient wet and dry bulb temperatures recorded at hourly intervals over the measuring period.

Smoke tests shall be conducted on all air distribution systems to ensure correct air diffusion from outlet terminals.

21.5.4 Commissioning of Boiler Plant

Follow the procedures laid down for carrying out Preliminary Checks and Start Operation in accordance with CIBSE Commissioning Code B and manufacturers' instructions.

Apparatus and Instruments:
Use apparatus and instruments detailed in CIBSE Commissioning Code B, Appendix B3.1. Apply tolerances defined in Appendix B3.2.

21.5.5 Commissioning Automatic Control Systems

Carry out commissioning of Automatic Control Systems in accordance with manual prepared by the controls equipment manufacturer. Carry out the checking and setting up procedure detailed in the CIBSE Commissioning Code C, Section C1.

Verify that control systems function to the requirements of the specification. Record results and include in the Operating and Maintenance Manual.

Measurement:
Carry out measurements in accordance with CIBSE Commissioning Code C, Appendix C2.1.

21.5.6 Commission Plant Items

Comply with the manufactures' recommendations for setting to work.

21.6 RECORDS

21.6.1 Instruments and Gauges

Ensure instruments are correctly calibrated. Record details of instruments on record sheets. Submit evidence of correct calibration of instruments to be used in connection with commissioning and testing.

21.6.2 Testing Records

The Contractor shall keep systematic hydraulic testing records of all tests. One set of the records shall be included in each of the Operating and Maintenance Manuals.

21.6.3 Water Systems Commissioning Records to BSRIA Guide BG02/2010

Keep a systematic record of commissioning results, one set shall be issued to the Contract Administrator for inspection prior to witnessing. One set of the witnessed records shall be included in each of the Operating and Maintenance Manuals.

For water systems:
Use record sheets as detailed in BSRIA Guide BG 02/2010, Commissioning of Water Systems in Buildings.

21.6.4 Air Systems Commissioning Records to BSRIA Guide BG49/2015
Keep a systematic record of commissioning results and distribute as indicated.
For air systems
Use record sheets as described in BSRIA Guide BG49/2015 Commissioning of Air Systems.

21.7 WITNESSING REQUIREMENTS

The Contractor shall include in his programme time after the completion of commissioning of all the Mechanical and Public Health Engineering Services for the demonstration of those services to the Contract Administrator/Engineer.

MECHANICAL SERVICES

- Demonstration of the heating systems, their operation, temperature control of space etc.
- Demonstration of the cooling systems, their operation, temperature control of space etc.
- Demonstration of the underfloor heating circuits including manufacturer sign-off
- Demonstration of the water flow rates at all commissioning stations.
- BMS functionality and update of the graphics.
- Functionality of heating controls.
- Functionality of all the ventilation systems.
- Demonstration of all the supply and extract air volumes.
- Demonstration of the operation and control of the Passive Stack Natural Ventilation systems including Manufacturer's sign-off
- Demonstration of domestic water flow rates and balance of the hot water system.
- Demonstration of random selection of hot water temperatures and correct operation of the blending valves
- View O&M documents including 'As Installed' drawings and commissioning, chlorination certificates etc. for comment, at least two weeks before handover.

PUBLIC HEALTH SERVICES

- Demonstration of the water discharging throughout the sanitary fittings etc. efficiently and quietly, including paper flush test on WCs.
- Provision of CCTV of the underground drainage pipework.
- View O&M documents including 'As Installed' drawings, test certificates etc. for comment, at least two weeks before handover.

We will not attend site to witness until all test/commissioning sheets have been issued.

21.8 PERFORMANCE TESTS

All major plant items shall, where appropriate, be tested at works, at the specified duty, and a compliance certificate forwarded to the Contract Administrator for approval before installation.

The Contractor shall demonstrate the performance of the complete installations including single, multi-duty plants and systems and plants specified for future use to the Contract Administrator. A schedule of the tests to be used for both the pre-commissioning and commissioning checks shall be issued by the Contractor.

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 Commissioning 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 the Certificate of Practical Completion until all tests have been carried out and the systems properly performing to the satisfaction of the Contract Administrator. Upon completion, one copy of all the witnessed commissioning sheets shall be included in the Operating and Maintenance Manuals.

21.8.1 Environmental Tests, Artificial Loads

Carry out environmental testing to prove the performance of the systems. The Contractor shall apply suitable artificial loads to provide test arrangements to simulate the full range of operating conditions and duties.

The Contractor shall include the cost for providing any artificial loads or test arrangements.

21.9 ELECTRICAL INSTALLATION TESTS

The test procedure shall comply with BS 7671 requirements for Electrical Installations (the IEE Wiring Regulations), IEE Guidance Notes No. 3, Inspection and Testing and other British Standards as appropriate.

The following tests shall be applied to the installation before the installation can be considered complete for handing over.

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

21.10 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 and test certificate for electrical installation in accordance with the latest IEE Regulations.

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. Ensuring that 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. Complete 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 Practical Completion.

21.11 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 to be communicated by the Contract Administrator and carrying out any adjustments necessary.

2. Further checking and adjusting as may be necessary or required by the Engineer or Contract Administrator and correcting any malfunctions to the automatic controls systems.

Final clearance of any outstanding defects under Defects Liability Period, just prior to issue by the Contract Administrator of final certificate of clearance of defects

certificate releasing balance of retention monies due to under the Conditions of Contract.

SECTION 22

22 RECORD DOCUMENTS

22.1 PROVISION OF RECORD DOCUMENTS

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.

All documentation shall be in plain English. The text of descriptive sections shall be concise and complete. The overall aim of the document shall be to provide clarity in conjunction with brevity on a need-to-know basis.

Jargon shall be avoided. All new terms shall be defined when first introduced. Where appropriate, terminology shall accord with BS 5643:1984 and BS EN 60300.

Abbreviations shall only be used once their meaning has been made unambiguous. Imperatives shall be used for instructions regarding the operation, maintenance and disassembly of engineering services.

All graphical material shall be legible and fully annotated to suit the purpose for which they have been included in the O&M manuals. Illustrations, drawings and diagrams that are incorporated in the manual shall be easily understood in conjunction with the supporting text.

Where possible, original artwork shall be used rather than second or third generation scans. If original artwork cannot be obtained, consideration shall be given to redrawing diagrams and illustrations.

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.

22.2 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.

Two hard copies of all Record Documents shall be provided plus two CD-r or DVD-r format. In the case of Drawings and Diagrams (other than Manufacturer's drawings) one set will print at A1 size and two sets print at A3 size. All to be clearly labelled “As Installed”.

Drawings shall be presented on CD-r or DVD-r using the latest AutoCAD format. Drawing files shall be clearly labelled and shall be complete with all computer files (X-Refs, Blocks) etc.

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.

22.3 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 Construction drawings, i.e. one FIFTIETH full size, 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 identity of each room or space housing plant, machinery or apparatus.

vi. The location and size of all flue access positions.

Drawings or sets of drawings to a scale consistent with that used for Construction drawings, i.e. ONE TWENTIETH full size which shall show the following as installed:

i. The detailed general arrangements of all boiler room, tank rooms and plantrooms, etc. including the location, identity, size and details of each piece of apparatus. The information with respect to size and details may be presented in schedule form subject to the prior agreement of the Contract Administrator.

ii. 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.

iii. 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.

iv. 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.

v. 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.

vi. 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.

vii. Record of pressure drops in all circuits throughout.

22.4 VALVE CHARTS AND CIRCUIT DIAGRAMS

Charts indicating the valve function and position in a line diagram and Gas system Diagram shall be provided and hung in a suitable position in the Boiler Rooms, Tank Rooms and Plantrooms, etc.

22.5 OPERATING AND MAINTENANCE INSTRUCTIONS

Operating and maintenance instructions shall comprise the following (all 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.

22.6 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.

22.7 BUILDING LOG BOOK

The Contractor shall supply to the Contract Administrator as a pre-requisite to Practical Completion of the Works, comprehensive building log books 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.

The building log book shall give details of the installed mechanical services plant and control, their method of operation and maintenance, and other details that collectively enable energy consumption to be monitored and controlled.

The information shall be provided in summary form, suitable for day-to-day use. This summary shall draw on, or, refer to the information within the Record Documents and Health and Safety File.

The building log book shall comprise all as described in the specification with the following:-

i) a description of the whole building, its intended use, design philosophy and intended purpose of the individual building services systems.

ii) a schedule of the floor areas of each of the building zones categories by environmental servicing, i.e. comfort cooling, heating etc.

iii) the location of all relevant plant and equipment, including simplified schematic diagrams.

iv) the installed capacities (input power and output rating) of all services plant.

v) simple descriptions of the operation and control strategies of the energy consuming services in the building.

vi) a copy of the report confirming that the building services equipment has been satisfactorily commissioned in accordance with the Specification.

vii) operating and maintenance instructions that shall include provisions enabling the specified performance to be sustained during occupation.

viii) a schedule of the building's energy supply meters and sub-meters, indicated for each meter, the fuel type, its location, identification, description and instructions on their use. The instruction shall indicate how the energy performance of the building can be calculated from the individual metered energy readings to facilitate comparison with published benchmarks.

The building log book shall be contained in one volume strongly bound in flexible cover and suitable for heavy usage over a long period of time.

The Contractor shall use the CIBSE "Building Log Book" template for this project.

SUMMARY OF TENDER

All items to be priced, no item shall be priced as 'included'
All prices to be net of VAT

1.	Preliminaries (check if applicable)	£
2.	Provision of Design and Calculations and preliminary drawings (See Clause 1 & 2)	£
3.	Provision of Working/Installation Drawings (See Clause 2.2 and Section 3)	£
4.	Provision of Builders Work in Connection Drawings (See Clause 2.2 and Section 3)	£
5.	Provision of Record Documents (See Clause 2.2 and Section 21)	£
6.	Disconnection, Removal and Disposal of Existing Services Installation including Drain Downs and making safe.	£
7.	Provision of Commissioning Programme and Commissioning with Demonstration of installed systems to Engineer	£
8.	Provision of "Teach In" of installed systems to end user	£
9.	Allowance for liaising and Co-ordination with Utilities companies for Gas & Water	£
10.	Supply and Install Gas pipework to Catering Kitchen, Independent Living Kitchen and Food Tech Classroom and associated equipment's	£
11.	Supply and Install LTHW Heating System including ASHPs, Buffer Vessel, Underfloor Heating and LST Radiators, ancillaries etc.	£
12.	Supply and Install Domestic Hot Water System including the electrical water heaters	£
13.	Supply and Install Cold Water System included Water Meter and Water Leak Detection System.	£
14.	Supply and Install Pipework Thermal Insulation	£
15.	Supply and Install Controls System and associated Electrical Installation	£
16.	Supply and Install of Hybrid ventilation system to the classrooms and ancillary items	£
17.	Supply and Install Ventilation Systems to other areas as noted on the room data sheets and all ancillary items	£
18.	Supply and install Above Ground Drainage and Rain water Services	£
19.	Any items not listed by the foregoing	

	…… …… ……	£
	Sub-Total	£
20.	Provisional Sum	
	Design, Supply and install new Split heat pump system to potential new server for the new school.	£ 4,000.00
21.	Contingency Sum	£ 7,500.00
	Total	£
	12 months maintenance of all systems installed as part of these Works	£

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 Contract Administrator. It is understood that the submitted tender includes all items of plant or equipment of the type and manufacture specified.

SPECIFIED CLAUSE NO.	ITEM OF PLANT OR EQUIPMENT	SUGGESTED ALTERNATIVE	EFFECT ON TENDER PRICE. STATE INCREASE OR DECREASE

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 ……..

APPENDIX A – ROOM DATA SHEETS

Room No.	Room Name	Proposed Area	Heating			Ventilation		Domestic Water			
		M2	Strategy	Room Temp. Min °C	Control	Strategy	Air Volume	Hot water	Cold Water	Mixed Temp °C	Gas
	Ground Floor										
0.00	Lift - Existing	1.81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.01	Independent Living	26.21	Wet UFH	21 +/- 2	Local Stat	Natural Vent - Cooker Hood Extract duct	Provided by cooker hood	Elec Water Heater	Mains	43	YES
0.02	Independent Living - Bath	4.36	Wet UFH	22 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	42 for Bath	N/A
0.03	Plant Room	10.29	None	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.04	Plant Room	19.29	None	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
0.05	Kitchen ST	1.94	Wet UFH	20 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.06	Kitchen	14.74	Wet UFH	20 +/- 2	Local Stat	Mechanical Supply & Extract	To compley with DW 172	Elec Water Heater	Mains	To Kitchen Designer requirements	YES
0.07	Kitchen ST - WC	1.89	Wet UFH	20 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
0.08	Circulation	8.65	Wet UFH	20 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.09	Head Office	26.89	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.10	Circulation Stairs	19.69	Wet UFH	20 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.11	Circulation	51.13	Wet UFH	20 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.12	Medical	15.25	Wet UFH	21 +/- 2	Local Stat	MVHR	8 L/S per Person with min. 2.5 AC/Hr	Elec Water Heater	Mains	43	N/A
0.13	Office	22.27	Wet UFH	21 +/- 2	Local Stat	MVHR	8 L/S per Person with min. 2.5 AC/Hr	N/A	N/A	N/A	N/A
0.14	Reception	27.25	Wet UFH	20 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A

0.15	Parent Room	7.36	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.16	IT Comms	2.11	Existing DX Split system to be retained	21 +/- 2	Local Stat	N/A	N/A	N/A	N/A	N/A	N/A
0.17	Visitor WC	3.44	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
0.18	Games Store	1.86	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.18A	Games Store	1.88	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.19	Quiet Dining/Flexible Room	33.27	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.20	Furniture Store Area	6.49	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.21	Flexible Space	73.92	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.22	Store – M&E Riser	2.26	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.22A	Store	2.26	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.23	Circulation	19.98	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.24	Fitness Room	43.45	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.25	Changing Room	12.71	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	42 for Shower	N/A
0.26	Changing Room	12.84	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	42 for Shower	N/A
0.27	Stair	19.88	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.28	Pupil Assist WC	3.57	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
0.29	WC Pupil	2.71	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
0.30	Hygiene Room	14.56	Wet UFH	21 +/- 2	Local Stat	MVHR	8 L/S per Person with min. 2.5 AC/Hr	Elec Water Heater	Mains	43	N/A
0.31	Lift Lobby	13.76	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.32	Lift - New	4.71	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

0.33	Classroom 03 - Performing Arts	62.03	Wet UFH	22 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	Elec Water Heater	Mains	43	N/A
0.33A	Store	5.16	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.34	Circulation	43.36	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.35	Group Room	12.09	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.36	Classroom 01	64.42	Wet UFH	22 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	Elec Water Heater	Mains	43	N/A
0.36A	Store	2.11	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.37	Classroom 02	64.14	Wet UFH	22 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	Elec Water Heater	Mains	43	N/A
0.37A	Store	1.98	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
0.38	Stair	20.65	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
		810.62									
	First Floor										
1.00	Lift - Extg	1.81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1.01	Classroom 09 - Science	75.31	Wet UFH	22 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	Elec Water Heater	Mains	43	N/A
1.01A	Store	3.85	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.02	Breakout Room	8.81	Wet UFH or LST Radiators with fast temperature response	23 +/- 2	Local Stat or TRV	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.03	Team Leader	8.81	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.04	Phase Leaders Office	21	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.05	Curriculum Lead	13.1	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A

1.06	Protected Lobby	15.65	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.07	Stair	19.86	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.08	Circulation	85.2	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.09	Lockers	1.71	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.10	Classroom 08	63.44	Wet UFH	22 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	Elec Water Heater	Mains	43	N/A
1.10A	Store	2.68	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.11	Pupil WC	2.4	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
1.12	Pupil WC	2.36	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
1.13	Breakout Room	6.08	Wet UFH or LST Radiators with fast temperature response	23 +/- 2	Local Stat or TRV	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.14	Cl. Store	2.02	N/A	N/A	N/A	Mechanical Extract	6 AC/Hr	Elec Water Heater	Mains	43	N/A
1.15	Staff Room	37.49	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	Elec Water Heater	Mains	43	N/A
1.16	Store M&E Riser	2.21	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1.16A	Store	2.19	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1.17	Classroom 07	57.2	Wet UFH	22 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	Elec Water Heater	Mains	43	N/A
1.17A	Store	1.89	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.18	Small Hygiene	11.64	Wet UFH	21 +/- 2	Local Stat	MVHR	8 L/S per Person with min. 2.5 AC/Hr	Elec Water Heater	Mains	43	N/A
1.19	Breakout Room	10.81	Wet UFH or LST Radiators with fast	23 +/- 2	Local Stat or TRV	Natural Vent	N/A	N/A	N/A	N/A	N/A

			temperature response								
1.20	Stair	16.96	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.21	Pupil Assit WC	3.52	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
1.22	Pupil Assit WC	2.45	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
1.23	Cleaners store	3.15									
1.24	Staff WC	3.17	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
1.25	Staff Assit WC	3.94	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
1.26	Lift Lobby	15.19	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.27	Lift - New	4.45	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
1.28	Classroom 06 - Art	62.03	Wet UFH	22 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	Elec Water Heater	Mains	43	N/A
1.28A	Store	5.16	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.29	Circulation	45.78	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.30	Group Room	12.39	Wet UFH or LST Radiators with fast temperature response	23 +/- 2	Local Stat or TRV	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.31	Classroom 04	64.27	Wet UFH	22 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	Elec Water Heater	Mains	43	N/A
1.31A	Store	2.11	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
1.32	Classroom 05	64.14	Wet UFH	22 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	Elec Water Heater	Mains	43	N/A
1.32A	Store	1.98	Wet UFH	18 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A

1.33	Stair	20.63	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
		788.84									
	Second Floor										
2.00	Lift - Existing	1.81	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2.01	Food Tech Classroom	77.95	Wet UFH	22 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	Elec Water Heater	Mains	43	YES
2.02	Food Tech Store	9.07	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	5 AC/Hr	Elec Water Heater	Mains	43	N/A
2.03	Faculty Store	9.11	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.04	Conference Room	35.91	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.04A	Elec cupbd	1.09	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2.05	Protected Lobby	14.43	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.06	Store	0.92	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2.07	Stair	19.86	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.08	Library/Common Room	66.59	Wet UFH	21 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	N/A	N/A	N/A	N/A
2.09	Lockers	1.65	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.10	Circulation	69.89	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.11	Cl. Store	1.99	N/A	N/A	N/A	Mechanical Extract	6 AC/Hr	Elec Water Heater	Mains	43	N/A
2.12	Pupil WC	2.38	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
2.13	Pupil WC	2.28	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
2.14	Physio Store	6.26	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.15	Physio	24.01	Wet UFH	21 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	N/A	N/A	N/A	N/A

2.16	Occi. Therapy Store	11.86	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.17	Occupational Therapy	28.67	Wet UFH	21 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	N/A	N/A	N/A	N/A
2.18	Snoezelen Room	39.35	Wet UFH	21 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	Elec Water Heater	Mains	43	N/A
2.19	Meeting Room	11.7	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.20	Speech & Language	14.53	Wet UFH	21 +/- 2	Local Stat	Hybrid Ventilation unit	To avoid overheating, min 10 L/Sec per person	Elec Water Heater	Mains	43	N/A
2.21	Pupil Assist WC	3.37	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
2.22	Store	4.3	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.23	Stair	17.04	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.24	Circulation	8	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.25	Cleaner Store	1.55	N/A	N/A	N/A	Mechanical Extract	6 AC/Hr	Elec Water Heater	Mains	43	N/A
2.26	Staff Assist WC	3.25	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
2.27	Staff WC	2.22	Wet UFH	21 +/- 2	Local Stat	Mechanical Extract	10 AC/Hr	Elec Water Heater	Mains	43	N/A
2.28	Lift Lobby	13.05	Wet UFH	21 +/- 2	Local Stat	Natural Vent	N/A	N/A	N/A	N/A	N/A
2.29	Lift - New	4.43	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		509.35									