MECHANICAL SERVICES SPECIFICATION

GREEN FIELD SPORTS

SAWTRTY, HUNTINGDON

Ref :	AX1937 Rev.B	**Client :**	Sawtry Parish Council
Prepared by :	I Williamson		
Date :	July 2022		
Approved By :	BB		

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REVISIONS

Revision	Date	Amendment
A	July 2022	Tender Issue
B	July 2023	Revised tender issue – updated to suit latest building layout.

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SECTION 1

STANDARD M&E CONTRACTUAL CLAUSES
FOR
DOMESTIC SUB-CONTRACT PROJECTS
TRADITIONAL (NONE DESIGN & BUILD) PROCUREMENT METHODS

CONTENTS

1.1 PROJECT PARTICULARS

Particulars of the project as a whole are given within the Main Contract Preliminaries.

The Contractor will be appointed as a Sub-Contractor to the Main Contractor. All Sub-Contract conditions shall be agreed with the Main Contractor.

The term Sub-Contractor when used within this specification and is deemed to be synonymous with the term Subtrader and the like which may be used elsewhere within the Contract Documentation.

Contractor, Electrical Contractor, or Mechanical Contractor referred to in this specification shall also be synonymous with the term Sub-Contractor

The Sub-Contractor shall include within their tender for the surveying of the building site, design, production of calculations, specification, drawings, purchase, delivery to site, off-loading, moving into position, marking out, setting up, alignment, erecting, fixing, wiring, connecting, setting to work, commissioning, testing, O & M Manuals, teaching and demonstrating the whole works as described in the Specification.

For a period of 12 months from the handover date, the Sub-Contractor shall repair and make good any defects arising in connection with the installation and / or equipment free of charge.

Details of the Pre-tender health and safety plan are included in the Main Contract Preliminaries Section.

The installation shall be carried out and in accordance with the specification / tender documentation and shall be in compliance with all current applicable standards and legislation.

Contractors are invited to submit a tender based on this document. If ultimately appointed the successful Contractor shall produce all working drawings / details etc., against this document for installation within the proposed development.

The construction program shall be confirmed with the Main Contractor along with start and completion dates and other program details.

The mechanical and electrical installation shall be as aesthetically pleasing, and appropriate for the building operation.

Information on the building layout, construction methods and finishes shall be obtained by consulting the Architects and Structural Engineers drawings and details, these should be obtained through the Main Contractor.

1.2 DEFINITIONS AND INTERPRETATIONS

Where used in the documentation the following definitions apply:

“ENGINEER” shall mean the person representing Axis M&E Consulting Engineers

“CLIENT” or “EMPLOYER” shall mean the Person, Persons, Company, Authority and their Representatives who have instructed that the works shall be carried out.

“CONTRACT ADMINISTRATOR” or “SUPERVISING OFFICER” shall mean the person appointed by the Client who is responsible for the administering of the Main Contract.

“SITE ENGINEER” shall mean Chief Site Supervisor or his Representative.

“CLERK OF WORKS” shall mean the person appointed to supervise the general works.

“MAIN CONTRACTOR” or “PRINCIPLE CONTRACTOR” shall mean the Person, Firm or Company undertaking the Main Contract and shall include their successors, heirs, executors and administrators named as a party to the Main Contract and the Contractor.

“SUB CONTRACT” shall mean the Contract made between the Main Contractor and the Contractor.

“CONTRACTOR” shall mean the Person, Firm or Company whose quotation for Specialist Engineering Works forming the subject of this Specification has been accepted and who has entered into a Sub-Contract with the Main Contractor and shall include his or their successors, heirs, executors and administrators.

“SPECIFICATION” shall mean the Specification on which the Tender is based.

“MATERIALS” shall mean all plant, materials and equipment for incorporation in the works.

“WORKS” shall mean and include all materials to be used and work to be done by the Contractor under the Contract and shall include supplying, fixing, testing, regulating and commissioning of the installations described in the Specification.

“PLANNING SUPERVISOR” shall mean the person appointed by the Client (or others) to act as Planning Supervisor in accordance with the Construction, Design & Management Regulations 1994 and any subsequent amendments to same.

“PRINCIPAL CONTRACTOR” shall mean the person appointed by the Client (or others) to act as Principal Contractor in accordance with the Construction, Design & Management Regulations 1994 and any subsequent amendments to same.

“SITE” shall mean the actual place or places to which the materials shall be delivered to where work shall be done by the Contractor, together with so much of the area surrounding the said place, or places, as the Contractor shall actually use in connection with the Works as otherwise than merely for the purpose of access to the said place or places.

“SHALL” shall mean mandatory.

“SHOULD” shall mean optional.

“WILL” shall mean informative.

1.3 TENDERING

Ensure tenders include for all work necessary to meet the requirements of the Specified Work and its completion and proper integration with the Works generally.

The tender figure shall be deemed to be fully inclusive of all charges and expenses incurred.

Tenderers are advised to visit site during the tender period to satisfy themselves of the site and the access to it.

The Contractor shall be deemed to have read the whole of the Specification and the accompanying drawings and to have checked the accuracy of all schedules and diagrams and to fully understand the intent of the scheme

Any contradictions noted between the Specification, Drawings and existing site conditions/installation must be brought to the attention of the Engineer during the Tender Period when a ruling will be given.

If there are any discrepancies in, or omissions from, the Drawings, Schedules, Manufacturers Quotations or Specifications, or if the Tenderer is in any doubt as to the true meaning of any part of the Contract Documents, they shall request clarification from the Engineer.

Where reference is given to suppliers or manufacturers quotations, the Sub-Contractor shall ensure that such quotations meet the requirements of the tender scheme with regard to both Specification and quantities and that all terms and conditions forming part of the quotations are acceptable to the Sub Contractor and that such terms and conditions will enable compliance with the tender offer.

Any catalogue or model numbers specified were current at the time of writing, in the event of these numbers changing or becoming obsolete the advice of the Engineer shall be sought before tendering.

The Sub Contractor shall also allow within his tender for all liaison required with the Architect, Client, Structural Engineer, Contractors and Sub-Contractors during the design and construction period to enable designs to be fully coordinated and working details discussed and agreed.

The Sub-Contractor shall allow for installing all equipment in a neat, tidy, workmanlike manner. Services shall be routed in corners and follow the building to give an aesthetically acceptable installation.

The Sub-Contractor shall allow for all building deviations, beams, etc., when estimating services runs. No extras will be allowed for failure to comply with this paragraph.

Where and to the extent that quantities are not included in the specification, tenders must include for all work shown or described in the tender documents as a whole or clearly apparent as being necessary for the complete and proper execution of the Works.

It shall be the Contractor's responsibility to establish final measurements and quantities before ordering any materials, plant or equipment from any manufacturer.

All materials and equipment shall be new unless otherwise stated in this Specification or on the tender drawings.

During the Tender Period, the Architect/Engineer may advise the Tenderers, by addenda, of additions, deletions, omissions, or alterations in the Contracts. All such addenda shall become a part of the Contract Documents as if originally provided.

The Sub-Contractor shall complete and return the tender summary, failure to return or to complete fully the tender summary may jeopardize the acceptance of the tender.

The absence of any item from the tender summary shall not be taken as an omission from the contract; the Contractor shall include for such missing items and add them to the list in a like manner.

The Employer and his representatives offer no guarantee that the lowest, or any tender, will be recommended for acceptance or accepted, and will not be responsible for any cost incurred in the preparation of any tender.

1.4 INTERIM CLAIMS FOR PAYMENT

Interim claims for payment shall include a statement indicating:-

- Value of work complete for each item from the Summary of Tender.
- Priced schedule of unfixed materials on site.
- Value of work complete against each agreed variation.
- Value of unfixed materials on site for each agreed variation.

Materials stored off site will not normally be paid for unless specific agreement is reached between the Quantity Surveyor, Main Contractor and Client in accordance with the Contract

1.5 MANUFACTURERS/SUPPLIERS:

Where manufacturers, suppliers or installers of products are NOT identified by name, select products that comply in all respects with the specification and, as and when requested, demonstrate such compliance.

Where manufacturers, suppliers or installers of products ARE identified by name, or names, but reference is made to "Or approved" equivalent, the submitted tender must include the named or one of the named suppliers. Alternatives may be selected and shall be submitted to the CA for approval, separately.

Check that any proposed alternatives comply with any stated British (or other equivalent recognized International) Standards. Confirm equivalence in quality, operation and space requirements to those items which have been specified by name. If, and when requested demonstrate the proposed alternative is fully equivalent to the specified item and identify any constructional, cost, program, maintenance or other differences.

A list of proposed manufacturers/supplies of products, equipment and plant, including all items for which the choice of manufacturer/supplier is at the discretion of the Subcontractor, must be submitted with the Tender.

1.6 ALTERNATIVE MANUFACTURERS/SUPPLIERS:

The Sub-Contractor shall base the tender on the specified items / manufacturer, however, the successful Tenderer may approach the Engineer with suggested alternatives before commencing on site.

In addition to and at the same time as his tender for the Subcontract Works as defined in the tender documents, the Subcontractor may, at his discretion, submit alternative design proposals and/or method(s) of construction/installation for consideration.

Any alternative material offered shall not form part of the Tender offer but will be considered provided there is a benefit to be gained either in cost, quality or delivery.

Such alternative(s) must be clearly priced as a cost option and include all additional costs arising from necessary changes to the details of the installation, including changes to the design and drawings, as well as any associated ancillary equipment items.

Full technical data for each such alternative must be submitted with the Tender together with details of any consequential amendments to the design and/or construction/ installation of other parts of the Works.

The design responsibility for the change will be rest with the Sub-Contractor who will be required to confirm to the Engineer via the Main Contractor, that he (the Contractor) indemnifies the Engineer for any time spent and costs incurred by the Engineer as a direct result of changing from the materials originally specified.

The Sub-Contractor must ensure that all specified materials are correctly applied and installed strictly in accordance with the manufacturers advice and requirements. Any conflict between information given in the Specification and/or tender drawings and that given by the manufacturer must be brought to the attention of the Engineer before tenders are submitted.

Any costs incurred by the Sub-Contractor through not installing materials in accordance with the manufacturers requirements will not be reimbursed through the Main Contract.

1.7 SCHEDULE OF RATES

A schedule of rates must be submitted with the Tender, or within 14 days of request.

It must include all items and materials included in the tender, together with their rates, extended and totaled. The rates given shall be inclusive of all on-costs. Price Preliminaries separately

Such totals shall agree with the Subcontract Sum and subtotals shall agree with the priced breakdown of the tender.

Correction of errors in the quantification will not lead to adjustment of the Subcontract Sum.

The prices given shall be the installed cost to the Client and shall be used for costing variations to the Contract and the evaluation of work for interim payments.

When used for costing variations of a like basis it is deemed that the schedule price given includes for all costs associated with contract administration overheads and profit and that no additional charges will be levied.

1.8 VARIATIONS

General additions or omissions of work shall only be carried out on receipt of written instructions in accordance with the General Conditions of Contract.

No order for such alterations, additions, or omissions will be issued until an estimate of cost has been submitted by the Contractor unless specifically instructed in writing by the Supervising Officer.

1.9 CDM REGULATIONS:

The Contractor shall include in his tender for fully complying with all requirements of the current UK Health and Safety Legislation, Regulations and Codes of Practice, including the 1994 CDM Regulations and any transitional provision of the regulations and subsequent amendments.

Comply with the requirements of the CDM Regulations by:

- Adhering to the rules of the Health and Safety Plan.
- Reporting accidents, injuries or dangerous occurrences to the main contractor.

- Providing the main contractor with appropriate input to the health and safety plan, including risk assessments, and to the health and safety file.
- Providing the main contractor with information on the subcontract works which might affect the health or safety of any person.

The Contractor shall include for the continual update of documents, etc. as necessary, and for the provision of all record drawings, plans, maintenance procedures, O & M Manuals, details and locations of all materials used during the construction phase, etc., as required by the Health and Safety Executive

Provide any other documents that may be required such that a completed Health and Safety Manual can be finally produced and handed to the Client by the PS/PC or other party in order that the Client has final documentation to satisfy the CDM Regulations and to enable the Client to operate and maintain the “Works” in accordance with HSE Legislation.

1.10 STANDARDS AND REGULATIONS

Provide all materials and works in accordance with the appropriate British Standard or Code of Practice and where no BS or CP is applicable the Agreement Certificate for the particular item.
Comply with all statutory instruments and regulations, relating to the area of the site current at the date of tender.

Comply with the requirements of the Local Authority Building Inspector.

Comply with all Statutory Obligations arising from current relevant legislation and regulations, together with other requirements, such as the following (see also particular specification sections).

- Relevant British & European Standards
- Relevant CIBSE design guides / commissioning codes / technical memoranda etc.
- Current Building Regulations
- Institution of Gas Engineers Publications / CORGI standards
- Current IEE Wiring Regulations
- HVCA Guides & Good Practice Notes
- Statutory Obligations
- Health and Safety at Work etc Act 1974
- Management of Health & Safety at Work Regulations 1999
- Gas Safety (Management) Regulations 1996
- Gas Safety (Installation and Use) Regulations 1998
- Public Health Acts
- Electricity Acts
- Electricity at Work Regulations 1989
- Factories Act 1961
- The Workplace (Health, Safety and Welfare) Regulations 1992
- The Construction (Design and Management) Regulations 1994
- The Construction (Design and Management) (Amendment) Regulations 2000
- The Health and Safety (Display Screen Equipment) Regulations 1992
- The Control of Substances Hazardous to Health (COSHH) Regulations 2002
- The Control of Substances Hazardous to Health (Amendment) Regulations 2003
- Control of Asbestos at Work Regulations 2002
- Personal Protective Equipment at Work Regulations 1992
- The Construction (General Provisions) Regulations 1961
- The Lifting Operations and Lifting Equipment Regulations 1998
- Other relevant Safety Regulations
- Water Supply (Water Fittings) Regulations 1999
- Relevant CIBSE design guides / commissioning codes / technical memoranda etc.

- Public Utility Company and/or Statutory Authority regulations, specifications, and requirements.
- British Standards and Codes of Practice.
- BS 7671 - Requirements for Electrical Installations (IEE Wiring Regulations).
- Insurance Company Requirements.
- LDSA Fire Safety Guides.
- IEC Standards.

Ensure all equipment and systems are installed in accordance with the relevant standards and that operational compatibility exists between the systems and any other system installed at the same location.

Any installation or parts thereof installed by the Contractor deemed by the Engineer to be untidy, installed incorrectly, or not in accordance with the above will be removed and correctly installed to the satisfaction of the Engineers at the Contractors cost. Any subsequent costs caused by abortive builders' works, making good, delay or disruption to other trades will be met by the Contractor.

In laying out the works, the Contractor shall at all times give proper consideration to the future maintenance of the plant and shall include for such component parts as are available from the manufacturer of the equipment or plant to ensure ease of maintenance.

1.11 TENDER DRAWINGS:

Tender drawings means drawings listed in within the appendix of this specification

The drawings provided (together with this Specification) are intended to provide sufficient information to enable tenders to provide estimates for the required work and provide the basis for working drawings. Not all items or matters referred to in the Specification are indicated on the drawings and similarly not all items detailed on the drawings are described in the Specification.

It is the responsibility of the tenderer for all materials, items of equipment, etc. necessary to provide a complete finished installation as intended and for offsetting and alteration of service runs to achieve co-ordination with the building and other services/equipment, etc.

The tenderer shall, upon request, be provided full access to all available relevant project drawings.

Claims for additional payment for alterations or additions to the works brought about by conflict between the works and building detail or other services will not be considered if the information was available to avoid such conflict prior to tender.

Unless previously advised by the Engineer the tender drawings are not intended for use as working drawings.

1.12 INSTALLATION / WORKING DRAWING:

The Contractor shall provide and prepare a full set of working drawings. The drawings shall be to a scale not less than the tender drawings. The working drawings shall be used to enable installation of the works and to enable other Contractors to produce coordinated working details

The main features of installation drawings should be as follows:

- Plan layouts to a scale of at least 1:50, accompanied by cross-sections to a scale of at least 1:20 for all congested areas. Dimensions shall be taken from site measurements where possible.

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

The Sub-Contractor should liaise with the Main Contractor to obtain Architectural/Structural Engineering Drawings.

The Contractor shall through the Main Contractor provide duplicate copies of all drawings for the Architect, other Service Contractors, Structural Engineer and Engineer at least 15 working days before work or fabrication commences.

The Contractor shall be fully responsible for any errors in these drawings whether or not approved by the Engineer. No additional costs will be payable as a result of error or as a result of lack of co-ordination between building detail and drawings or between services, and, in addition, all costs resulting from disruption to other trades as a result of error or oversight shall be born by the Contractor.

The tender drawings are not intended for use as working drawings. However, reproducible copies of the tender drawings will be made available upon request for use by the Contractor as a basis for preparing his working drawings. The Contractor shall take full responsibility for all details shown on the final working drawings.

A full set of drawings shall be kept on site in order that a record of all service runs, and changes to the working drawings can be maintained. These drawings shall form the basis for the “As Fitted” drawings.

1.13 BUILDER'S WORK DRAWINGS

Builder's work is excluded from the Subcontract. Builder's Work excludes drilling and/or plugging walls, floors, ceilings etc., for fixings of service, such work is included in the Subcontract.

The Contractor shall provide all information with regard to builders’ work in connection with the services as and when required. Provide fully dimensioned drawings showing both size and position of builder's work.

The Contractor shall be responsible for establishing at the start of the contract the nature of the information that will be required and for providing the information in whatever means that may be agreed.

Generally all items of builders work other than chases shall be detailed on drawings provided by the Contractor, the drawings shall be prepared in good time so as in no way to impair the progress of construction. 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).

1.14 AS-INSTALLED DRAWINGS:

The Contractor shall produce the “As Fitted” drawings which shall be based on the tender drawings and shall be equal in quality to the tender drawings.

Drawing shall show 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 / tender 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.

The drawings shall include all relevant information and shall exclude any information that is relevant only during tender and construction. Each drawings shall be clearly labelled “As Fitted Drawing” and shall bear the Contractors title block.

The Contractor shall maintain on site, a record of all changes to the tender scheme as works proceed so that “As Fitted” drawings can be produced immediately after the installation has been completed.

The Contractor shall submit one set of “As Fitted” drawings to the Supervising Officer for approval. Immediately following such approval, the Contractor shall forward to the Supervising Officer one set of drawings in reproducible form and/or on disc which shall be retained by the Client for record purposes.

Late production of the “As Fitted” Drawings will delay certification of the final account and completion.

1.15 PREPARATION OF DRAWINGS

Prepare drawings to commonly recognised scales generally on A1 sheets and details and schedules on A4 sheets.

Use symbols and line conventions in accordance with BS EN ISO 3766, BS EN ISO 7518 and BS EN ISO 11091 Recommendations for symbols and other graphic conventions.

Agree with the EA the document numbering/registration system to be used before preparing any documents.

1.16 DIMENSIONS:

Where installations are dependent upon site dimensions ensure that these are available before proceeding with the Works.

Do not take dimensions by scaling from the drawings. Where dimensions are indicated on drawings check these on site, as appropriate, to ensure building construction and manufacturing tolerances can be accommodated.

Do not order or manufacture equipment using dimensions indicated on the Tender drawings, specification or schedules.

Where setting out is undertaken by the Main Contractor check its accuracy and obtain his approval before proceeding with the work.

1.17 MANAGEMENT OF THE WORKS

The Contractor must, during the construction of the works, engage a competent foreman on site to supervise the work, whose identity shall not be changed without the written agreement of the Supervising Officer.

The foreman must be capable of taking decisions and receiving instructions which are binding on the Contractor.

1.18 LIAISON / COOPERATION

Co-operate with the Contractor, other subcontractors, suppliers, local authorities and statutory undertakings in the execution of their work.

The Main Contractor shall be responsible for coordinating the works of all Sub-Contractors. Under the direction of the Main Contractor, the Contractor shall fully liaise with all other trades whilst preparing working drawings and whilst installing the works.

Before carrying out any work on, or making connections to, any plant or equipment supplied by others, the Contractor shall verify the exact position and nature of the equipment on site with the appropriate Contractor or Supplier and shall take into account and accommodate positions of services and connections installed by other trades.

The Contractor shall ascertain the exact position of all switches, socket outlets, radiators, etc. and to verify the positions of any fixed furniture, or special finishes, the swing of doors, tile layouts and any other such like factors which may affect the arrangement of the works.

1.19 PROGRAMME & PROGRESS:

Provide detailed services programs to assist the Contractor in producing a Master Program for the Contract Works.

Due allowance is to be made in the program(s) for the Works for, but not limited to, the following:

- Ordering and installation periods.
- The completion of drawing, etc. including the minimum working days for comment 14 working days.
- Work resulting from instructions issued in respect to the expenditure of provisional sums.
- Concurrent work by other trades.
- Any temporary works necessary for the completion of the engineering services installations.
- Pre-commissioning, commissioning and performance testing of the engineering services installations.
- Preparation and provision of Record Drawings and Operating and Maintenance Manuals.

Provide a separate and detailed commissioning program for agreement with the EA. Make due allowance for the following:

- Commissioning, demonstration and instruction procedures.
- Provision of written notice before each (or series of) test, inspection, commissioning or demonstration procedures are to be carried out, not less than ten working days
- Demonstration to the EA that test instruments and equipment are accurate.

Record progress of the Works weekly on a copy of the program kept on site. Update or redraft program if any circumstances arise which affect the progress of the Works.

1.20 STATUTORY AUTHORITIES / UTILITIES

Orders for the incoming services may be placed by the Subcontractor. Include within the tender for all time / resources associated with liaison / placing orders

Liaise with the Statutory Authorities and provide any test notices required to ensure final connections are made in accordance with the requirements of the testing and commissioning program.

1.21 DELIVERY / HANDLING / STORAGE

Provide adequate and safe protection for all materials and products during transport to site.

Deliver all tubes, conduit, trunking and associated equipment with open ends effectively plugged, capped or sealed.

Offload and transport about the Works all materials and products as recommended by manufacturers.

The Contractor shall ensure that the condition of all materials and equipment is maintained during the course of the Contract and that no damage, corrosion, soiling or deterioration of any kind affects the materials or equipment

Store all materials and products as recommended by manufacturers. Provide sufficient, safe and secure storage for all materials and products. Provide racks to prevent distortion for storage of conduits, pipes and similar materials.

Store all fittings, accessories and sundry items in clean bins or bagged and stowed in racks and maintained under suitable weatherproof cover.

1.22 PROTECTION OF THE INSTALLATION

Provide adequate and safe protection for all materials and products after installation. Check regularly the protection provided after installation of equipment and inform the Main Contractor if inadequate.

Install items such as grilles, diffusers, lighting fittings, switches, accessories etc. as near to completion as practicable. Only install filter media when the plant items concerned are being commissioned and tested.

Protect during erection all easily damaged materials with hardboard covers or heavy duty polythene sheet. Such items include but are not limited to control panels, switchboards, distribution boards.

Cap all open ends of pipes, ducts, conduit and trunking etc except when being worked upon. Leave plant and equipment in a ready to paint condition where specified as part of the Works or to be carried out by others.

Leave plant and equipment in a ready to paint condition where specified as part of the Works or to be carried out by others. Paint parts liable to corrosion immediately after removal of any temporary protection.

Replace material, plant or equipment where deterioration or damage has occurred prior to handover.

The Contractor shall be responsible for ensuring that proper precautions are taken to protect the building and its contents where naked flame is used in the course of the installation, commissioning or testing.

Ensure that fire extinguishers, fire blankets or other devices required by the local Fire Officer are available in areas where such hazards exist.

1.23 COVERING UP

Ensure no section of the Works are covered, concealed, or insulated until inspected and completion of a witnessed satisfactory test.

Give notice when Works which are to be covered or concealed are ready for examination and/or measurement of not less than 7 days.

1.24 TESTING AND COMMISSIONING

The Contractor shall ensure that the whole of the works are complete, tested and commissioned before the final inspection is carried out by the Engineer.

The Engineer will not certify completion until all works under the Contract have been completed, tested and demonstrated to his complete satisfaction.

Agree a program for pre-commissioning checks, setting to work, commissioning and performance testing, and allow for all costs incurred. Compile a detailed commissioning program and confirm/agree with the main contractor.

Appoint an "approved engineer", to supervise the whole of the testing, commissioning, performance testing and instruction of client's staff.

Provide a written statement to the Engineer confirming that each installation has been correctly tested and commissioned and that the performance requirements can be achieved.

Demonstrate to the Engineer that all system components are operating correctly, and the completely integrated installation will function in accordance with the specified performance requirements.

Where required, provide formal method statements supported by risk assessments detailing all commissioning procedures.

Provide all necessary facilities to enable tests to be witnessed and inspections carried out either on site or at manufacturer's works.

Test all equipment, material and systems as detailed in Sections. If an inspection or test fails, repeat the procedure, until satisfactory results are obtained.

Complete all tests before any paint, cladding or similar materials are applied or before services are concealed.

Ensure all requirements such as cleanliness, protection from harmful external and internal elements
etc. are provided prior to commencement of commissioning.

Provide test equipment subject to a quality assurance procedure complying with BS EN ISO 10012.

Do not start performance testing, including system demonstration, system proving or environmental and capacity testing, until commissioning of the system is completed to the satisfaction of the Engineer.

Maintain on site full records of all commissioning and performance testing, cross referenced to system components and on completion of the Works include a copy in each Operating and Maintenance Manual.

Provide all certification documents for approval before any system is offered for final acceptance.

Where a test indicates non-compliance with the Specification submit immediately details of the non-compliance and proposals for corrective action.

Arrange access for personnel who require to be in attendance, to manufacturer's or other off site premises when any inspections and tests carried out.

Following satisfactory completion of testing and when the installations are in a safe and satisfactory condition, set to work, regulate and adjust, as necessary, to meet the specified design requirements.
Provide all necessary instruments and recorders to monitor systems during commissioning and performance testing.

1.25 PRACTICAL COMPLETION

When the Contractor is confident that the works are complete, he shall inform the Main Contractor whereupon an inspection will be carried out by the Engineer and a list of outstanding and/or remedial works prepared. The Contractor shall attend to all items noted immediately in order that the installation is completed to the Engineer's satisfaction before the handover date.

Practical Completion will not be achieved until works are complete to the satisfaction of the Engineer and all testing and commissioning is satisfactorily completed.

When the Engineer is satisfied that the Works are complete he will, through the Main Contractor notify the Supervising Officer accordingly and a Practical Completion Certificate will be issued to the Main Contractor by the Supervising Officer.

Failure by the Contractor to comply with these requirements will delay completion and may result in a claim by the Client for non-completion.

Systems may not, without the prior written approval of the EA be used before Practical Completion. Systems to be used before practical completion for the benefit of the Contractor and/or Subcontractor must have all defective consumable elements (including lamps and tubes) replaced by new not more than seven days prior to Practical Completion.

1.26 FINAL INSPECTION AND HANDOVER

Upon completion of all outstanding works and/or remedial works the Contractor shall notify the Main Contractor that all works are ready for handover.

A final inspection will then be carried out at an agreed date to suit all parties. The inspection will be carried out by the Engineer or his representative and a responsible representative of the Contractor shall be present. If the work has been completed to the satisfaction of the Engineer or his representative, a Handover Certificate will be issued.

1.27 OPERATION AND MAINTENANCE INFORMATION

To satisfy the provisions of the Health and Safety at Work Act the Employer will not accept handover of the installations until full and adequate information concerning the installations is

in the possession of his operating and maintenance staff. Failure to comply with this requirement will delay handover.

O&M information shall include:

- Record Drawings and Schedules.
- Operating and Maintenance Manuals.
- Blank maintenance logs.
- Log book

Prepare manuals in draft as the Works progress and make suitable arrangements where the Works are subject to Partial Possession or Sectional Completion.

Prepare two temporary Manuals with provisional record drawings and preliminary performance data available at commencement of commissioning to enable Employer's staff to familiarise themselves with the installation. These should be of the same format as the final Manuals with temporary insertions for items which cannot be finalized until the installations are commissioned and performance tested.

Manual shall comprise the information detailed in the technical section of the Specification.

Provide attendance, at no expense to the Employer, to put into service, operate 24 hours a day and maintain the systems to the Employer's requirements, including the provision of suitable competent labour, in the event that the Record Drawings and/or Maintenance Manuals are not available when the Works would, in the opinion of the EA, otherwise qualify for Practical Completion.

In the event of the Subcontractor failing to provide this service satisfactorily the Employer shall be entitled to make his own arrangements and recover the full cost through the Contract.

1.28 TRAINING OF EMPLOYER'S STAFF:

Before practical completion explain and demonstrate to the Client the purpose, function and operation of the installations including all items and procedures listed in the Operation and Maintenance Manual:

1.29 DEFECTS LIABILITY PERIOD:

The defects liability period shall be 12 months unless stated otherwise in the Main Contract documents.

Prepare and submit records of failures or malfunctions of any part of the Subcontract Works during the Defects Liability Period, together with details of remedial action taken, subsequent re-testing and the results.

Notify the Main Contractor of damage, failures or malfunctions to the Subcontract Works demonstrably caused by incorrect operation of the installations, vandalism or other actions by a third party.

Inform the CA, via the Main Contractor, in writing when all defects are finally rectified so that an inspection may be carried out prior to the issue of a Final Certificate.

SECTION 2

STANDARD MECHANICAL SERVICES SPECIFICATION

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2.1 PLANT & EQUIPMENT

2.1.1 HEATING BOILERS

All boilers shall be positioned on a concrete plinth positioned to afford adequate access space for on-going maintenance, repairs and replacement. Packaged boilers shall also incorporate a fabricated baseframe. Boilers shall be installed strictly in accordance with the manufacturer's recommendations so as not to infringe or curtail the maker's guarantee.

Where boilers are of sectional construction requiring on-site erection, such erection work shall be carried out to the manufacturer's instructions by Specialist Engineers approved by the manufacturer and shall include hydraulic pressure testing and flushing of the erected boiler before final pipework connections are made.

All boiler assemblies shall include all necessary control and safety devices.

Where multiple boilers or modules are coupled, each shall be provided with isolating valves on flow and return connections, separate isolation of fuel source and where used with a static open feed and expansion system, separate open vent connections routed through three port vent cocks to a common open vent riser.

All water boilers shall be fitted, as a minimum, with an adjustable control thermostat and a hand reset limit thermostat. Where necessary the limit thermostat shall be separately fitted in the boiler flow outlet pipe before the isolating valve.

All steam boilers shall incorporate combustion and water level control equipment to conform with requirements for unattended operation.

Boiler Mountings - Water Boilers :

All water boilers shall be fitted with the following mountings in addition to anything other described in the Particular Specification or on the relevant drawings:-

- Thermometer.
- Altitude gauge with cock.
- Enclosed pattern safety valve fitted with padlock and a copper discharge run clear of any insulation to terminate 150mm above F.F.I. with birds beak.
- Drain cock.

Boiler Mountings - Steam Boilers

All steam boilers shall be fitted with the following mountings in addition to anything other described in the Particular Specification or on the relevant drawings:-

- Steam space pressure gauge with syphon and cock.
- Feed water check and isolating valve.
- Blowdown valve and drain.
- Enclosed pattern safety valve with locked setting and discharge routed to high level external position. Where applicable a small bore drain shall be piped from the valve discharge to obviate seat erosion.
- Two sets of water gauge fittings complete with gauge glass protectors, isolating cocks and drains.
- Set of automatic water level controls including high and low water audible and visual alarms.
- Main steam angle pattern crown valve.

2.1.2 DIRECT GAS FIRED STORAGE WATER HEATERS

All direct fired water heaters shall be mounted on builder's work concrete bases to the dimensions recommended by the unit manufacturer, positioned to afford adequate access space for on-going maintenance, repairs and replacement.

Unvented direct fired water heaters shall be installed with all necessary safety and control equipment .

Direct gas fired storage water heaters shall be of the type, size and capacity described in Section 3 of this Specification and/or as shown on the drawings.

All units shall include a sacrificial anode rod to afford corrosion protection and where the shell is constructed of anything other than copper, dielectric nipples at each pipe connection.

Atmospheric gas burners shall be fully automatic including auto ignition or where permanent pilot is specified, piezo ignition, together with facilities for external time control. All usual safety and control devices including adjustable control thermostat, hand reset limit thermostat and flame failure shut-off shall be included.

Flue systems for direct fired water heaters shall be as specified elsewhere.

Mountings and connections shall be as specified for hot water storage calorifiers with the addition of de-stratification pumps/controls where recommended by the unit manufacturer.

2.1.3 HOT WATER STORAGE CALORIFIERS – VENTED SYSTEMS

Hot water storage calorifiers shall be of the type and configuration described in Section 3 of this Specification and/or as shown on the relevant drawings and shall conform to the requirements of BS 853, 1990.

In all other than hard water areas, calorifiers shall be manufactured from hard rolled pure copper sheets with brazed seams and connections. Heater battery/coil shall also be of copper. In hard water areas, construction shall be from galvanised steel. All water heating vessels shall include a sacrificial anode.

All calorifiers shall have a flanged and bolted head. Connections up to and including 50mm n.b. shall be screwed b.s.p.t., connections of 65mm and above shall be flanged to BS 4504 all extended to clear insulation finish.

All calorifier shells shall have the following mountings/fittings.

- Safety valve to BS 6759 Part 1 (min size 20mm) with discharge piped to low level.
- Bursting disc to BS 2915 with discharge piped to safe location. (This facility is only required where primary waterheating operating pressure is greater than the calorifier shell design pressure. Not applicable to steam heated equipment).
- Vacuum breaker sized at 0.25 x cross section area of largest outlet.
- Drain valve
- Thermometer
- Altitude gauge and cock
- Pocket for temperature control sensor
- Secondary flow outlet isolating valve (fitted after open vent take-off).
- Secondary return isolating valve and non-return valve.
- Secondary cold water feed isolating valve
- Boss or flanged pad for electric immersion heater as specified.
- Inspection manlid.

Primary heating connections shall incorporate the following:-

- Isolating valves, unions/flanges etc., arranged to permit the removal of the heating element with minimum disruption.
- Temperature control valve sensing secondary storage temperature.
- Over-ride safety limit shut off valve where primary heating temperature is above 100°C.
- Thermometers on primary flow and return connections
- Pressure gauge with syphon and cock on steam heated primary flow.

Vertical calorifiers shall be mounted on a builder's work concrete base. Horizontal calorifiers shall be supported on purpose made cradles with an inert liner between the cradle and the calorifier shell. Cradles shall be either wall mounted or bolted to a builder's work concrete base.

All calorifiers shall be positioned so as to afford adequate working space around the unit for on-going maintenance and repairs including removal and replacement of primary heater where applicable.

2.1.4 HOT WATER STORAGE CYLINDERS – UNVENTED SYSTEMS

Unvented cylinders shall be of vertical configuration and constructed from either copper or lined mild steel as required by Section 3 entirely in accordance with BS 7209, 1990. Cylinders shall be factory pre-insulated and shall incorporate an internal aluminum protective rod.

Unvented domestic hot water cylinders shall be of the size and capacity described in Section 3 of this Specification and/or shown on the drawings.

The cylinder manufacturer shall also supply as part of a complete package the following safety and control equipment which shall be fitted as directed by the manufacturer. Where available, the equipment shall be obtained from the relevant heater manufacturer.

Safety devices:-	For heaters of 15 litres capacity and below: Temperature relief valves to BS 6283 Part 1 **and** Combined Temperature and Pressure relief valve to BS 6283 Part 3 both complete with piped discharge incorporating an air-break tundish. For heaters of more than 15 litres capacity: Combined Temperature and Pressure relief valve to BS 6283 Part 3 complete with piped discharge incorporating an air-break tundish.
Control devices:-	Pressure reducing valve as BS 6283 Part 4 on cold water feed. Check valve as BS 6282 Part 1 on cold water feed. Expansion valve as BS6283 Part 1 on branch from cold water feed and including a piped discharge with air-break tundish. Expansion vessel as BS 6144 on branch from cold water feed. Temperature control valve fitted to primary heating connections with immersion sensor in cylinders. (Where applicable).

All isolating and drain valves shall be incorporated as required for indirect cylinders. The cold water feed isolating valve must not be fitted between the cylinder and the expansion valve. Unvented cylinders shall be installed as described for indirect cylinders. Connections to units of non copper construction shall include dielectric interface nipples.

2.1.5 CIRCULATION PUMPS

Pipeline mounting pumps shall be supported on purpose made steel platforms incorporating suitable anti-vibration material or mountings.

Floor mounting pumps shall be fitted with holding down bolts supplied by the Contractor, and shall be located onto purpose build builder's work concrete bases.

All circulating pumps shall be installed such that they do not impart any mechanical vibration to either the fabric of the building or to the relevant pipework system.

The Contractor shall supply purpose manufactured compressed impregnated machinery cork to the correct size and 50mm thick for insertion within the concrete construction.

Purpose made flanged or screwed anti-vibration bellows shall be fitted on the suction and discharge side of each individual pumping unit.

Where pumps are fitted in parallel duplication each pump shall be fitted with an isolating valve on the suction connection and a non return valve and isolating valve on the discharge connection.

Where pumps are fitted in series duplication an isolating valve shall be fitted to the suction end of the set and to the discharge end of the set. A loose piece of pipe equal in length and connection type to a single pump, shall be provided and fitted on a purpose made holding bracket beside the pumpset.

Where pumps are fitted on a by-pass, the branches from the main shall be made with an easy sweep and a non return valve shall be fitted in the main between the suction and delivery connections.

Where pump connections differ from the specified pipework sizes, purpose made taper pieces shall be provided at the pump connection. All surrounding valves, strainers etc. shall be to pipeline, not connection, size.

All individual pumps are to be fitted with either flanged or union joints to enable individual removal and replacement. Drain valves shall be provided between pump isolation valves to enable pump replacement without system draining.

The suction and discharge connections to each pumpset shall each be provided with a pressure gauge with loose red pointer and cock as specified elsewhere.

Each pump unit shall be provided with a driving motor suitable for the available electrical supply and the applicable working environment.

If pump bodies incorporate a gland drain connection, this shall be piped, in galvanised tubing, to discharge over the nearest gully. Care shall be taken to ensure that the shaft orientation of glandless pumps conforms with the relevant manufacturer's recommendations.

All pumpsets shall be fitted with an engraved plate bearing the working pump duty.

2.1.6 OIL STORAGE AND DISTRIBUTION

All oil storage and distribution systems shall be manufactured and installed generally in accordance with the requirements of BS 799 and The Control of Pollution (Oil Storage) (England) Regulations 2001.

A weight operated fire valve shall be provided at the position where the oil line enters the boiler house. This shall be controlled by a fusible link system, with a fusible link above each oil burner and a quick-release device at the entrance to the boiler room. Provide all necessary wire, pulleys, supports, warning notices etc., to form a complete installation. Wire shall be stranded steel and the pulleys of not less than 33mm diameter shall be provided at all changes of direction.

The position of fusible links shall be agreed before fixing.

Where cable runs are likely to be too complex an alternative system using electronic sensing to a solenoid release above the fire valve is to be used.

Oil storage tanks are to be hoisted and installed by the Contractor who shall provide a damp-proof membrane between the tank bottom and the piers. The piers will be provided by the Main Contractor to the Contractor's drawn and approved details. All tanks shall be installed with a 1 in 48 slope down from the outflow end to its drain/sludge connection.

Oil storage tanks are to be provided with the following as a minimum:-

- 500mm diameter manhole with bolted cover. (When the nominal capacity exceeds 4,580 litres)
- Calibrated dip-stick or tape
- Oil contents gauge, graduated to read the usable quantity of oil specified
- Where the filling point is remote from the tank, an audible high level alarm is specified
- Vent pipe terminating in the open air, and fitted with an approved terminal cap
- Filling pipe, terminating in fullway valve, brass cap and chain, located in purpose made fill-point box with door and drip tray
- A non-corrodible plate at filling point, approximately 250mm x 100mm clearly marked to show the grade of oil to be used
- Sludge valve with plug
- Outlet valve
- All necessary screwed B.S.P. thread bosses for the above connections.

Where dictated by limited access, or when specified in Section 3 of this Specification, allowances must be made for a specialist tank manufacturer to weld the tank in position, on the site. It should be noted that seams must be welded inside and outside.

The oil pipe shall be in black heavy gauge mild steel tubing with malleable iron fittings where exposed and welded joints where laid in ground. The oil pipeline to be installed between the tank outlet valve and the oil burners, shall have plugged tees at all changes in direction, to facilitate cleaning.

Where laid in ground, pipes are to be coated with Denso priming paste and then wrapped with two layers of standard Denso tape.

Where laid in boiler room floor ducts the Contractor shall supply 10mm thick mild steel diamond tread chequer plating duct covers with provision for easy lifting and substantial mild steel bearers.

The connections to each oil burner shall be made in flexible tubing and shall be provided with a filter and stop valve.

Where a heavier grade of fuel oil than either Kerosene or Gas Oil is to be used a twin type filter shall be incorporated in the oil supply lines as near as possible to the tank outlet valve. This twin filter shall be in addition to the individual burner filters.

All filters shall have metal bodies and the filter screen of appropriate gauge for the fuel in use.

Tank outflow heaters, oil line tracer cable heating and insulation are to be as specified in Section 3.

2.1.7 COLD WATER STORAGE TANKS

All tanks to store cold water for domestic purposes shall be constructed to conform with the requirements of the relevant water supply authority for potable water storage under the Water Supply, Water Fittings Regulations.

Cold water storage tanks shall be of the construction and dimensions or nominal capacity identified on the drawings or as described in Section 3 of this Specification.

Tanks shall be fully thermally insulated either by virtue of composite construction or by the application of insulating materials as specified elsewhere.

As far as is practicable all major connections to tanks shall be made using manufacturer's tappings. Where on-site tappings are unavoidable, holes shall be clean cut and treated. Connections shall be by longthread tank connectors with flanged backnut and locknut. Sealant shall be non-hardening suitable for use with potable water.

Unless specified to the contrary, structural supports for cold water storage tanks will be provided and fixed free of cost to the Contractor. Where the supports are steel beams for steel tanks, the Contractor shall ensure that hardwood bearers of the same dimension as the steelwork face and of equivalent thickness to the tank insulation, are provided and fitted beneath the tank.

Composite construction tanks shall be supported by a marine quality plywood platform of dimensions conforming with the plan size of the tank.

Where the underside of a tank cannot be insulated, a purpose made drip tray shall be fitted beneath the tank to guard against condensation drips. A minimum gap of 300mm must be maintained between the underside of the tank and the drip tray.

All supplies to tanks shall be controlled by a float operated valve of low or high pressure type dependant upon the supply conditions and fitted with a copper float on an adjustable drop arm.

All storage tank outlet connections shall be individually valved. As a minimum requirement, each tank shall have the following tappings/connections.

- Make-up water connection for float operated valve
- Overflow connection of 2 times the bore of make-up or 32mm whichever is the greater and fitted with insect screen
- 22mm tell-tale overflow if tank capacity is greater than 1000 litres, or if main overflow discharges in a concealed position. Tell-tale to be fitted with insect screen.
- Drain connection in base of tank of same size as main overflow, piped to gulley position
- Outlet connection from side of tank
- Three temperature probe monitoring pockets, one at outlet level, one just below high level water mark and one equidistant between.
- Screened vent
- Sealed inspection access over float valve

Further tappings shall be provided as required to meet the requirements of Section 3 and/or the drawn details.

2.1.8 FLUE SYSTEMS

Appliance flue outlets shall be connected to vertical chimneys be means of purpose made flue pipework and fittings. In all cases, supports shall be arranged such that no flue weight is taken on the appliance.

Flues for pressurised combustion equipment or where fan assisted flues are used, e.g. condensing boilers, shall be twin wall, 304 grade stainless steel, with insulated annulus and flanged linear joints, clamp band casing joints.

Flues for pipework at negative to zero operating pressure on atmospheric gas or oil fired appliances shall be twin wall, 304 grade stainless steel, with insulated annulus and socket/spigot liner joints, clamp band casing joints.

Care shall be taken in laying out and grading flue pipework to ensure the removal of internal moisture. All gas fired installations shall incorporate a drain tee with trapped UPVC drain tube run to a convenient discharge position.

Clean out doors shall be provided at necessary locations to enable efficient maintenance and inspection of the plant to be carried out.

Flue pipework bracketing shall generally conform with the relevant manufacturer's recommendations. In all cases due allowances shall be made for expansion movement. Brackets fitted in internal locations shall be painted gloss black, external bracketing shall be either stainless steel or galvanised finish.

All flue passing through fire compartment divisions shall be fitted with the manufacturer's purpose made fire stop closure plates.

2.1.9 CLOSED FEED AND EXPANSION UNITS

Closed feed and expansion units shall be of packaged design including a cold water break tank with float controlled mains cold water feed inlet valve incorporating a Class A air gap, duty and standby pressure pumps and control equipment all mounted within a single cabinet, together with the specified number and size of expansion vessels each with diaphragm separation of system water and fixed volume air cushion.

The controls package shall include as a minimum, pressure sensors for pump on-off control and no-volt contacts for both high and low pressure alarm. Further controls and alarms shall be as specified in Section 3 of this Specification.

The link line from the pumpset to the system shall include a non return valve at the pump discharge, a tee connection to the expansion vessel(s) and 2 metre high anti-gravity loop with auto air vent at high point and isolating stop valve at the system connection. Unless specified to the contrary, the system connections shall normally be made into the suction side of the main circulation pumpset.

The systems served by a closed feed and expansion unit shall include the following:-

- Full bore air purger with auto air vents, fitted into main system flow pipe.
- Quick-fill tee connection into system return incorporating a stop valve with loose flexible hose and union connectors. A corresponding stopcock with double check valve shall be provided from the mains cold water system adjacent to the quick-fill point. The size of the quick-fill facility shall be as specified but not less than 20mm n.b.

Where a pressurised system is installed, the Operating and Maintenance Manuals shall include a written scheme for the periodic examination, by a competent person, of those parts required to be so considered under 'The Pressure Systems and Transportable Gas Containers Regulations'.

2.1.10 TEMPERATURE AND PRESSURE MEASUREMENT

Unless specified to the contrary, facilities for the measurement of system operating temperature and pressure shall be provided at the following locations in addition to other places particularly described elsewhere.

Equipment	**Required Temperature / Pressure Measurement Provision**
Heat Generating Plant, Chiller Plant, Direct DHWS Heaters	Both temperature and pressure gauges shall be mounted directly to the appliance where such facilities exist, or as close as possible on the main outlet pipework. A thermometer shall also be fitted as close as possible to the appliance return/intake connection. On open vented applications, an altitude gauge shall be substituted for the pressure gauge.
Steam to Water Calorifiers	A pressure gauge shall be fitted to the primary flow connection. Secondary water-side gauges shall be as for Heat Generating Plant.
Water to Water Calorifiers. (incl.. DHWS)	A thermometer shall be fitted to the primary flow connection pipework adjacent to the appliance (downstream of any automatic control device). Secondary water-side gauges shall be as for Heat Generating Plant.
Circulating Pumpsets	Pressure gauges shall be fitted to suction and delivery pipework. Where duplicate pumps are fitted the gauges shall be fitted to the combined suction and delivery pipework.
Pressure Vessels, Compressed Air Receivers, Vacuum Tanks.	A Pressure/vacuum gauge shall be fitted direct to the equipment.
Pressure Reducing Station.	Pressure gauges shall be fitted locally both upstream and downstream of all reducing valves.
Three-port Motorised Control Valves.	A combined temperature and pressure test point shall be fitted into the pipework adjacent to each port of each valve. Test points shall be of the Twin-seal, self sealing type complete with captive removable dustcap as IHL Twinlock.
Water to Air Heater Batteries.	A combined temperature and pressure test point shall be fitted into the pipework adjacent to each flow and return connection.

<u>Temperature Gauges</u>

Temperature gauges shall be 100mm dia dial type mercury in steel. Cases shall be brass, without flange if of rigid stem, direct mounting pattern or with backing flange for board mounting if of capillary remote type.

Calibration shall be in degrees Celsius with a black pointer and clear black lettering on a white background. Ranges shall be selected such that the normal working temperature occurs at the 2/3 position of the scale. Divisions shall be not more than 5°, not less than 2°. The dial shall bear the Maker's name.

Direct mounting gauges shall have bottom entry if for horizontal pipework or rear entry for vertical pipework. The gauge face shall be fitted in the vertical plane unless directed otherwise by the Engineer. Direct mounting shall generally be used except in cases where accessibility impedes direct observation or where equipment vibration might damage the instrument. Where remote instruments are used, they shall be mounted using brass round headed screws onto polished hardwood boards secured to the building fabric in an agreed location.

All thermometer bulbs shall be housed in the manufacturer's stainless steel pockets fitted to the pipeline with a BS 21 pipe thread. Before fitting the thermometer bulb, each pocket shall be charged with non melting, heat conducting grease. Pockets shall be fitted to penetrate to a depth equal to 75% of the pipe bore or if over 100mm nominal bore, 80mm. In pipework 50mm n.b. and below, the pipe in the immediate vicinity of the pocket shall be increased by a minimum of 12mm nominal to obviate flow restriction.

Capillary tubing for remote instruments shall be of the correct length and have an armoured sheath. Capillary tubes shall be installed without kinks or twists and be neatly and securely clipped. They shall have radiused bends to a minimum of 50mm pulled around a former for consistency and shall be routed, as agreed with the Engineer, for minimum risk of damage .

Altitude Gauges, Pressure Gauges, Vacuum Gauges

Altitude Gauges, Pressure Gauges, Vacuum Gauges shall be 100mm dia dial, bourdon tube type to BS1780.

Direct mounting shall generally be used except where accessibility impedes direct observation or where equipment vibration may damage the instrument. Where remote gauges are used, they shall be mounted using brass round headed screws onto polished hardwood boards secured to the building fabric in an agreed position.

Cases shall be brass without flange if for direct mounting or with backing flange if for remote board mounting. All gauges shall be fitted with dials in the vertical plane and have bottom entry connection fitted with a brass gauge cock with ebonised hand lever.

Gauges fitted to steam services shall also incorporate a syphon, of either 'U' or ring pattern, charged with water, fitted between the gauge cock and the service pipeline.

Calibration of altitude gauges shall be in metres head of water, pressure gauges in bar or millibar (gauge) and vacuum gauges in millimetre of mercury (gauge). Dial faces shall be in white with clear black lettering, pointer shall be black. Altitude gauges shall incorporate a loose red pointer set to the operating static head of the system. Where pressure gauges are intended to measure a fixed working pressure, they shall also incorporate a loose red point set to the relevant reading. All dial faces shall carry the name of the Gauge Manufacturer.

Capillary tubing for remote instruments shall be run in small bore soft temper copper of the correct length, installed without kinks or twist, neatly and securely clipped. Bends shall be radiused to a minimum of 50mm, pulled around a former for consistency and shall be routed, as agreed with the Engineer, for minimum risk of damage.

2.1.11 RADIATOR HEAT EMITTERS

Radiators shall be provided of the make, type and size as described in Section 3 of this Specification and/or shown on the drawings.

Radiators shall be arranged with bottom opposite end flow and return connections, the flow fitted with a union wheel radiator valve, the return with a union lockshield radiator valve. Valves shall be of the angle or straight pattern as dictated by the individual arrangement. An air venting plug shall be fitted in the top corner connection at the return end of the radiator.

Unless indicated to the contrary, radiators shall be fitted at least 225mm clear of floor finishes. Where pipework is fitted below radiators there shall be a space of 100mm below the lowest pipe and a space of 75mm between the topmost pipe and the bottom of the radiator. No radiator shall project above the underside of any window-cill.

All radiators shall be fitted on the manufacturers brackets properly secured to the building fabric. Where applicable, anti-squeal inserts shall be fitted between the radiator lugs and the hanging brackets.

Pre-finished radiators shall be protected by the Contractor against damage and marking once fitted by adapting the manufacturer's packing to suit or encasing in cardboard sheeting. Protection shall be completely removed immediately prior to final handover.

Where radiators are to be finally decorated by others, they shall be left fitted by the Contractor in a clean and un-marked condition. When required, radiators shall be un-coupled and dropped, to allow the decoration of the rear of the heater and the wall behind, and subsequently re-fitted, filled and re-vented.

Before ordering, the Contractor shall verify the available height and length at each radiator position and clarify any anomalies with the Engineer.

2.1.12 FAN CONVECTOR HEAT EMITTERS

Provide fan convector heaters of the make, type and size as described in Section 3 and/or shown on the drawings.

Floor standing fan convectors shall be mounted on a builder's work timber plinth of a height to suit the adjacent skirtings and secured back to the wall.

High level and ceiling mounted heaters shall be independently hung from the building structure using threaded drop rods fixed in accordance with the heater manufacturer's recommendations.

Fan convectors shall be provided with a wheel union valve on the flow connection and a lockshield union valve on the return.

Where fan convectors are exposed to view, the valves shall be contained within the unit casing. Where fan convectors are fully concealed above ceilings etc, valves may be outside the heater casing.

Provide key operated air vent cock extended to an accessible position, and where at the low point of its feed pipework, a drain cock.

Floor and wall mounting conventional air flow fan convectors shall have in-built thermostats to control fan speed off/low and low/medium.

Horizontal mounting and reverse air flow vertical mounting fan convectors shall have remote room thermostats to control fan speed off/low and low/medium. Alternatively, when specified, all fan convectors may have proportional speed control.

All fan convectors shall incorporate an in-built thermostat to inhibit fan operation during low water temperature conditions and a discreet summer/winter switch to enable fan operation in summer mode irrespective of thermostat dictates.

All fan convectors shall incorporate a washable type air filter located immediately behind the air intake grille/aperture.

Once fitted fan convectors shall be protected by the Contractor from damage or marking. Protection shall be either by use of the manufacturer's packaging, suitably adapted, or encasing in sheet cardboard. All protective coverings shall be completely removed immediately prior to final handover.

2.1.13 UNIT HEATERS

Provide unit heaters of the make, type and size as described in Section 3 and/or shown on the drawings.

Fans shall be of the axial type where no external static pressure capability is required and centrifugal type where external or ductwork resistance is applied. All fans shall be fully guarded.

All unit heaters shall be independently suspended from the building fabric using drop rod hangers, cleats and bearers as necessary in accordance with the relevant manufacturers recommendations.

Flow and return connections to unit heaters on hot water systems shall be individually valved with a wheel valve on flow and a lockshield valve on the return. An air bottle with manual release and spit pipe shall be provided on each flow connection adjacent to the heater and a drain tee and cock interposed between the heater and the return lockshield valve.

Unit heaters fitted on steam systems shall be individually isolatable with a wheel globe valve on inlet and a wheel gate valve on condensate outlet. All steam fed heaters shall be individually trapped, using high capacity float type traps.

The fan operation of unit heaters shall be either individual or group controlled from a space mounted temperature sensor as specified in Section 3. Each unit heater shall be supplied by the Contractor with a coil operated contactor suitable for remote switching.

Except where connected to distribution outlet ductwork, all unit heaters shall incorporate an outlet louvre with individually adjustable blades.

2.1.14 PIPE COIL HEAT EMITTERS

Pipe coil heat emitters shall be of the size and configuration shown on the drawings and/or described in Section 3.

Each pipe coil shall be individually valved on flow and return connections with unions on coil side.

Pipe size changes between connections and coil shall be achieved using eccentric sockets, bottom eccentric at flow end, top eccentric at return end. An airlet plug shall be fitted to each pipecoil at the return end high point and a drain cock at the low point.

Pipe coil supports shall be generally be single split pipe rings with either hanger drop rods, floor plated floor supports or back plated wall supports dependant upon location. Details shall be agreed fully with the Engineer before fixing commences.

2.1.15 FANS

Provide fans of the make, type and size described in Section 3 and/or shown on the drawings.

All fans shall be supplied complete with an electrical drive motor either direct coupled or with belted drive train as specified.

With belt driven fans the motor and the fan shall be mounted on a common base frame and adequate provision shall be made for accurate belt tensioning adjustment. A spare drive belt set shall be supplied with each belt driven fan.

Standby motors either coupled or loose shall be provided where specified in Section 3.

All fans shall be of substantial construction using materials compatible with the service air conditions. All rotating parts shall be accurately balanced to eliminate vibration.

Fans shall be fully isolated from the ductwork system and the building fabric by means of properly selected anti-vibration mountings, flexible ductwork couplings, anti-vibration hanger brackets etc.

The Contractor shall allow for one pulley/drive train change on constant speed belt driven fansets during final commissioning.

2.1.16 PLANT & EQUIPMENT LABELLING

All plant and equipment, e.g. boilers, pumps, fans, shall be identified by a rectangular, engraved, permanent plastic or metal label screw fixed to either the item itself or where impractical to a bracket fitted to adjacent pipework or structure.

Each label shall clearly describe the item to which it refers, its identification number, the service being handled, and the particular building areas being served.

2.1.17 CONNECTION TO APPLIANCES

The Contractor shall be responsible for making all final connections to items of plant and equipment provided and installed by him, except where this is specified to be carried out by others.

The Contractor shall be responsible for the satisfactory reconnection of any existing plant or equipment which he disconnects during the course of the work.

Where specified the Contractor shall also fix and/or connect items of plant and equipment supplied by others.

2.1.18 VIBRATION ISOLATION

All plant and equipment involving rotating or reciprocating parts shall be effectively isolated from the pipework/ductwork installation and the building structure as follows:-

For pumps, flexible bellows with tie-bars, suitable for the operating medium and pressure, shall be fitted directly to each pump water-side connection. Pump brackets shall incorporate anti-vibration feet, springs, cork or packing as applicable.

For fans, flexible ductwork connections manufactured from canvas, neoprene or other suitable material shall be fitted to both inlet and discharge ports of each fan. Cross-sectional dimensions shall be at least equal to the relative fan connection sizes and a minimum spacing between rigid faces of 50mm shall be maintained. Care must be taken to ensure air-tightness between rigid and flexible materials.

Fan supports shall incorporate anti-vibration feet and/or springs as recommended by the relevant manufacturer.

Air handling units shall be treated as one-piece fans insofar as ductwork connections are concerned. In cases where the integral fan/motor assembly is not entirely isolated from the unit frame, the whole air handling unit shall be mounted on anti-vibration feet or packing and all pipework connections shall incorporate either flexible bellows or metal braided hose connections.

2.1.19 ELECTRICAL MOTORS

All equipment under this Contract requiring a prime mover shall include an electric motor and drive train. The Contractor shall ensure that motors installed in the same situation are provided with similar enclosures and where practicable are of similar manufacture.

All motors shall be suitable for the voltage and frequency of electrical supply at the site.

In situations where damp or steam are likely to prevail, motors are to be totally enclosed. In industrial situations such as plant rooms, motors shall be of the drip-proof type. Where used in a situation likely to be exposed to volatile fumes, motors shall additionally be of flameproof construction.

All motors shall be rated for continuous operation at the duty stated.

2.1.20 EQUIPMENT GUARDS

Every rotating, reciprocating or moving part of equipment supplied by the Contractor shall be properly protected by means of manufacturers standard or purpose made guards conforming with the requirements of the current Health and Safety legislation.

2.2 PIPEWORK & PIPEWORK ANCILLIARIES

2.2.1 PIPEWORK GENERAL

All pipework shall be spaced at least 150mm from any electrical conduit or cabling. Pipework shall be spaced in a manner that affords subsequent access to any pipe for maintenance or removal without disturbance to the remaining pipework and insulation.

In laying out pipe runs etc., the Contractor shall be responsible for obtaining information from other site Specialists to ensure adequate space is left available for the fitting and maintenance of all equipment.

No joints shall be formed in the thickness of walls, floors or ceilings. It shall be the responsibility of the Contractor to ascertain the thickness of plaster and other wall finishes, skirting heights, sill heights and floor finishes. Pipework shall generally be set around all piers and columns and shall follow the contour of the building whether so indicated on the drawing or not.

All piping shall be erected to present a neat and orderly appearance, arranged parallel to or at right angles to structural members of the building, and to give maximum headroom not obstructing windows and doorways. All pipe drops shall be plumb.

All pipework valves, fittings and equipment forming the piping installation shall be erected so that they can be dismantled and are accessible for repair and replacement.

Unions or flanges shall be provided at valves and equipment so that they can be dismantled. No pipe shall be installed without a flange or union at a point where it passes through a wall, floor or ceiling. Flanges or unions shall be provided on straight horizontal unobstructed runs at no greater than two random length intervals.

Springs and set shall be formed on long lengths of tube and may be forge drawn or cold drawn, formed to true radius and free of deformation in bore or thinning of tube wall. Double sets made to pass an obstruction on site shall be formed in one piece, each pulled to a full 90 degrees in the same plane.

At all low points in the system a drain cock shall be neatly fitted. At all high points provision shall be made for the release of air entrained in the medium.

All branches from horizontal steam mains shall be taken from the top of the main and shall be made in such a manner as to allow for expansion and contraction in both mains and branch and for steam quality improvement.

All branches from horizontal compressed air mains shall be taken from the top of the main.

All work on Natural Gas pipework installations must be carried out by Corgi registered, fully trained personnel. Corgi registration cards shall be kept available for inspection at any time during the progress of the works. Failure to provide requested identification on demand, will necessitate the removal of that operative from the works.

2.2.2 PIPEWORK GRADIENTS

All pipework shall be installed with continuous and uniform gradients to affect the efficient natural venting or draining of the particular service. Gradients of services shall be appropriate to the services and shall follow the following rule, unless otherwise specified or stated differently within client standard specification of detailed specification.

Pipework Services	**Gradients**
LPHW Heating	1 : 500
Chilled water Mains	1 : 500
LPHW Heating branches	1 : 250
Chilled Water branches	1 : 250

Hot and Cold Water Services	1 : 500
Steam Services	1 : 250
Condensate Services	1 : 250
Compressed Air Services	1 : 250

2.2.3 PIPEWORK SPECIFICATION

Pipework tubing shall conform to the following British Standard or ISO standard unless specified differently within client standard specification, Model Engineering Standard Specification, or particular specification.

Service	**Pipework Type**
Natural Gas	Sizes 15mm to 150mm inclusive:- Black Heavyweight quality mild steel tubing to BS 1387 Sizes above 150mm:- Black mild steel tubing to BS3601
Steam	Sizes 15mm to 150mm inclusive:- Black Heavyweight quality mild steel tubing to BS 1387 Sizes above 150mm:- Black mild steel tubing to BS3601
Heating, ,Chilled Water, Condensate, Oil	Sizes 15mm to 150mm inclusive:- Black Heavyweight quality mild steel tubing to BS 1387 Sizes above 150mm:- Black mild steel tubing to BS3601
Compressed Air, Overflows from water tanks	Galvanised Heavyweight quality steel tubing to BS 1387
Above ground Cold Water Services, Domestic Hot Water, Drains from Safety Valves and air vents Heating Cold Water Feeds	Copper tubing to BS 2871 table X
Below ground Cold Water	Medium Density Polyethylene (MDPE) blue to BS 6572 & BS 3284
Below ground Natural Gas	Medium Density Polyethylene (MDPE) yellow to ISO 4437
Direct Expansion Refrigerant	Refrigerant quality copper tubing to BS 2871 Part 2 Tbl. 2 C106. Fully annealed up to and including 28 mm, half hard thereafter. All internally degreased by manufacturer.

Jointing Methods

Pipework jointing methods and materials shall conform to the following method or material to British Standard or unless specified differently within client standard specification, Model Engineering Standard Specification, or particular specification.

Service	**Location/Conditions**	**Method**
Heating, Steam Condensate, Natural Gas, Oil, Chilled Water	Up to 7 bar g. working pressure and Exposed to view, or In accessible locations, or In plant areas	Up to and including 50mm nominal bore:- Screwed taper threads to BS 21. 65mm nominal bore and above -Welded with flanged joints to BS 4504
Heating, Steam, Condensate, Natural Gas, Oil, Chilled Water	Above 7 bar g. working pressure or In concealed positions or where Inaccessible	All sizes welded with flanged joints to BS 4504. Where equipment dictates flanges may be to BS 10
Compressed Air	In all locations	All sizes Screwed to BS21 with taper threads
Copper Services (Water)	In all locations	Capillary soldered joints on sizes up to 108mm. Sizes 67mm and above may alternatively be Bronze Welded to the requirements of BS 1724. Connections to equipment etc to be taper threads to BS 21 or parallel threads to BS 2779 as necessary.
Medium Density Polyethylene Services	Below ground.	Fusion welded either socket, butt or saddle as applicable. MDPE to metal pipework connections to be by purpose made compression joint bspt threaded fusion socket or loose steel flanged adaptor. Ferrous metal shall be protected against corrosion by Denso wrapping.
Refrigerant Lines (dx)	In all locations	All sizes brazed in accordance with HCVA Jointing of Copper and its Aloys. COP 1990. Pipework below 19 mm O.D. may alternatively be connected using flared joints following de-burring and cleaning.

Jointing Materials

Screwed Joints

Service	Compound
Heating, Chilled Water, Compressed Air	Boss White and Hemp; PTFE tape
Steam, Condensate	Graphited Paste
Natural Gas, LPG	Hermetic sealant formulated for use with gas (e.g. Plasticoll X10G). PTFE tape, heavy grade formulated for use with gas, unsintered to BS 5292 type C.
Oil	Hermetic sealant formulated for use with oil. PTFE tape, heavy grade, unsintered to BS 5292 type C.
Domestic Water Services	Boss Blue and Hemp. PTFE tape unsintered to BS 5292 type C.

Flanged Joints

All services	Composite asbestos free material (e.g. Klingerite) graded to suit the relevant service. Brass corrugated Taylors Ring with relevant jointing compound to both faces. N.B. Flat-faced flanges to have full face joint rings.

Soldered Joints

BS 2871/X Copper Pipework	All fittings to have integral lead-free solder ring. Topping up by end feeding is not preferred but where necessary only lead-free solder shall be used. Self cleaning flux shall not be used.

Brazed Joints

Refrigerant Lines (dx)	Copper to copper joints to use filler rod of copper/phosphorous alloy with minimum 15% silver, (CPI as table 3, BS 1845). Copper to ferrous joints to use fluxless filler rod of copper/silver alloy with minimum 42% silver, (AG2 as table 2, BS 1845) and separate flux. Dry nitrogen is to be passed through pipework during all brazing operations to prevent oxidisation.

In all cases, all excess jointing compound and material shall be cleaned from the joint at the time it is made. Similarly excess flux shall be removed before the area local to the made joint cools. All jointing materials used on hot and cold water services shall be WRC approved.

2.2.4 COPPER PIPEWORK – WATER SERVICES

Copper pipework shall be light gauge unless otherwise specified for example when undertaking work within NHS properties when the Model Engineering specifications will take preference.

Pipe ends shall be prepared for capillary type fittings and cut square and cleanly using purpose made cutters. All irregularities and swarf are to be dressed off to produce a smooth bore and butt end with outer surfaces free from deep scratches.

The cleaning of pipe ends and fittings sockets prior to soldering shall be carried out using wire wool, emery cloth or purpose made wire brushes. Self cleaning fluxes shall not be used.

Springs and sets shall be formed on a light gauge tube bender using the correct size formers, or in small bore tubing may be made by hand using a correctly sized internal spring. All springs and sets shall be to a true radius and shall be free from deformation in the bore, excessive thinning of the outer arc tube wall or any kinking of the inner arc tube wall.

Extreme care shall be taken to ensure that no damage is caused to the pipework by vice jaws, clamps, hand tools etc. Minor scratches etc., shall be removed by dressing with wire wool etc. Any sections or fittings showing major damage shall be replaced as instructed by the Engineer.

2.2.5 MDPE PIPEWORK

Generally, polyethylene pipework for gas services shall be laid to a depth giving a minimum cover of 600mm whilst water bearing pipework shall have a minimum cover of 900mm.

Trenching shall be excavated to a depth of 100mm below pipeline base level and a 100mm sharp sand bed laid before the pipework is installed. After the pipework installation has been completed and tested as specified elsewhere, a further layer of sharp sand to a depth of 100mm over the top surface of the pipe shall be added before the trench is back-filled to ground level. Care shall be taken to ensure that no large objects e.g. bricks, concrete blocks, are included with the back-filling exercise. Unless specified to the contrary, the above trenching and filling will be carried out free of charge to the Services Contractor by the Main or Building Contractor. The Services Contractor shall however, be fully responsible for ensuring that the work is properly executed including whatever costs are necessary to cover for the necessary supervision.

During the back filling operation, the Services Contractor shall supply and lay a continuous, 150mm wide proprietary plastic warning marker tape, or mesh, positioned between 150mm and 250mm below ground level. The marker tape shall include written identification of the service covered and shall incorporate a stainless steel wire for detector sensing.

Medium density polyethylene tubing up to 63mm nom. shall be supplied in coil form to minimise the number of joints necessary during construction. Sizes 90mm and above shall be supplied in 6m straight lengths. All open ends shall be protected and fitted with purpose made caps or plugs until jointing is carried out.

Jointing shall be performed by socket fusion for sizes up to and including 125mm. Sizes up to and including 63mm may be jointed by hand but sizes 90mm and 125mm shall involve the use of mechanical alignment and clamping equipment.

Butt fusion may be used on sizes 63mm and above but must be used for the jointing of 180mm and larger pipes. Specially designed equipment for locating the pipework in axial alignment, for preparing the jointing surfaces and for heating and controlling the forces during jointing must be used.

Service off-takes may be effected by the use of branch saddles and tapping tees. Where saddle fusion is employed, mechanical aids shall be used to ensure correct alignment and to control the heating and jointing forces.

Where polyethylene valves are incorporated, jointing shall be by either socket or butt fusion as recommended by the valve manufacturer. Where metal valves are installed in MDPE pipelines anchorage shall be provided to counteract the operating torque of the valve. Jointing to metal valves shall be by compression transition couplings.

2.2.6 REFRIGERANT PIPEWORK (DX)

Refrigerant pipework routes shall be such as to minimise the length of runs and the number of directional changes. Pipework joints shall also be minimised to reduce the risk of leakage and hence refrigerant emissions to atmosphere.

Pipework shall be designed and arranged to maintain refrigerant velocities and gradients to prevent trapping oil and sludging and to ensure that oil is returned to the compressor under all conditions, including lowest stage of capacity unloading. All horizontal discharge lines shall be sloped away from the compressor to prevent gravity oil return to the discharge ports.

All tubing shall be supplied and stored in clean condition with ends sealed. Cleanliness shall be maintained throughout the installation phase by purpose made plugs, caps and blanking flanges fitted to all open sides.

Pipework shall have flexible couplings to prevent vibration transmission where it is connected to compressors and air cooled condensers. Gas pulsation dampers shall be fitted where appropriate to minimise noise and vibration transmission.

On completion of installation work the pipework shall be pressure and leak tested using dry nitrogen. The pressure test shall be to a minimum of 1.5 times the maximum working pressure and shall be applied for not less than a continuous period of 24 hours. Initial and final readings shall be noted, advised to the Engineer, and recorded in the Commissioning Report.

Following the pressure testing, the system content of test nitrogen shall be released to atmosphere and the complete installation triple evacuated, the final stage being over a minimum period of 24 hours.

Final Torr readings shall be taken with the vacuum pump switch off and isolated. The Torr readings shall be checked after a period of 2 hours and both sets of readings advised to the Engineer and recorded in the Commissioning Report.

2.2.7 SCREWED PIPEWORK

Pipework screwed joints shall be made in accordance with the provisions of BS 21 and shall be clean threaded, pulled tightly and made with approved jointing material.

Tubing shall be free of mill scale, rust or deformation. Threading is to be carefully performed to produce an accurate concentric thread tapered to relevant BS, clear and free from all burrs, snags and swarf. Subject to these provisions threading may be carried out by hand or by automatic machine.

No screwed joint shall be located within the thickness of the building fabric. Where joints in such locations are inevitable, they shall be welded and tested prior to building-in or covering over.

Any exposed threads or joints on black tubing shall be painted with red-oxide, exposed threads or joints on galvanised tubing shall be painted with galvanised paint.

Where tube is galvanised care shall be taken to ensure that threads are carefully cut so that the number of exposed threads is minimised.

Where pipes are held in vices, as when screwing, care should be taken to ensure that the pipe surface and fittings, beads etc. are not damaged. Any pipework so damaged shall not be fitted.

2.2.8 FLANGED PIPEWORK

All flanges are to be fitted true and square with the pipe axis. Flanges shall be machine faced and trimmed at the edges.

Bolt holes shall be drilled and not punched. Flanges on screwed work shall be screwed bspt. All flanges shall be manufactured from mild steel to BS 4504 to the table appropriate for the pressure specified.

Flanges for welded pipework shall be of the type known as “Welding neck” or “Slip-on” flanges.

All flanged joints shall be flush and truly aligned and shall employ full face joint rings. Nuts, bolts and washers shall be bright mild steel and the bolts shall be of the correct length, threaded to ISO metric coarse, with a maximum of two threads extending above the face of the nut. Washers shall be fitted beneath both bolt head and nut.

2.2.9 WELDED PIPEWORK

Pre-formed heavy weight welding fittings, in accordance with BS 1965 Part 1 and amendments, shall be used. Pipework shall be properly profiled to receive the fittings with end faces machined and bevelled at right angles to the axis of the bore.

Profiled entries into tubing for branch connections may be flame cut but the cut edges must be filed smooth and all swarf and cuttings removed from the bore of the tube before the fitting is offered up for welding. Segmental or cut-and-shut bends will not be permitted.

All pipework and fittings shall be completely free from rust or foreign matter.

Welding shall be to Class II by electric arc process to BS 2971 using welding materials to BS 639 or to Class II by oxy-acetylene process to BS 2640 using welding materials to BS 1453.

Oxy-acetylene welding shall not be used for pipework above 100mm n.b. or for flanges above 50mm n.b.

All Welders employed on the work, both on and off site, shall hold a currently valid Certificate of Competency for Oxy-acetylene Welding Grade A or Metal Arc Welding as appropriate to the work in hand.

Any Welder may, at the Engineer's discretion, be required to carry out a specimen butt and branch pipe connection fusion test at site in accordance with BS 4872 Part 1 Procedures and Acceptance Levels for which a Welder Approval Test Record to Appendix B of the standard shall be kept for each test. Welders shall not be allowed to continue welding on the work either on or off site if their standards of workmanship prove to be unsatisfactory.

Proper attention shall be given to the correct alignment of pipe with fittings. No improper weld penetration shall be allowed into the bore of the tube or fitting.

Upon completion of the weld, the proper degree of post weld heat treatment shall be applied to normalise the weld. The weld shall then be hammered, properly dressed and painted with red-oxide.

Adjacent to each weld, the Welder shall stamp his Certificate of Competency Number.

No welding shall be carried out in extremely cold or severe weather conditions which are likely to affect weld quality.

In welded pipework, flanged joints shall be provided at intervals of not more than 12 metres. All sets, double sets and springs shall be formed on long lengths of tube without joints and shall be free from distortion, the full pipe bore being maintained throughout.

The Engineer reserves the right to have up to 2% of the site-made welds removed for examination. Any welds removed shall be made good by welding in lengths of pipe not less than 300mm long. The Contractor shall make no extra charge for such re-instatement.

Should a test piece prove to be unsound or not made as specified, then the Engineer shall be entitled to cut further test pieces of work performed by the Welder responsible for the faulty test piece up to an additional 2% without charge to the Client. If these further samples also show evidence of faulty work, the Engineer reserves the right to instruct the Contractor to cut out and re-make all welds carried out by the Welder responsible for the faulty work and this shall be done without charge to the Client.

Any faulty weld sections removed shall be made good by welding in lengths of pipe not less than 300mm long, subject to the Engineers instructions. It must be understood that permission to weld may be refused on any Contract and that the Engineer's decision in this respect will be final and binding upon the Contractor.

2.2.10 FITTINGS FOR USE WITH STEEL PIPEWORK

Screwed fittings for use with mild steel tubing on Steam and Condensate services shall be wrought iron, heavy quality manufactured to BS 1740. Screwed fittings for all other services using mild steel tubing shall be beaded or banded, malleable iron, manufactured to BS 143. Steel tubulars shall be of heavy quality to BS 1387.

All fittings for use with black mild steel tubing shall be natural, black finish. Fittings for use with galvanised mild steel tubing shall be hot dipped galvanised.

Welding fittings for use with black mild steel tubing shall be black, heavy quality, for butt welding, manufactured to BS 1965.

Flanges for use with mild steel tubing shall be of mild steel, faced and drilled in accordance with the relevant BS table to suit the working conditions. Flanges shall have either screwed taper threads to BS 21 or be of the slip-on type for welding as applicable.

All malleable iron unions shall be of the Navy pattern, incorporating bronze to bronze conical seats.

All junctions and changes in direction shall be carried out using short sweep pattern fittings. Square fittings shall only be incorporated when venting and draining necessitates and where approved by the Engineer.

Reduction in pipe diameters shall be made by using one fitting only e.g. reducing socket, bend, tee. Sockets shall reduce eccentrically when fitted in horizontal pipework and concentrically when in vertical pipework. Bushes will not be permitted.

2.2.11 FITTINGS FOR USE WITH COPPER PIPEWORK – DOMESTIC WATER SERVICES

Fittings for use with copper tubing to BS 2871/X shall be manufactured from copper, high quality copper alloys or gunmetal and be non-dezincifiable, incorporating lead-free solder rings for capillary jointing.

All such fittings shall be from the Yorkshire Potable range manufactured by IMI Yorkshire Fittings Ltd in accordance with BS 864 Part 2.

On all sizes above 108mm and where necessary on sizes between 67mm and 108mm inclusive, bronze welding fittings shall be used.

Flanges for use with copper tubing shall be of gunmetal or bronze dependant upon size and jointing method specified before. All flanges shall be faced and drilled in accordance with the relevant BS table to suit the working conditions. Brass nuts, bolts and washers shall be used wherever non ferrous flanges are employed on copper services.

Flanges on sizes above 54mm may be two piece comprising a copper alloy centre joint face and a coated mild steel backing ring.

Unions for use with copper tubes shall incorporate brass to brass conical seals.

Reduction in pipe diameters shall be made by using one fitting only. Sockets shall reduce eccentrically when fitted in horizontal pipework and concentrically when in vertical pipework.

2.2.12 FITTINGS FOR USE WITH MDPE PIPEWORK

In installations where MDPE pipework is used the manufactures own fittings shall be used. Different colour installations such as MDPE Blue for MCW installations and MDPE Yellow for Gas service for example shall use corresponding colour fittings.

Where transition installations are required between MDPE pipework and metal pipework then they shall be of non-dezincifiable brass/gunmetal.

Changes in direction shall be undertaken using the flexibility of the pipework in preference to the use of MDPE fittings to perform the bend. When utilising the natural flexibility of the MDPE pipework the minimum-bending radius shall be 15 time the nominal diameter of the pipework.

Where MDPE pipework fittings are used to produce the arc in the pipework then the minimum-bending radius shall be 25 times the nominal bore of the pipework.

2.2.13 PIPEWORK BRACKETS AND SUPPORTS

All pipework shall be adequately supported. Supports shall be arranged as near as possible to joints and changes in direction. The spacing of supports shall be in accordance with the following:-

Steel Pipework

Nom Size	Horizontal Spacing	Vertical Spacing
mm	m	m
15	2	2.5 *
20	2.5	3 *
25	2.5	3 *
32	2.5	3
40	2.5	4
50	2.5	4
65	3.0	5
80	3.0	5
100	3.0	5
125	4.0	5
150	4.5	5

Copper Pipework

Nom Size	Horizontal Spacing	Vertical Spacing
mm	m	m
15	1.2	1.8 *
22	1.2	1.8 *
28	1.5	2.5 *
35	1.8	3
42	1.8	3
54	1.8	3
67	2.4	3.7
108	2.4	3.7
133	3.0	3.7
159	4.0	3.7

* To a minimum of 2 brackets for each normal room height drop.

Where two or more pipes are supported together, the support spacings are to be based on the centres required for the smallest bore pipe.

Vertical pipes shall be supported in such a manner that no strain is imposed on horizontal branches.

Under no circumstances shall pipework depend upon a wall through which it passes for support.

Fixing to the building structure shall be selected to be compatible with the strength and construction of the building fabric. Details shall be agreed with the Engineer before installation work commences.

Supports shall be selected to suit the duty required and the area in which the pipe is to be installed, special attention being paid to ensure the free expansion and contraction of the pipework.

Brackets shall be purpose made and be of malleable iron or zinc plated steel for ferrous pipework and brass for copper pipework. Copper pipe saddles shall not be used neither shall any form of plastic clip. Where, due to the adoption of a bracketing system, it is necessary to utilise plated steel clips for the support of copper pipework, nylon inserts shall be fitted between the clip and the pipework.

Brass screw-on clips shall be fitted with brass screws, malleable iron screw-on clips shall be fitted with BZP steel screws. If the clip is counter drilled, counter-sunk screws shall be used, otherwise round head shall be used.

Brackets for all chilled water pipework, cold water pipework and where identified for steam pipework, shall incorporate an inert structural spacer section equal in thickness to the relative insulation and a

corresponding oversize clip (the insulation finish shall be carried through the clip). This arrangement shall also be applied on all services located external to a building.

Brackets for refrigerant pipework fixed to walls shall generally be of the 'Hydrazord' type. Where direct wall fixings are not practicable, then refrigerant pipework shall be supported on suitably sized cable tray provided and fixed by the Contractor. The cable tray shall be hot dipped galvanised, heavy duty with return flanging. All bends, tee sections, etc., shall be made using the proprietary manufacture's fittings, no site made fittings will be allowed. The cable tray shall be supported at regular intervals in accordance with the manufacturer's recommendations and the spacing of supports shall be such that no 'sag' is apparent when the tray is fully loaded.

2.2.14 PIPEWORK EXPANSION

The expansion of pipework shall be taken up by natural off-sets and changes in direction of the pipe runs where possible.

Where this cannot be achieved, expansion shall be accommodated by the inclusion of fabricated expansion loops or purpose made expansion bellows as shown on the relevant drawings and/or described in the Particular Specification.

Branch connections from mains are, whether shown on the drawings or not, to incorporate double sets to provide swinging joints such that mains expansion movement shall not be impeded by or transmitted to the branch pipework.

Where expansion loops are to be employed they shall be of the design and dimensions shown, fabricated from the same material as the pipeline they serve and be formed in long lengths of pipe without intervening joints. Loops shall be fabricated in a single plane with flanged end joints on the same axis. Where expansion bellows are to be employed they shall be of the manufacture and type specified and be installed entirely to suit the manufacturer's recommendations.

Cold draw on all flanged expansion devices shall be equivalent to 50% of the compensated expansion and be pulled by means of high tensile bolts through the flanges. Bolts shall be pulled up diagonally to prevent distortion and uneven stressing. After flanges are abutted, the pulling-up bolts shall be replaced one by one with bolts of the correct finished length. Cold draw shall not be pulled up until all anchors and guide brackets are properly installed and secure.

The Contractor shall supply and fix all necessary anchors between the pipework systems and the building structure. Anchors shall be constructed to withstand the maximum forces exerted during thermal expansion and contraction and during pressure testing. Details of the proposed pipe anchors shall be submitted to the Engineer for approval before any installation or fabrication commences.

Wherever expansion bellows or compensators are incorporated, guide brackets to control the pipe movement in the vertical and lateral planes shall be fitted. Where the expansion unit is adjacent to an anchor point at least two such guides shall be fitted, one two pipe diameters and one fifteen pipe diameters distant on the free side. Where the expansion unit is fitted midway between two anchor points, a minimum of four guide brackets shall be fitted, two either side spaced as previously described.

The design and arrangement of pipe guides shall be entirely compatible with the building structure and fabric. All details shall be agreed with the Engineer before any fabrication or installation commences.

2.2.15 PRESSURE TESTS

The Engineer may witness each test and the Contractor is to give due notice, in writing, of the proposed date of each test.

Wet Services

Each system shall be thoroughly flushed through to remove all scale, dirt and other foreign matter prior to carrying out the testing and commissioning.

On completion of the installations, the systems are to be filled with water, completely sealed from the atmosphere, and tested hydraulically to a pressure of 4 bar or twice the normal working pressure whichever is greater. These tests are to be carried out before any pipe ducts have been covered in or any insulation applied.

If required, the system is to be tested in sections during the progress of the work, to avoid interference with the progress of the building. Any additional valves, tappings, plugs etc, necessitated by sectional testing shall be provided by the Contractor at no additional cost. Such facilities shall, where practicable, be removed from the final arrangement.

Each section under test shall be for a minimum period of one hour when no fall in pressure shall be observed. When a system has been tested in sections, the installation shall be tested out as a whole following the completion of all works.

If the systems are not to be used immediately after the hydraulic test, the Contractor shall, if so required, empty down the systems and shall return to site and refill the systems when instructed to do so.

Natural Gas

Gas pipework installations shall be soundness tested and purged before being brought into commission. Soundness testing shall be carried out in accordance with the following procedure which is based on the recommendations of British Gas Publication IM/5.

All tests must be carried out under steady state conditions. If the pipework is inside a building then the internal temperature should be stable. If the pipework is external then the weather conditions should be stable although the pipeline should not be exposed to heavy sun.

The Contractor shall generally utilize the following procedures

- Estimate the total volume of the installation to be tested. (Guidance on this can be obtained from tables 1 and 2 in IM/5)
- Determine the test period. This shall be 4 minutes plus an additional minute for each 80 dm^3 (or part thereof) over 360 dm^3
- Cap off or otherwise isolate the section of the installation to be tested and fit a water gauge to the purge point test nipple
- Apply a nitrogen supply to the test section and raise the installation pressure to 50 mbar
- Allow the installation to stabilise for 5 minutes and re-establish 50 mbar pressure as necessary
- Isolate the nitrogen source and observe the water gauge reading for the period of time determined above. If there is any perceptible movement in the gauge reading then the test is failed. The source of leakage must be identified and repaired and the whole test repeated.
- When the test has been completed with no perceptible gauge movement, that part of the installation can be regarded as safe and the test certificate completed
- The tested work is then to be purged as recommended in British Gas Publication IM/2 second edition, December 1989 using the Direct Purging method to replace the test nitrogen/air mixture with fuel gas
- Once fully purged, the work can be brought into commission. The connections to items of equipment or plant not included within the test due to pressure limitations etc., should be examined using leak detection fluid whilst the system is under operating conditions

- Three to four days after putting to use, joints in ill-ventilated or unoccupied areas and ducts should be re-examined using a suitable gas detector (the use of leak detection fluid is not acceptable for this purpose).

Compressed Air

Compressed air installations shall be pressure tested following the principles outlined for wet services but using bottle fed compressed air as the testing medium.

Air temperature in the vicinity of the pipework section being tested shall be stable throughout the period of the test.

Any equipment incapable of supporting the applied test pressure should be valved off or removed. Manufacturers test certificate shall be provided for all such equipment.

2.2.16 PIPE SLEEVES

All pipes passing through walls, floors, ceilings, partitions etc. shall be provided with sleeves of similar material to the pipe.

Sleeves shall be free of internal burrs and shall have an internal diameter sufficient to allow free movement of the pipe. Under no circumstances shall sleeves be used as pipe supports and pipes shall be fitted concentrically within the sleeve.

Sleeves shall be cut to the correct length such that they protrude not less than 2mm but not more than 6mm proud of the finished surface. The Contractor shall be responsible for ensuring that sleeves are correctly located and built in.

The annular gap between pipes and sleeves passing through external walls, ducts, subways etc., shall be caulked with an approved flexible sealant to provide an effective permanent vermin and weatherproof barrier. Where passing through firewalls and/or smoke barriers, the gap shall be caulked with a flexible, fire-proof sealant, of the appropriate rating.

2.2.17 COVER PLATES

All pipes passing through walls, floors, ceilings and where exposed to view shall be fitted with cover plates having dimensions suitable for the available clearances. Cover plates shall generally be of plastic construction, white finish.

2.2.18 ELECTROLYTIC ACTION

All connections between copper pipework and ferrous pipework or equipment shall include an inert material barrier in the form of a non-metallic fitting or joint ring to prevent direct contact and the setting up of electrolytic or any other deleterious action.

2.2.19 FINAL CONNECTIONS TO WATER OUTLETS

The Contractor shall make the final connection of water services to all sanitary ware, domestic appliances, kitchen appliances and draw-off points etc.

All final connections shall include a service valve.

Hot water dead-legs to draw-offs and appliances from circulation mains should be kept as short as practicable but in any case must not exceed 5m total length.

Dead-legs from blending valve outlets must not exceed 2m total length.

2.2.20 PAINTING OF PIPEWORK

Where located within a building, all mild steel pipework, brackets and equipment, except that which is galvanised, shall be painted with one coat of red oxide priming paint prior to the application of any specified insulation.

Where located external to a building, all mild steel pipework, brackets and equipment, except that which is galvanised, shall be painted with two coats of red oxide priming paint, one before erection and one after erection.

Before painting, all surfaces shall be thoroughly cleaned and wire brushed.

All low temperature un-insulated pipework, including flanges, valves, brackets and equipment exposed to view in plant rooms, walkways and ducts shall be painted with an additional coat of black gloss paint after erection.

Exposed ferrous surfaces which when commissioned will be too hot to accept standard paint, shall be painted with suitable heat resisting priming, undercoat and finishing paint to an approved colour.

In addition to rust-proofing etc as described above, Natural Gas pipework shall be painted two further coats of undercoat and one coat gloss ochre yellow.

2.2.21 VALVES GENERAL

Valves shall be installed where indicated on the drawings, specification. If in any location the Contractor considers that a valve is necessary for the isolation, regulation or commissioning of a system but no such valve is indicated, he shall draw this to the attention of the Engineer for instruction during the pipework installation period.

All valves and cocks shall be installed in positions which permit easy access for operation and maintenance but shall not be located where a leaking gland may drip onto electrical equipment.

All screwed valves and cocks shall be fitted with a union coupling directly adjacent on the down-stream side.

All items of plant and equipment shall be individually isolated from the relevant system.

All control valves shall be isolated at each port in a symmetrical arrangement with union couplings between each isolating valve and the control valve. On three port modulating control valves, the mixing/diverting port leg shall additionally be fitted with a characterised plug regulating valve for balancing the parallel pressures. Double regulating valves may be used in lieu of separate isolating and regulating valves in these instances.

All distribution mains shall be isolated at their source e.g. plant room, plant headers etc. Where distribution mains form circulation circuits, the return connections shall be similarly valved but utilising regulating valves for balancing.

All connections from distribution mains shall be individually valved. Flow connections or feed connections shall be fitted with isolating valves, circulation return connections shall be fitted with regulating valves.

Isolating valves shall incorporate hand wheels. Regulating valves shall have lockshield covers. Where lockshield pattern valves are not available in the size required, wheel valves shall be fitted with the wheel handles removed, after regulation, and handed to the Client.

Where nominated on the drawings or where necessary to achieve proper balancing, regulating valves shall be of the commissioning type having characterised plugs and proportional flow adjustment with pressure tappings.

Pressure/flow charts shall be included within the Operating Manuals for each commissioning valve.

Unless specified elsewhere, valves shall be as follows or equal and approved. (Such approval must be obtained from the Engineer in writing before the equipment is obtained).

All valves shall be suitable for the system medium and test pressure.

Service	Description	Manufacturer	Fig. No.
LPHW Heating, Chilled Water, Condensate, Oil	Wheel valve 15mm to 50mm	Hattersley Crane	33x D151
	Wheel valve 65mm and above	Hattersley Crane	M549 FM52
	Lockshield valve 15mm to 50mm	Hattersley Crane	33xLS D237
	Lockshield valve 65mm and above	Hattersley Crane	M549 (remove wheel) FM52 (remove wheel)
	Double regulating 15mm to 50mm	Hattersley Crane	1432B D921
	Double regulating 65mm and above	Hattersley Crane	M733DR DM920
	Commissioning 15mm to 50mm	Hattersley Crane	2432(or 24736/M on low flow) D931
	Commissioning 65mm and above	Hattersley Crane	M2733 DM940
	Check valves 15mm to 50mm	Hattersley Crane	47 D138
	Check valves 65mm and above	Hattersley Crane	M651 FM492
	Drain cocks on Equipment	Hattersley Crane	81HU with lever D344 1/2 with lever
	Drain cocks on Pipework	Hattersley Crane	371 D340
	Radiator/Convector Wheel valve	Hattersley Pegler	2407.CP/ 2386CP 97, 98, 99 or 100Wh
	Radiator/Convector Lockshield valve	Hattersley Peglers	2407LS.CP/2386LS.CP 97, 98, 99 or 100 LS
	Radiator valves Thermostatic	Danfoss Randall	RA-FN (Two Pipe) RA-G (Single Pipe)
	3 way vent cocks	Hattersley Nabic	85 175

Service	Description	Manufacturer	Fig. No.
Steam	Stop valve Screwed Bronze 15mm to 50mm	Hattersley Holmes Bailey	13 1425 2000
	Stop valve. Flanged Bronze	Hattersley Holmes Bailey	17 1432 7409
	Stop valve. Flanged CI 65mm and above	Hattersley Holmes Bailey	M731 1441 7509
	Throttling valve. Screwed Bronze 15mm to 50mm	Hattersley	Vee-Reg 0123
	Throttling valve Flanged Bronze 15mm to 50mm	Hattersley	Vee-Reg 014
Compressed Air	Plant/mains isolation 15mm to 50mm	Hattersley Crane	13 D7
	Plant/mains isolation 65mm and above	Hattersley Saunders	M3731 A/HT
	Service connection 15mm to 50mm	Crane Spirax	D171A Ball valve
Compressed air	Check valve 15mm to 50mm	Hattersley Spirax	1213 Check valve
	Check valve 65mm and above	Hattersley	M3736
Natural Gas	Isolation of branch mains and appliances	Yorkshire Hattersley Crane	YL203 - 12mm 100 D171 - 15mm up
	Mains - screwed to 65mm	Hattersley	200m
	Mains - flanged to 65mm	Hattersley	201m
	Mains - flanged 80 and above	Hattersley	M519

Mains fed Hot and Cold Water (Copper Pipework)	Stopcocks- Mains/ branches 15mm to 54mm	Hattersley Yorkshire	13 YP514 DZR/GM
	Stopvalve - mains 67mm and above	Hattersley	M598
	Servicing valves (fitted to all draw offs)	Yorkshire Ballofix Hattersley	480 - 100
	Single check valves	Yorkshire	Socla 421/423
	Double check valves	Hattersley Yorkshire	249 Socla 4421/4423
	Drain cocks	Hattersley Crane	371 D340
Mains fed Cold Water (Polyethylene Pipework)	Stopcocks to 63mm	Yorkshire	771 DZR/GM
	Stopcock on incoming connection (20mm & 25mm sizes)	Yorkshire	787 DZR
	Stopvalves above 63mm	Hattersley	M598 with adapters

Service	**Description**	**Manufacturer**	**Fig. No.**
Tank fed Hot and Cold Water	Isolating valves-Mains/ Branches up to 54mm	Hattersley Yorkshire	33x 415GM
	Isolating valves- Mains 67mm and above	Hattersley	35 PN16
	Servicing valves (fitted to all draw offs)	Yorkshire Ballofix	480 -
	Drain cocks	Hattersley Crane	371 D340
	Non Return Valves 15-54mm	Hattersley Crane	47 D138
	54 and above	Holden & Brooke	Senflux
Where Butterfly Valves specified LPHW, Chilled Water, Hot & Cold Water	Mains & Equipment Isolation, 65mm & above	Hattersley Crane	950 Semi lugged EDPM F624 lugged EDPM
Oil, Gas	Mains & Equipment Isolation 65mm & above	Hattersley Crane	4951 Semi lugged Nitrile F614 lugged Nitrile

2.2.21 AIR VENTING

All high points on heating and hot water systems shall be provided with one of the following means of venting:-

- Automatic Air Valve of aluminum bronze construction with nickel alloy valve and seat and stainless steel float (as Winn type A). A lockshield pattern gate valve shall be fitted immediately before each A.A.V. and a copper drip pipe shall be run from the eliminator outlet to discharge in an approved position.
- Up to and including 50mm nom bore, a full bore air bottle shall be formed by means of an equal square tee with an 80mm long space nipple terminating in a cap with a 10mm vent pipe taken from the top of the cap to terminate in an agreed position 2m above floor level in a 10mm bronze needle valve (as Hattersley 5N) fitted with a square headed bronze plug into the open end.
- On pipework above 50mm nom bore, the air bottle bore shall be maintained at 50mm.

2.2.22 STRAINERS

Strainers shall be of bronze construction, Y pattern, full bore pipe size fitted with a stainless steel screen as BSS Ltd fig 47N sizes 15mm to 50mm and fig 48XN above 50mm.

Strainers fitted to shower type valves shall be of 'Y' pattern, supplied by the same manufacture as the shower valve and to the same finish. Integral 'top-hat' type strainers will not suffice.

All two port and three port automatic control valves fitted to either water or steam systems shall be protected from ingress of foreign matter by strainers fitted to the upstream side of all inlet ports.

Strainers shall also be fitted upstream of all items of plant where the internal water passages are susceptible to blockage by foreign matter e.g. non storage calorifiers, plate type heat exchangers, air heater batteries, water chillers, high efficiency boilers etc. etc.

2.2.23 TEMPORARY STRAINERS

During pre-commissioning filling and testing all water systems shall be fitted with temporary strainers to remove construction debris such as nuts, bolts, weld splash etc. which would otherwise damage the system equipment or block the conventional strainer screen.

The temporary strainers shall be positioned in agreed locations wherever necessary to protect the system, each being fitted between two flanges in a purpose made section.

The temporary strainers shall be removed before final commissioning and be available for inspection by the Engineer.

2.2.24 SAFETY RELIEF VALVES

All heat generating equipment and all vessels/pipework subjected to a pressure greater than atmospheric, shall be fitted with a Safety Relief Valve.

Valves shall be sized in accordance with the relative manufacturer's recommendations to suit the heating capacity and/or pressure limitations of the system/equipment. In no cases shall valves of less than 20mm nom bore be used.

Safety Relief Valve set pressures shall be adjusted at commissioning stage to 115% of maximum working pressure on Steam and Gaseous services, 125% of maximum working pressure on Liquid Services.

All valves shall incorporate a padlock or lead seal to lock the set pressure and to obviate unauthorised tampering.

Valves shall be of the enclosed pattern.

On open-vented systems, the bore of the outlet pipe shall equal the bore of the inlet connection. On closed expansion systems, the bore of the outlet pipe shall be one size greater than the bore of the inlet connection. Outlet pipes shall be arranged to drain naturally and include, where site conditions or valves type demands, a separate small bore drain tube routed to a suitable gulley.

Safety Relief Valves shall be mounted vertically and fitted directly to the equipment/system with the minimum possible length of pipe and no intervening valve or other restriction.

Dischargers from relief valves fitted to systems operating at up to 90°C shall be routed to terminate 200mm above floor level with an anti-drip profile. Discharges from relief valves fitted to systems operating above 90°C shall be routed to terminate in a safe but unconcealed location to be agreed on site with the Engineer.

2.2.25 THREE PORT VENT COCKS

Where multiple boilers, hot water generators, calorifiers etc. are installed in battery form, serving an open vented system, each unit shall be fitted with a three port vent cock.

The inlet to the cock shall be piped directly to the appliance with no intervening valve or other restriction. The outlet port of the cock shall be piped, to couple with the other outlets into a common vent line run to discharge over the feed tank. The third, side port of the cock shall be routed to low level adjacent to the appliance in a similar fashion to the safety relief valve discharge.

2.2.26 THERMOSTATIC MIXING VALVES

Thermostatic mixing valves shall be manufactured in accordance with BS 1415 Part 2 and BS 1224.

The contractor shall supply, install and commissioning valves complete with the following:

- Double check non return valves on each service feeding the Thermostatic Mixing valve (TMV) The Contractor shall check that the TMV may have integral check valves fitted within the body of the unit itself. Where this is the case they are generally single check valves and the Contractor shall then include to install an additional check valve to each feed.
- Non return check valves shall be to BS 6268, and shall comply with the requirements of the TMV manufactures requirements.
- Strainer on each service feeding the TMV
- Ballofix isolation valves to enable isolation for maintenance on either the TMV itself, the Non return check valves or the strainers.

All fittings shall be currently approved by and currently listed on that produced by the Water Research Centre (WRC). The TMV components also being approved by the Water Fittings Byelaws scheme listed by the Water Research Centres.(WRC)

Each thermostatic mixing valve outlet shall be set to a maximum outlet temperature of 41 deg C, except where fitted to bidets where this temperature setting shall be 37 Deg C.

Set temperatures shall be checked and recorded following site commissioning. Recordings of all temperatures at the given positions shall form part of the Information within the operation and maintenance manuals and / or the Health and Safety CDM regulation file for the project.

Each thermostatic mixing valve shall be capable of shutting down the supply from the TMV in the event of the cold water service failing. As required by the Health Guidance note ‘Safe’ Hot water and surface temperatures.

Thermostatic Mixing valves shall be suitable for a minimum maintained pressure of 0.1 bar and up to 6 bar with the inlet water temperatures between 10 and 72 Deg C.

2.2.28 PIPEWORK INSULATION

General

The contractor shall include for a specialist thermal insulation contractor to undertake all such works. Specialist Contractor shall be registered with the Thermal Insulation Contractors Association (TICA).

The insulation shall be suitable for the temperatures and conditions likely to be encountered within the system.

The whole of the thermal insulation works shall be in accordance with BS 5970, BS 5422, BS476 and current Building Regulations Part L including associated second tier documentation.

For the purpose of qualification for Enhanced Capital Allowances, the thickness of insulation should comply with BS 5422:2001 “Environmental Thickness Tables” as specified by the DETR.

All insulation and ancillary materials shall be used in accordance with manufacturers application and safety information.

No insulation materials are to be applied to any part of the installation until the prescribed tests have been carried out and declared satisfactory by the Contractor Administrator.

Before insulation materials are applied, all surfaces must be clean, dry and free of all rust and scale. All traces of surplus soldering flux and building materials dust and debris must be removed from copper piping.

Insulation materials must not be delivered to site until the works are ready and once on site must be stored in the manufacturers cartons in a dry and clean condition.

No insulation material shall contain asbestos. All insulation materials shall be CFC free.

It is stressed that the greatest care must be taken to achieve a first class appearance to the final product and any work which, in the opinion of the Contract Administrator, is sub-standard shall be removed and replaced at no charge.

Service Temperatures up to 100ºC

Thermal insulation shall be applied to the following pipework services including all fittings, etc.

- All heating pipework not forming controllable, useful heating surface or in locations liable to freezing.
- All hot water service circulation pipework together with any concealed dead-legs and any dead-leg liable to freezing.
- All chilled water pipework.
- All cold water pipework except where on view in sanitary and or kitchen areas.

Pipework insulation shall be cfc-free phenolic foam, bore coated rigid pre-formed sections, having a factory applied vapour barrier facing of Bright Class O reinforced aluminum foil having the following properties;

- For normal applications - standard density 35 kg/m³
- For positions liable to repeated contact / damage - enhanced density 50 kg/m³
- Thermal conductivity - 0.018 W/m·K at 10ºC mean (fully aged)
- Smoke emission - Less than 5% in accordance with BS5111:Part 1
- Fire rating - Class O (unassisted by facings)

Insulation thickness shall be as follows

Pipe size	Heating	DHWS	CWS	Chilled Water	Ext CWS

					*
15/15	15	20	15	15	70
20/22	20	25	15	15	30
25/28	20	25	15	20	20
32/35	25	25	15	20	15
40/42	25	25	15	20	15
50/54	25	25	15	20	15
65/67	30	30	20	25	15
80/76	30	30	20	25	15
100/108	30	30	20	25	15
125/133	35	30	20	30	15
150/159	35	30	20	30	15
200	35	35	20	30	15
250	35	35	25	30	15
300	40	35	25	35	15
Vessels	40	35	30	40	25

* Also applies to Indoor unheated areas except for 15 mm pipe size, 25 mm thickness shall be applied

The mechanical services contractor shall install purpose designed high density pipe support inserts having the same thickness and finish as the pipework insulation.

Pipework insulation shall be applied in accordance with the recommendations of BS 5970 2001 and the manufacturers application guide.

All longitudinal and radial joints shall be tightly butted and sealed with 50mm wide adhesive foil tape, to provide a permanent and continuous vapour barrier over the insulation. All insulation terminations shall be sealed with tape to maintain the vapour barrier and a purpose made aluminum end cap to maintain a neat appearance.

Security of sectional insulation shall be reinforced by additional bands of 50mm wide aluminium foil tape at 330mm centres, equally spaced between the joints. (ie; two additional bands per metre section)

Bends, elbows, branch connections etc., shall be fully insulated with carefully site fabricated and mitred sections of pipework insulation finished with a neat and fully sealed covering of aluminum tape.

In all locations on chilled water and cold water installations and in locations where freezing is likely to occur on other water services, flanges and valves shall be insulated to the same standard as the adjacent pipework using oversize sections neatly cut, jointed and taped.

In all locations on chilled water and cold water insulated pipelines and all other services where located external to the building, high density load bearing inserts of the same overall diameter as the adjacent insulation and complete with reinforced aluminum foil jacket, shall be introduced between the pipe and the pipe support arranged to continuously maintain the vapour barrier.

Pipes or cylindrical vessels having a diameter greater than 325mm, shall be insulated using slab material having closely scored 'V' slots in its inner face.

Service Temperatures between 100ºC and 200ºC

All surfaces including valves, flanges etc having operating temperatures above 100ºC shall be thermally insulated.

Insulation thickness shall be as follows and shall conform to BS:5422: 2001.

Pipe Size	All Services
15	60
20	65
25	70
32	70
40	75
50	75
65	80
80	80
100	100
125	100
150	100
200	100
250	100
300	100
350	100
400	100
Vessels/Tanks	100

Insulation material shall be Rockwool Limited Rock lap 800 having a nominal density of 120 kg/m³ , a thermal conductivity of 0.044 W/m·K at 100ºC mean temperature and a factory applied Bright Class O aluminum foil vapour proof jacket with an integral self-adhesive lap. Abutting sections to be joined with 75mm wide aluminum tape.

All supports on services having an operating temperature in the range 100°C to 200°C shall include a high density load supporting block of equivalent thickness to the pipe insulation, fitted between the pipe and the clip. The aluminum foil casing shall be carried continuously through the clip.

Refrigerant Pipework (dx)

Refrigerant pipework shall be thermally insulated using Class 'O' quality Armaflex, with a minimum thickness of 13 mm, or to conform to the thicknesses referred to in BS 5422 : 2001.

Pipework insulation coverings - Internal

All insulated pipework services on permanent view in rooms, circulation spaces, plant and other such dedicated areas, shall be finally finished using 0.35mm thick light grey rigid PVC sheeting ('Isogenopak') with purpose made fittings.

All longitudinal joints shall be overlapped 40mm secured with plastic rivets at 15Omm centres and over-taped with matching self-adhesive PVC tape. The longitudinal joint shall then be turned out of sight.

Circumferential joints in straight lengths shall also be overlapped 40mm but left unrivetted and untaped to allow for expansion. Circumferential joints at fittings shall be taped.

Terminations at valves, flanges etc., shall be fitted with the manufacturers closure end caps.

The above shall apply unless otherwise specified within the particular section of this specification. For example, when undertaking work within NHS properties the Model Engineering specifications will take preference.

Pipework Insulation coverings - External

Pipework located externally to building, or within areas subject to external conditions of humidity, shall be weatherproof finished using 0.8mm thick polyisobutylene (P.I.B.) sheeting having a tensile strength of not less than 3.5 N/mm² with all joints overlapped 40mm and sealed using the manufacturers own solvent welding agent.

All joints shall be arranged to shed water. PIB shall be carefully applied ensuring no creasing or sagging, with bends etc., spirally wrapped.

All bracketing shall be kept to the outside of the weatherproof finish using insulation thickness high density support blocks at the relevant loading points.

Armaflex insulation on external refrigerant pipework shall be finished with two coats of Armaflex HN paint to a natural grey colour finally colour banded to Clause 2.20.

The above shall apply unless otherwise specified within the particular section of this specification. For example, when undertaking work within NHS properties the Model Engineering specifications will take preference.

2.2.29 PIPEWORK LABELLING AND IDENTIFICATION

Pipework

All piped services shall be identified in accordance with BS 1710 using adhesive tapes to BS 4800 colours (except where exposed to view and decorated).

The basic identification colour and code indications shall be placed at junctions, at both sides of valves, serviced appliances, bulkheads, wall penetrations and at any other place where identification is necessary.

Each label shall comprise 2 x 15Omm bands of the basic colour with a centre 100mm wide band of the safety or reference colours.

Where applicable, a 25mm wide band of direction flow arrows shall be fitted to the downstream side of the colour band.

The bands of tape shall be applied to oil and dirt free surfaces only. The length of tape shall be trimmed to suit the circumference of the pipe or insulation, as applicable, allowing for a 13mm minimum overlap on the blind side.

Valves

All valves located in plant rooms, service voids or where adjacent to plant shall be identified.

The identification shall be in the form of either a brass or traffolite disc, permanently chained to the valve with chromium plated brass chain, bearing a reference number corresponding with that on the framed and glazed valve chart.

Water Outlet Labels

The Contractor shall provide and install at all nominated cold water drinking outlets, a small white traffolite label with black lettering, to read - DRINKING WATER.

The Contractor shall provide and install at all unblended hot water outlets, a small red traffolite label with white lettering to read - VERY HOT WATER.

Labels shall be fixed by means of chromium plated dome-head screws to the wall surface immediately behind and above the relevant tap.

2.3 DUCTWORK / MECHANICAL VENTILATION

2.3.1 GALVANISED STEEL DUCTWORK

The Contractor shall supply install and commission ductwork installations as detailed, employing specialist ductwork manufacturers / installers as necessary.

All sheet metal ductwork shall be manufactured and installed in accordance with HVCA Specification DW 144 with exceptions where identified in the following clause (unless stated otherwise within the particular section of this specification).

For NHS healtcare projects the Model Engineering specifications will also apply.

Ductwork shall be manufactured using hot dipped galvanised sheeting to BS EN 10142 grade PO2G, 275 mass coating, M finish, B surface with C surface treatment, to the nominal cross sectional sizes shown on the drawings, based on the standard sizes and thicknesses described in DW 144 except no gauge less than 0.8mm shall be used for indoors applications or less than 1.0mm for outdoors applications.

Longitudinal seams shall be made using either the ‘Grooved Seam’ or ‘Pitsburg Lock’ method with continuous sealant injected during the seam forming process.

Cross joints in rectangular ducts shall be by slide-on flanges with bolted corner joints and knock-on clamps. Slip joints may be used for adjustable sections only when they shall be angle reinforced for their full girth, integrally sealed and fixed using mechanical rivets at 50mm centres.

Rectangular ductwork shall be provided with additional stiffening as necessary to obviate vibration and drumming by either cross breaking or beading or closer spacing of cross joints.

Cross joints in circular ductwork shall be plain socket and spigot, with or without connectors, with integral sealant and mechanical rivet fixings. Flanged joints, with gaskets, shall be used in strategic positions to facilitate future removal.

Bends in circular ductwork shall be 0.5D throat radius on sizes up to 400mm and segmented thereafter. Branches off main ducts shall be by 45^{o} shoes or by using ‘Deflectrol’ insert air turns. Shape changes shall be long taper with the total included angle not exceeding 30^{o}. Offsets shall be at a maximum angle of 30^{o}.

No ductwork shall be leakage tested unless otherwise stated in Section 3 of this specification or unless to Class C High Pressure.

2.3.2 FLEXIBLE DUCTING

Flexible ducting shall be used in positions shown on the drawings and for final connections to false ceiling mounted grilles and diffusers.

Flexible ducts shall be supported at 1m intervals and unless specified to the contrary, shall not exceed 2m in length.

Joints between flexible and rigid ducting shall be secured by worm drive metal clips.

Where used in general positions including un-fire rated above ceiling locations, flexible ducting shall be manufactured from an aluminium/polyester/aluminium laminate enclosing a high tensile steel continuous wire helix.

Where specified to be thermally insulated, flexible ductwork shall be manufactured as described for general use with an additional external layer of fibreglass insulation having an outer jacket of reinforced aluminum laminate to provide a vapour barrier and a class 1 resistance to fire spread.

Where specified to be fire rated, flexible ducting shall be manufactured from vinyl coated fibreglass fabric with a coated spring steel inner wire helix.

Flexible ducting shall not be used for anti-vibration joints to fans or other oscillating equipment.

2.3.3 DUCTWORK SUPPORTS

Rectangular ductwork running horizontally shall generally be supported on mild steel bearers passing beneath the duct suspended by a hanger drop rod at either end from the building structure.

Steel bearers shall be either of angle iron, square cut with all sharp burrs removed and painted with two coats of red-oxide rust prevention paint or proprietary channel (e.g. 'Unistrut') self galvanised finish with ends treated after cutting and fitted with plastic blanking caps. All bearers shall be of sufficient length to ensure a clearance of 25mm is maintained between the drop rod hangers and the sides of the duct or duct insulation where applicable.

On un-insulated ductwork a neoprene isolation strip shall be fitted between the bearer and the duct. The neoprene shall be of such density that under loaded condition its thickness is not less than 10mm.

On insulated ductwork a high density load bearing phenolic foam strip isolator of equivalent dimensions to the thickness of the insulation and the bearer length between drop rods, shall be fitted between the bearer and the duct.

Rectangular ductwork running vertically shall generally be supported from purpose made mild steel angle cantilever brackets located one either side of the rising/dropping duct, secured back to the building fabric. Extended angle iron flanges, mechanically riveted or bolted to the duct sides shall bear on the cantilever brackets with a neoprene isolator, as specified before, interposed. Clearance between the cantilever brackets and the duct or duct insulation sides shall be maintained as for drop rods on horizontal ducts.

Supports for circular ducts shall be by full circumferential mild steel split bands, with splits on the horizontal centreline and two drop rod hangers. Single point vertical centreline hangers will not be accepted.

On un-insulated ductwork the neoprene isolator, as specified before, shall be fitted around the whole circumference of the duct.

On insulated ductwork a pre-formed high density phenolic foam insert of insulation thickness shall be incorporated between the split band and the duct.

2.3.4 TURNING VANES

Air turning vanes shall be of the correct profile to ensure complete changes of direction of the airflow, with extended leading and trailing edges and with the radius and spacing selected to achieve uniform velocity through the bend.

Air turns shall be rigidly fixed to the ductwork such that drumming and vibration or blade oscillation occurs.

Turning shall not be achieved by means of unequal square elbows and all turning vanes should be installed with an angle incidence between 40 and 50 degrees. No air turns in excess of these angles of incidence shall be allowed and the Contractor shall be requested to remove these and replace them at their own expense.

At square take off branches on air supply systems and on all square take off branches to supply air diffusers the use of 'Deflectrol' insert air turns. The deflectrol shall be of the 15 degree type, as manufactured by Senior Coleman Ltd or equal and approved.'

Branch connections on supply air systems shall not normally require 'deflectrol' fittings when the

leading edge of the ductwork shoe is installed to the branch.

2.3.5 VOLUME CONTROL DAMPERS

To enable efficient control and regulation of air movement in accordance with the design intent volume control dampers shall be provided wherever necessary. Not all dampers will be shown on the tender drawings but as guidance to minimum requirements they should be positioned as follows:-

- At all main duct divisions, to each leg
- At all branch connections off main ducts
- At all minor branches where they serve three or more outlets
- At all duct terminations to grilles, diffusers, etc. (These dampers may be integral with the terminal).

Dampers shall be multi-leaf opposed blade operation in independent housing with spigots or flanges sized to suit the relevant duct. Single leaf dampers will not be accepted.

Dampers shall be manufactured from galvanised mild steel or stainless steel with side linkages, blade shaft air seals and on operating temperature up to 70°C, nylon bearings on temperatures above 70°C, oilite bearings.

Hand balancing dampers shall be fitted with a locking adjuster which indicates degree of opening.

Motorised dampers shall be complete with any necessary motor mounting platform and extended linkages and shall be capable of tight shut-off.

Multi-damper arrangements shall include all necessary linking actuation rods etc. Multiple assemblies shall include all necessary mullion joining plates, seals and fixings.

All dampers shall be of rigid construction and be free from vibration or excessive noise production in their operating positions.

2.3.6 FIRE DAMPERS

Provide fire dampers on ventilation ductwork passing through designated fire barriers, these shall have fire tested certification at least equal to the barrier in which they are fitted.

All fire dampers shall carry the Loss Prevention Certification Board (LPC) marking.

Fire dampers shall be of the spring loaded curtain type with blades packed out of the air stream held by a fail-safe fusible link rated at 72°C. External indication of blade status shall be provided. Damper sizes shall be to suit duct sizes and shall have galvanised steel casings and stainless steel shutters with side seals.

Note - The damper forms part of the fire barrier and as such must be rigidly fixed and fire sealed to the building fabric. Wherever the building construction allows, dampers must be mounted in a HEVAC installation frame positioned centrally in the wall or floor thickness.

Although the attendant builderswork will be carried out by others, the Contractor shall be responsible for ensuring the correctness of the work. Where it is proposed to utilise other methods of fixing, drawn details shall be submitted to the Engineer for comment prior to the work being undertaken.

All fire dampers shall be tested to show correct operation after installation and reset prior to handover.

2.3.7 SMOKE DAMPERS

Where fire dampers are also designated as smoke control dampers they shall be constructed from similar materials as above but be of the parallel multi-blade type and incorporate fail-safe closing and motorised re-setting.

Precise details of control shall be as described in Section 3.

All smoke dampers shall carry the Loss Prevention Certification Board (LPC) marking.

2.3.8 ACCESS DOORS

Provide access doors in all ventilation ductwork adjacent to volume control dampers, fire dampers, smoke control dampers, heater/cooler batteries and elsewhere where access for maintenance and/or inspection is required. Doors shall also be provided throughout for internal cleaning.

Each section of ductwork between internal obstructions shall be accessible with doors fitted at a maximum of 10m centres. All doors shall be manufactured from galvanised mild steel and be of sufficient size to facilitate the necessary access and view. Where physical size is limited, multiple doors shall be provided.

Doors shall be provided with a matching frame and incorporate an air tight seal with cam type fasteners to all sides (except hinge side on hinged doors). A captive chain shall be fitted between door and frame where doors are not hinged.

Door and frame shall be fitted flush on un-insulated ductwork sized 300mm x 300mm or greater. On un-insulated ductwork sized less than 300mm x 300mm and on all insulated ductwork, door and frame shall be surface fitted. Ductwork apertures to receive access door frames shall be suitably reinforced to obviate distortion of the door frame and poor seal performance.

2.3.9 GRILLES AND DIFFUSERS

Provide grilles and diffusers of the make, type and size as described in Section 3 and/or shown on the drawings.

For NHS healtcare projects the Model Engineering specifications will also apply (eg. Provide grilles with removable cores for cleaning where required).

Grilles and diffusers fitted to suspended false ceilings and served from the main distribution by flexible ducting shall be mounted to purpose made plenum boxes with circular spigot connection and in accordance with the grille manufacturers recommendations. The whole assembly shall be independently supported from the building structure and not reliant upon the suspended ceiling.

Unless specified to the contrary, grilles and diffusers shall have integral opposed blade volume control dampers operated by key through the face of the terminal.

Visible screw fixings shall be of cross head countersunk pattern with a non rusting finish to compliment the specified terminal finish.

All terminals shall be fitted square and level with the building fabric and finishes.

2.3.10 DUCTWORK FLEXIBLE CONNECTIONS

Ductwork connections to all fans, air handling units or other items of plant which may produce vibration, shall be made using a flexible connection.

Unless specified as requiring special qualities, e.g. fireproof, noise break-out attenuation etc., flexible connectors shall be purpose made from machine stitched heavy weight canvas trapped to the adjacent rigid duct and plant by mild steel angle and/or flat iron continuous girth clamps.

The canvas shall not be fitted unduly tight nor slack and shall be air sealed to the rigid duct and plant with non hard setting sealant mastic. The free gap between rigid items shall be not less than 50mm nor more than 100mm.

2.3.11 TEST HOLES

22mm diameter test holes are to be provided in all ductwork before and after each item of plant and at all main branches and before all balancing dampers whether shown on the drawings or not.

Test holes shall be arranged in accordance with CIBSE Commissioning Code, Series A, Air Distribution and BSRIA Application Guides 1/75 and 1/77. All test holes shall be sealed with 'top-hat' type grommets.

2.3.12 TENDER DUCTWORK DRAWINGS

The Contractor should note that the tender drawings are intended as a diagrammatic representation of the design intent and do not necessarily show all bends, sets and precise positional locations.

The Contractor shall allow for gathering all site dimensions, obtaining certified drawings of all plant and equipment and producing detailed manufacturing and installation drawings incorporating all necessary offsets, bends and adjustments to provide a fully co-ordinated installation conforming with the design intent.

2.3.13 DUCTWORK SYSTEM PRESSURE DROP REVIEW

On completion of the ductwork installation drawings, and prior to installation and procurement of air handling units, fans and other air movement devices the contractor shall calculate and review the index circuit system pressure drop of each system and compare to original design figures.

Where final calculated system pressure drops differ from the original design figures by a margin that could effect system performance, this shall be brought to the engineers attention.

2.3.14 DUCTWORK THERMAL INSULATION

General

The contractor shall include for a specialist thermal insulation contractor to undertake all such works. Specialist Contractor shall be registered with the Thermal Insulation Contractors Association (TICA).

The insulation shall be suitable for the temperatures and conditions likely to be encountered within the system.

The whole of the thermal insulation works shall be in accordance with BS 5970, BS 5422 and Building Regulations Part L including all associated second tier documentation.

For the purpose of qualification for Enhanced Capital Allowances, the thickness of insulation should comply with BS 5422:2001 “Environmental Thickness Tables” as specified by the DETR.

All insulation and ancillary materials shall be used in accordance with manufacturers application and safety information.

No insulation materials are to be applied to any part of the installation until the prescribed tests have been carried out and declared satisfactory by the Contractor Administrator.

Insulation materials must not be delivered to site until the works are ready and once on site must be stored in the manufacturers cartons in a dry and clean condition.

No insulation material shall contain asbestos. All insulation materials shall be CFC free.

It is stressed that the greatest care must be taken to achieve a first class appearance to the final product and any work which, in the opinion of the Contract Administrator, is sub-standard shall be removed and replaced at no charge.

Ductwork Insulation

Unless specified to the contrary in Section 3 of this specification, the following ductwork shall be thermally insulated:-

- All fresh air intake ductwork connections between the external air terminal and the air handling plant
- All ductwork carrying air heated above ambient conditions
- All ductwork conveying air at a temperature below ambient conditions.

The insulation material for all ductwork conveying air between 10°C and 80ºC shall be cfc-free phenolic foam, rigid slabs, having a factory applied vapour barrier facing of Bright Class O reinforced aluminum foil, having the following properties.

- Thickness, 35 mm
- Standard density, 40 kg/m³ (For normal applications)
- Enhanced density, 50 kg/m³ (For positions liable to repeated contact and damage)
- Closed cell content, 90% minimum
- Thermal conductivity, 0.018 W/m·K at 10ºC mean
- Smoke emission, Less than 5% in accordance with BS5111:Part 1
- Fire rating, Class O (unassisted by facings)

The mechanical services contractor shall install purpose designed high density Duct Support inserts having the same thickness and finish as the duct insulation.

General principles of application etc shall be as described under relevant Clause for pipework applications.

Insulation and vapour seal shall be continuously maintained through non fire-rated walls or other barriers. Similar ducts passing through fire-rated walls or barriers shall have the insulation and vapour barrier stopped and sealed at the fire damper.

Insulation Coverings - Internal

Insulated rectangular ductwork in permanent view locations shall be finally finished with 0.5mm thick light grey PVC sheeting in flat sheet form adhered to the insulation using the manufacturers adhesive and pre-formed corner angles all fitted with plastic rivets at 15Omm centres and ail joints finally taped with matching self-adhesive PVC tape.

Insulation Coverings - External

The whole of the insulation shall be encased with 22 gauge stucco embossed aluminum cladding secured with pop rivets at 225mm centers and incorporating a “water shed” on the top. All joints shall be sealed with mastic to provide a waterproof installation.

Care shall be exercised when cladding air conditioning ductwork to ensure any riveting of the aluminum cladding does not perforate the foil facing on the insulation and destroy the vapour barrier.

The above shall apply unless otherwise specified within the particular section of this specification. For example, when undertaking work within NHS properties the Model Engineering specifications will take preference.

2.4 TESTING & COMMISSIONING

2.4.1 GENERAL REQUIREMENTS

The contractor shall appoint a suitable specialist commissioning engineer / specialist sub-contractor to undertake all required commissioning activities. Include for all costs associated with the testing and commissioning process, including attendance by specialists / manufacturers

The mechanical services systems are to be thoroughly commissioned and tested to prove that they are capable of achieving the specified performance, to prove the correct and stable operation of all control systems and are safe to operate and maintain.

Environmental tests are to include, where necessary, the provision of artificial loads to simulate the full range of operating conditions. The correct operation of each system is to be demonstrated on completion of the commissioning and testing.

Fully detailed method statements are to be provided in advance for each system, to indicate the methods to be employed. Tests are to be carried out in accordance with agreed and recognised standards such as those produced by CIBSE / BSRIA.

A testing and commissioning program shall be produced by the contractor, and issued to all parties for review / comment. Once agreed the commissioning program shall be included within the main contract program.

2.4.2 PRE-COMMISSIONING REQUIREMENTS

Pre-Commissioning shall generally be carried out by the Mechanical Services Contractor and their specialists as specified elsewhere and as follows:-

Item	Required Pre-Commissioning Actrivities
Plant and Ductwork Cleaning	The Mechanical Services Contractor shall thoroughly clean all internal and external surfaces of ductwork and plant.
Hydraulic Pipeline Testing	All pipework installations shall be tested by the Mechanical Services Contractor.
Flushing	All pipework installations, except compressed air systems, shall be flushed by the Mechanical Services Contractor.
Pre-Commission Cleaning	The Commissioning Specialist shall be in attendance and witness the flushing exercises and the subsequent cleaning of strainers. The chilled water and low temperature hot heating installations shall be pre-commission cleaned and treated by the Mechanical Services Contractors water treatment specialist. The Commissioning Specialist shall be in attendance and witness the pre-commission cleaning and treatment.
Sterilisation	All domestic hot and cold water systems shall be sterilised by the Mechanical Services Contractor. The Commissioning Specialist shall be in attendance and witness the sterilisation exercise.
Water Supplies	The Commissioning Specialist shall confirm the presence of water supplies to all tanks and outlets.
Ductwork Leakage	The Mechanical Services Contractor shall test ductwork for leakage where specified.
Electrical Supplies	The Mechanical Services Contractors controls specialist shall commission the whole controlsn installation. The commissioning specialist shall establish that all electrical connections have been made during Pre-Commissioning and that power is available to all equipment.
Rotating Equipment	The commissioning specialist shall check for free rotation of equipment and correct alignment, security and tension of belt drives and operate fans and pumps to check direction of rotation.
Test Certificates	The Mechanical Services Contractor shall provide copies of all test certificates related to tests undertaken at manufacturers works and pre-commissioning tests.

2.4.3 COMMISSIONING REQUIREMENTS

The full extent of the Mechanical Services installations shall be commissioned by the commissioning specialist, working in conjunction with the commissioning Engineers of equipment manufacturers and systems specialists.

Requirements are as follows

Service	Required Commissioning Actrivities
Pipework Systems	Anti-confusion Pressure/vacuum Welding/Jointing Certification Valve tightness Cleanliness, internal and external Flow rate/balancing System component pressure drops Pressure reducing valve settings Safety relief valve setting and operation Operation of all components Performance - temperature/noise Purity of fluid Earth bonding
Ventilation Systems	Flow rate/balancing Leakage (where requested in Section 3) Cleanliness, internal and external Damper operation Fire and smoke damper operation System component performances - heat/cool Batteries/filter CV/VV box operation/calibration Performance - temperature/noise/air change Operation of all components Purity Earth bonding
Plant & Equipment	Component performance - heat/cool batteries/filter Operation - normal, abnormal, safety devices, interlocks Performance - duty/speed/pressure/efficiency/noise Standby Sequence Cleanliness, internal and external Vibration Electrical safety/security/bonding
Internal Conditions	Environmental - temp, humidity, air change, noise Air flow direction, distribution, draughts
Controls / BMS	Full functional tests Component operation Settings Control action - limits, response time, alarms, interlocks Electrical safety/security/bonding

The Commissioning Specialist shall appoint a suitably qualified Commissioning Engineer who shall be responsible for supervising commissioning and who shall be resident on site full time throughout the commissioning and post-commissioning periods.

Where manufacturers offer a commissioning service this must be used in preference to other methods. All manufacturers reports shall be included in the final documentation.

The Commissioning Specialist shall regulate and adjust valves, apparatus, plant and equipment such that the whole of the works shall be left in a satisfactory working order to the requirements of the Engineer.

Before commencing final balancing of water circulation systems the Mechanical Services Contractor shall remove, clean and replace all strainers.

Where appropriate, the systems shall be commissioned in accordance with the latest edition of the CIBSE commissioning Codes.

Once all tests and balancing of the systems have been completed the whole of the works shall be operated under normal working conditions and fine tuning of controls undertaken to achieve stable operating conditions of the plant and within the building.

The commissioning Specialist shall be required to work closely in conjunction with the controls specialist to fine tune the systems. This operation of the installations under normal working conditions and fine tuning shall be undertaken during the commissioning period and shall not be considered as post commission proving.

The Commissioning Specialist shall maintain a diary on site and record all activities, including activities of other specialist and manufacturers commissioning engineers. The diary shall be available for inspection by the Engineer at all times.

The Commissioning Specialist shall provide all necessary instrumentation and measurement devices for commissioning of the Works.

2.4.4 POST COMMISSIONING REQUIREMENTS

The Commissioning Specialist shall demonstrate and prove to the Engineer that the systems operate correctly and with stability and the Commissioning Specialist shall undertake tests as directed by the Engineer.

The Commissioning Specialist shall be resident on site full time throughout the post commissioning period.

The Commissioning Specialist shall, in conjunction with the Mechanical Services Contractor and his other specialists, instruct the Employer in the operation, inspection and general maintenance of the whole of the Mechanical Services Installations.

Ensure that the following post-handover checks are performed with respect to the BMS / Controls systems.

- Global level checks
- Internal air temperature.
- Relative humidity.
- Ventilation.
- Energy consumption (ensure that the pulse-input counters match the meters).
- Check that each of the above meets the specified requirements.
- System level checks
- Control strategies. Check that any suspect control strategies are appropriate for the intended application. Check that the suspect control strategy has been implemented and commissioned correctly. Check that the control strategy is still appropriate for the intended use.
- Network communications. Check that all relevant field controllers communicate properly. Check for correct sharing between controllers of relevant data and correct inter-controller operation.
- Control set-points. Check that the set-points in question are correct and appropriate for the actual operating conditions.
- Control loop settings. Check that the control loop settings result in accurate and stable control. Check that all self-learnt characteristics are valid.
- Control zones. Check that the control zones are appropriate.
- Occupant controls. Check that occupant controls work correctly.
- Sub-system/component level
- Sensors. Check the accuracy and location of any suspect sensors.
- Actuators. Check that any suspect actuators operate correctly.
- Dampers and valves. Check that any suspect dampers and valves are not jammed and that they operate as intended.

2.4.5 COMMISSIONING REPORT

The Commissioning Specialist shall prepare a Commissioning Report for submission to the Engineer and ultimately for inclusion in the O&M Manual. The report shall contain the following:-

- Air flow volumes for each system, including duct traverse record sheets.
- Plant run times during tests.
- Terminal grille and diffuser volume flow records for all systems, including hood factor tests etc.
- Central plant test data including filter and coil pressure drops, etc.
- Fan performances including fan curves and plotted performance on high and low volumes where applicable.
- Pump performance including pump curves and plotted performance on high and low volumes where applicable.
- Water distribution systems water flow balance, control valve duties including valve performance data charts.
- Refrigeration plant commissioning data including water flows for chilled and low temperature hot water.
- Control settings for all plant.
- Control settings programmed into Building Management System.
- Control panel fuse ratings and overload settings.
- Record of all temperature and pressure point tests.
- Equipment running current for all three phases.
- Noise level recordings, including sketch plan of positions where readings were taken.
- Pressure test certificates.
- Clean water/system certificates for domestic water systems.
- Provision shall be made in the report for recording alterations made to control set points during post commissioning and the first twelve months of plant operation.
- Provision shall be made in the commissioning report for recording test data during any re-commissioning exercises.
- Sketch diagrams of systems indicating all equipment, controls and control and regulating valves all referenced.

2.4.6 WITNESSING OF COMMISSIONING RESULTS

Upon successful completion of commissioning notify the engineer.

Demonstrate to the Engineer that all system components are operating correctly, and the completely integrated installation will function in accordance with the specified performance requirements.

The engineer shall witness a percentage of commissioning results for each system, the engineer shall decide which points are to be verified. The Mechanical Contractor and their specialist commissioning contractor shall be in attendance for the duration of the witness testing.

The following additional witnessing requirements apply for BMS systems. Ensure that specialist on-site commissioning staff facilitate the witnessing process.

- Ensure that the BMS hardware is installed in accordance with specification
- Verify any operator software and associated graphics.
- Witness completely the control of any main and/or critical items of plant along with a random sample of other points.
- If less than 300 points, witness all points. Between 300 and 1,000 points witness 50% (minimum of 300 to be witnessed). If more than 1,000 points witness 20% (with a minimum of 500 points witnessed).
- Reserve the right to witness 100% of the points if the failure rate is greater than 5%.
- Witness a sample of specific functions, eg 10% of alarms and 10% of data logging.
- Witness one of several identical items of plant in detail with the others witnessed on a random basis.
- Verify the system security access.

- Verify that all safety-related functions perform to that specified, eg plant shutdown on fire condition.
- Verify all plant restarts according to that specified after building power failure and local power failure.
- Witness all power meter data-points to ensure that they match the meters.
- Ensure that trend logs are used when witnessing points in order to monitor the performance of control actions.
- Verify the handover of all operating manuals and system documentation.
- Verify the handover of backup copies of software.
- Verify the completion of any specified system operator training.

2.4.7 PIPEWORK FLUSHING AND CLEANING

Following completion of sections of the installation and following the completion of the complete system final pressure test, the systems shall be thoroughly flushed out so that all foreign matter is removed from the system.

Water systems shall be thoroughly flushed using clean water.

The flushing medium wherever possible shall be fed into the systems at high-level positions and flushed out at low points. Suitably sized flushing plugs with valves shall be used. Flushing through 15mm drain valves is not considered good practice to flush a system out by.

Prior to flushing taking place the Mechanical Services Contractor shall remove all filters, meters, circulating pumps, traps, valves, controllers non – return valves, and equipment / plant that may become damaged as part of a flushing process.

Sufficient time shall be given to ensure that all foreign matter is removed from the system. Flushing should also be undertaken under pressure at a pressure that is deemed suitable to the installed system. Care must be taken with regard to flushing old and existing systems at pressure.

The Clerk of works, Engineers or site Engineer shall witness Flushing procedures. The length of time to flush shall be recorded.

Once flushing has been deemed to be complete, the Mechanical Services Contractors appointed specialist water treatment provider or company shall take samples of water from each service, at the furthest point in each direction of the building. These samples shall be taken away for analysis to indicate whether flushing has been successful.

If samples indicate that further flushing is required then this shall be undertaken until agreeable analyses are obtained indicating that all foreign matter, suspended solids and impurities have been removed.

Following the completion of the flushing process the Mechanical Services Contractor shall undertake to remove all strainers, dirt pockets etc and thoroughly clean them out of any residual debris that may be held within them as a result of the disturbance caused be the flushing processes.

The Mechanical Services Contractor shall employ a specialist company of Water Treatment Engineers to advise on a suitable corrosion inhibitor which shall be added to the heating or cooling system to prevent corrosion or contamination of the pipework services.

The correct corrosion inhibitor shall be added to the final system fill. Determination of the system water content shall be undertaken by the Mechanical Services Contractor, who shall then inform the specialist. The water treatment specialist then will then advise the Mechanical Services Contractor of the correct dosage for the system(s).

The Engineer will be fully informed of these findings and undertake to give their approval prior to work taking place on the system.

Water treatment shall be added to a system via dosing pot, either presently installed within the existing system, or temporarily installed in a position agreed by the Engineer.

The Mechanical Services Contractor shall include for all associated costs with regard to the water treatment, and specialist advice.

Following the addition of the water treatment, a period of 1 week will lapse and then the specialist water treatment engineers shall test the system(s) at four separate locations to check the level of inhibitor within the system.

If these tests indicate an inadequate or unsuccessful water treatment exercise then the Mechanical Services Contractor shall at their expense undertake to repeat the water treatment until such time that successful tests are achieved to the satisfaction of the Clients Representatives.

Test results for the water treatment concentration shall be included in the operation and maintenance manual test certificates.

2.4.8 HEATING SYSTEM CORROSION INHIBITOR

Following the successful pressure testing of any water based heating system and before any heat test is applied, the installation shall be dosed with a corrosion inhibitor.

The inhibitor shall be Sentinel X 100, added at the rate of 1 part per 100 of the calculated system content.

Labels shall be attached to each boiler/calorifier/feed tank/make-up unit advising the presence of the inhibitor and the concentration to be used when refilling.

2.4.9 STERILISATION OF DOMESTIC HOT AND COLD WATER SERVICES

All new and interrupted existing domestic hot and cold water services shall be thoroughly and efficiently sterilised.

Sterilisation shall be undertaken prior to hand-over, and giving sufficient time period to receive test results back, prior to hand over.

Chlorine dioxide shall be activation to 2000 ppm using food grade phosphoric acid.

In pipework under pressure, disinfection shall be carried out through a properly installed injection point at the start of the pipeline using a chemical pump, until the measured residual chlorine dioxide at the end of the pipeline is not less than 10mgs./ltr. (10 ppm).

The charged water shall be left for 4 hours and the level checked again. If less than 5mgs./ltr. (5 ppm), the procedure shall be repeated. When satisfactory, the system shall be flushed out with fresh clean water until the residual chlorine dioxide level does not exceed 0.5mgs./ltr. (0.5 ppm).

Where junctions are inserted into an existing pipeline, the junction itself shall be cleaned and disinfected by immersion in chlorine dioxide activated to 25mgs./ltr. (25 ppm).

All visible dirt and debris shall be removed from the cistern and the cistern shall be washed out with clean water and drained.

All internal surfaces of the cistern including struts, tie-bars, ballvalve, overflow and internal fittings shall be sprayed with chlorine dioxide activated to 50mgs./ltr. (50 ppm).

The cistern shall then be refilled with clean water and charged with activated chlorine dioxide to give a residual level of 10mgs./ltr. (10 ppm).

Each draw-off supplied by the cistern shall be opened until every outlet has a residual chlorine dioxide level of at least 5mgs./ltr. (5 ppm) and can maintain 5mgs./ltr. (5 ppm) for 1 hour.

If residual levels fall below 5mgs./ltr. (5 ppm), the procedure shall be repeated.

The cistern and system shall be flushed out through the draw-offs until the residual chlorine dioxide level does not exceed 0.5mgs./ltr. (0.5 ppm).

Water samples shall be taken from selected outlets and submitted to an AKAS accredited laboratory for microbiological analysis for faecal coliforms, total coliforms, Total Bacterial Counts at 37ºC and 22ºC, and legionella test and analysis.

The Microbiological tests shall confirm that the Water from the installation is suitable for human consumption and free from harmful bacteria or chemicals.

A satisfactory certificate shall be obtained by the Contractor, and this, together with the Contractor's own Certificate verifying that sterilisation to the correct concentration and procedure has been carried out, shall be included within the handover documentation.

It must be noted that until such time as successful Microbiological tests are achieved that the systems cannot be given back to the client or any practical completion recommended to the Lead Consultant or Contract Administrator.

Microbiological tests take 7 to 10 days normally to complete.

All charges for water sampling, testing and certification shall be included for by the Contractor.

2.4.10 DISINFECTION OF WATER STORAGE TANKS

Disinfection of the tank shall be achieved by spraying all internal surfaces of the tank, including all struts, tie-bars, ballvalve, overflow and connections with anthium dioxide activated to 150 ppm.

All internal surfaces of the tank and all internal fittings shall be washed with fresh clean water and then the tank drained.

Anthium dioxide shall be sprayed onto all internal surfaces of the tank, struts, tie-bars, ballvalve, overflow and internal fittings until soaked.

The tank shall be left to air-dry.

The tank shall be refilled with fresh clean water from the ballvalve and the residual anthium dioxide level checked and should not exceed 0.5 ppm.

Procedures as laid down in Severn Trent reference 1NWAAB shall be observed.

Anthium dioxide levels shall be verified at levels up to 5 ppm by comparation, and above 5 ppm by means of titration.

A water sample shall be taken from the tank and subjected to microbiological examination for E. Coli, Total Coliforms and Total Viable Counts.

On satisfactory completion of the work, certificates of compliance shall be issued.

2.5 OPERATING AND MAINTENANCE INFORMATION

2.5.1 OPERATING AND MAINTENANCE MANUALS:

To satisfy the provisions of the Health and Safety at Work Act the Employer will not accept handover of the installations until full and adequate information concerning the installations is in the possession of his operating and maintenance staff.

Provide Record Documents - being part of the Works - prior, and as a prerequisite, to Practical Completion to the satisfaction of the Engineer.

Prepare manuals in draft as the Works progress and make suitable arrangements where the Works are subject to Partial Possession or Sectional Completion.

Submit draft Record Documents to the Engineer for comment prior to commissioning.

Prepare two temporary Manuals with provisional record drawings and preliminary performance data available at commencement of commissioning to enable Employer's staff to familiarise themselves with the installation. These should be of the same format as the final Manuals with temporary insertions for items which cannot be finalised until the installations are commissioned and performance tested.

Provide the Engineer with copies of the final Manual prior to Practical Completion. Number of weeks before with prior agreement of the Planning Supervisor

Prepare electrical record drawings in accordance with BS EN 61082.

Prepare Operating and Maintenance Manuals for heating systems requiring a trained operator in accordance with BS EN 12170.

Prepare Operating and Maintenance Manuals for heating systems not requiring a trained operator in accordance with BS EN 12171.

Ensure record documents clearly record the arrangements of the various sections of the Works as actually installed and identify and locate all component parts.

Correlate record documents so that the terminology and the references used are consistent with those used in the physical identification of the component parts of the installations.

Ensure the building log book contains the information outlined in the Building Regulations Part L2, Conservation of fuel and power in buildings .

The operating and maintenance manuals must include:

Section	Required Contents
Introduction	Including overview, list of abbreviations, schedule of record drawings and valve charts and locations, service identification.
General Description of Systems	To give full description of systems and associated plant with schematic sketches of systems to enhance the explanatory notes, to be compiled in conjunction with manufacturer's information. All manufacturers information shall be marked to illustrate the precise equipment/components used. The section to have sub-sections covering air systems, water cooling systems, water heating systems, domestic hot water systems, etc., etc.
Design and Performance	To show full details of plant and systems design operating temperatures, etc.
Technical Data	Technical details and performance to each item of plant taken from manufacturer's information. To have sub-headings covering air systems, water cooling, water heating systems, domestic systems, etc.
Building Management System	To include a full description of the management system and incorporate information to be provided by the controls specialist. To have sub-headings covering all systems.
General Operating and Maintenance Notes	General notes covering the measuring techniques and equipment to check the plant performance on periodic basis. To have sub-sections covering regulation of systems, measurement, safety precautions, planned maintenance and plant log.
Procedure for	This section to be covered by a 'general section' covering procedure routine operation and operational

Operating and Maintenance	notes. Under a main procedure section, sub-sections covering normal operation, initial setting up, routine inspection, draining down water systems and refilling water systems. Under a sub-procedure section, sub-sections covering such items as:- Replacement and adjusting fan drive belts, renewing filter media, taking pumps off line, inspection and cleaning domestic hot water heaters, changing pump selection, greasing motor bearings, earth continuity tests, earth loop impedance, insulation resistance tests, etc., etc.
Emergency Procedure	General section and sub-section covering emergency procedures, first aid action and emergency telephone numbers for out-of-hours contact.
Fault Tracing	General section and sub-sections covering fault tracing including charts for quick analysis of typical control misfunctions.
Maintenance	General section and sub-sections covering schedules, inspections, lubrication, adjustment, replacement, overhaul, frequencies and cleanliness. The section shall include maintenance sheets covering all systems, e.g. water cooling systems, water heating systems, domestic water systems, control systems.
Commissioning Report	The commissioning report detailed elsewhere shall be incorporated in the final operating and maintenance manual.
Spares	List of spares based on manufacturer's recommendations. List of holding spares (as handed over with plant).
Test Certificate	Test Certificates for complete plant and equipment.
Valve Charts	Copies of the valve charts as provided in plant areas etc (see clause 2.34).
Manufacturer's Literature	Provide comprehensive sets of manufacturers original (not photocopied) literature, in clean condition, covering general information and detailed instructions for each item of plant or equipment. Each set shall include:- • Catalogues and leaflets detailing and identifying the equipment installed. • Operating and maintenance instructions. • Performance charts, curves, rating data. • Wiring drawings for plant items incorporating any site modifications. With full manufacturer's references including:- •Plant serial numbers. •Order reference numbers. •Reference for ordering spares. •Plant component drawings where appropriate. •The above information shall be presented in binder form with suitable index.

Encase the Manuals in A4 size, plastic-covered, loose leaf, four ring binders with hard covers, each indexed, divided and appropriately cover- titled. Fold drawings larger than A4 and include in the binder so that they may be unfolded without being detached from the rings.

2.5.2 AS INSTALLED DRAWINGS

Prepare Record Drawings and Schedules to a scale not less than 1:50 from the "As Installed Drawings" maintained on site as the Works progress.

Endorse all such documents 'RECORD DRAWINGS'. Where agreed with the Engineer certain detailed information may be provided in schedule form.

Provide reduced scale copies for inclusion in the operating and maintenance manuals.

Record Drawings and Schedules must include, but are not limited to:

- Location, including level if buried, of Utility Service connections, including those provided by the appropriate Authority, indicating points of origin and termination, size and material of service, pressure and/or other relevant information.
- Disposition and depth of all underground systems.
- Schematic drawings of each system indicating principal items of plant, equipment, zoning, means of isolation, etc. in sufficient detail to make it possible to comprehend the system operation and the inter-connections between various systems.
- Details of the principles of application of automatic controls and instrumentation.
- Diagrammatic dimensioned plans and sections of each system or service showing sizes and locations of all ancillaries, plant, equipment controls, test points, and means of isolation etc. including any items forming an integral part of the engineering systems provided by others (such as plenum ceilings, builders' work shafts, chimneys etc.).
- Detailed wiring drawings/diagrams/schedules for all systems, including controls, showing origin, route, cable/conduit size, type, number of conductors, length, termination size and identification,

and measured conductor and earth continuity resistance of each circuit.
- Location and identity of each room or space housing plant, machinery or apparatus.
- Dimensioned plans and sections at a scale of 1:20 of plantrooms, service subways, trenches, ducts and other congested areas where in the opinion of the Engineer smaller scale drawings cannot provide an adequate record. Indicate the location, identity, size and details of each piece of apparatus.

2.5.3 PLANT ROOM DRAWINGS

Provide good quality plant room drawings, schedules and schematics.

Hang the following in each plant room, any other appropriate location or where directed by the Engineer.

- Schematic drawings showing identification and duties of equipment, numbers and locations, controls and circuits.
- First aid instructions for treatment of persons after electrical shock.
- Location of all incoming service isolating and metering facilities.
- Emergency operating procedures and telephone numbers for emergency call out service applicable to any system or item of plant and equipment.

In addition each plant roomshall be provided with a composite valve chart in diagrammatic and list form, showing the location of all valves, referenced consistent with the operating and maintenance instructions, and As Fitted drawings.

Where gas services are present (in all but individual domestic installations), the Contractor shall provide a line diagram in a readily accessible position as close as possible to the primary meter, indicating the position of all installation pipework, meters, emergency controls, valves and pressure test points of the gas service within the building.

Protect drawings by framing under glass or other rigid, transparent, cleanable and protective surface.

2.5.4 USER INSTRUCTION

Before practical completion explain and demonstrate the purpose, function and operation of the installations including all items and procedures listed in the Operation and Maintenance Manual to the Employer's maintenance and operational staff / or nominated representative.

The instruction shall utilise the Operating and Maintenance Manuals for the basis of training of the Employers staff and demonstrate the safe day to day running and maintenance of all systems, plant and equipment.

The Contractor shall arrange the attendance of specialist manufacturers, suppliers, sub-contractors etc., as necessary to provide a comprehensive understanding.

Provide full training for the operation of the controls, monitoring or BMS. Ensure that training is completed before the BMS is handed over.

Ensure that each trained operator signs a training acceptance certificate(s).

Provide appropriate reference and training manuals for the operator.

2.5.5 SPARES

Before practical completion submit to the Engineer a schedule of spare parts as called for in individual sections and any others that the Subcontractor recommends should be obtained and kept in stock by the Employer for maintenance of the services installations included in the Subcontract.

State against each item the manufacturer's current price, including packaging and delivery to site. Identify those items which are additional to those specified for inclusion in individual Sections.

In addition The Contractor shall provide and hand over to the Client on or before the date of handing over, the following:-

- A set of loose keys to fit every key operated valve, drain cock, stop cock, air valve and mixing valve in the installation, consisting of three keys of each size and type required.
- One spare drive belt set for each belt driven device.
- One complete set of filter cells for each air filter.

All spares shall be packaged in protective coverings to facilitate storage and shall be clearly identified and referenced against the equipment to which they pertain.

SECTION 3

PARTICULAR MECHANICAL
SERVICES SPECIFICATION

CONTENTS

3.1 GENERAL DESCRIPTION

This specification details the Mechanical Services requirements for the Sawtry Sports project, to replace the existing building on the site.

The facility comprises a mix of new build, and existing upgraded building areas.

The development will provide changing facilities, WC's, club room, kitchen, and other general ancillary areas.

Mechanical services will all be fully renewed, no existing services are to be retained.

The new mechanical services plant and infrastructure specified herein (ie. space heating, domestic water services) are sized to be able to accommodate the proposed future extended building area (ie. a further 2no. changing rooms to the south).

Mechanical Contractors will be invited by the Principle Contractors to submit tenders based on these tender documents.

Particulars of the project are given in Main Contract Preliminaries.

3.2 SCOPE OF WORKS

The Mechanical Services Sub-Contract will include the following:

- DOMESTIC HOT & COLD WATER SERVICES
- LOW TEMPERATURE HOT WATER HEATING (FROM AIR SOURCE HEAT PUMP)
- MECHANICAL VENTILATION
- CONTROLS / BUILDING MANAGEMENT SYSTEM (BMS)
- TESTING & COMMISSIONING ETC.

The Sub-Contractor shall include within their tender for the surveying of the building / site, installation drawings, final coordination, purchase, delivery to site, off-loading, moving into position, marking out, setting up, alignment, erecting, fixing, wiring, connecting, setting to work, commissioning, testing, O & M Manuals, teaching and demonstrating the whole works as described in the Specification.

For a period of 12 months from the handover date, the Sub-Contractor shall repair and make good any defects arising in connection with the installation and / or equipment free of charge.

The Contractor shall be fully responsible for the proper co-ordination of all works within his charge with other trades on the project and for the production of all details required to achieve such co-ordination. Any cost incurred in this respect shall be deemed to be included within the tender offer.

Where there is a discrepancy, the information provided in the Particular Section of the Specification shall supersede Standard Clauses.

The Engineering Services Installations covered by this Subcontract comprise the Mechanical Services Installations.

Tenderers are advised to visit site during the tender period to satisfy themselves of the site and the access to it.

The construction program shall be confirmed by the Main Contractor along with start and completion dates and other program details.

Information on the building layout, construction methods and finishes shall be obtained by

consulting the internal layout drawings and details, these should be obtained through the Main Contractor.

The Contractor shall submit final technical submittals for all plant and equipment, for Engineer review, prior to final procurement.

Building Services Consultant:

Contact: Iain Williamson

Axis M&E Consulting Engineers
No. 8 Poplars Court
Lenton Lane
Nottingham
NG7 2RR

Tel: 0115 979 1875
email: iain.williamson@axisconsult.co.uk

Architect

Contact: Nick Cooper

HSSP Architects

PERA Business Park
Nottingham Road
Melton Mowbray
LE13 0PB

3.3 CONDITIONS OF CONTRACT

Refer to main contract documentation.

3.4 PROGRAM

Refer to main contract documentation.

3.5 DRAWINGS AND SPECIFICATION

All work shall be carried out to conform with the requirements of the standard Specification Sections 1 and 2 in addition to the particular requirements of Section 3.

Information on the buiding layout, construction methods and finishes can be obtained by consulting the Architects drawings and details, these should be obtained through the Main Contractor.

The Mechanical Contractor shall produce all necessary installation and working details to achieve the successful completion of the project

3.6 COMMISSIONING

The Contractor shall set to work and commission the new Mechanical Services Systems installed under this contract. The Contractor should refer to section 2 of this specification for requirements

The Contractor shall include to provide a fully detailed commissioning program at the outset of their works to the Principle Contractor for incorporation into the Principle Contractors main program. The Contractor shall note that the Consulting Engineer will require the commissioning information as part of the documentation prior to any practical complete of the overall project.

The Contractor shall include to employ specialist Commissioning Engineers to undertake all aspects of the commissioning process as part of this project.

3.7 COORDINATION BY THE CONTRACTOR

This project is to be procured on a 'traditional' basis, with the M&E services detail design having been completed by Axis M&E Consulting Engineers.

The Contractor shall be responsible for final installation coordination, and equipment selection / procurement.

This shall include final coordination with the new electrical services, building fabric, structure, and other trades.

The contractor shall measure / verify existing available space exists prior to final equipment / material procurement. Where any issues exist, this shall be brought to the attention of the Engineer.

Primary pipework shall generally be routed via the roof voids (and flat roof area ceiling void). Refer to section drawing. The tender drawings indicate approximate routings, final routings shall be assessed by the Contractor at installation stage, including coordination with the roof structure / electrical services.

Where mechanical services equipment requiring maintenance access is located within the roof voids (eg. Ventilation units) ceiling access hatches and roof void walkways shall be provided by the Principle Contractor. Include for liaison with Principle Contractor to establish equipment locations and walkway setting out.

Final ceiling grille positions shall be coordinated with the electrical services / lighting.

The Contractors attention is drawn to the plantroom areas. Limited space exists, detailed final installation stage coordination / setting out will be required, including coordination with the electrical services.

3.8 PART L COMPLIANCE

The new build parts of the project will be assessed as a new build project under the (2016) version of Approved Document Part L2(A).

Compliant Building Regulations Part L2A BRUKL / SBEM calculations have been produced by Axis based on the current scheme (see appendix).

Existing refurbished areas will be assessed under Part L2(B) of the current Building Regulations. The compliance methodology will be elemental, and SBEM calculations are not required for these parts.

The contractor shall ensure that the installations comply Part L2(B) and relevant second tier documentation (eg. Non-Domestic Compliance Guide).

The Contractor is not required to take responsibility for Part L compliance, this remains with the design team, provided that the requirements of the project specifications and drawings are followed.

The Contractor will be required to appoint a specialist to provide a final on-construction stage Energy Performance Certificate (EPC) for the building at completion.

3.9 MECHANICAL SERVICES ISOLATIONS / DEMOLITION

The Contractor shall include for the decommissioning, isolation, drain down and removal of all existing building mechanical services.

This shall include domestic hot and cold water services and mechanical ventilation services

The Contractor shall make due allowance for shutdowns, drain downs, isolations etc. as required to facilitate the isolations and removals.

All internal distribution pipework and domestic hot and cold water plant shall be disconnected, drained and made safe, prior to removal.

No natural gas, or DX air conditioning systems are understood to be present.

The Contractor shall include for visiting site prior to submission of tender to fully identify the scope of works, the extent of removals, working conditions, method of isolating existing services etc within the existing building. In submitting a tender this will be deemed to have been done.

3.10 COLD WATER SERVICES

3.10.1 INTRODUCTION

Modify / divert the existing primary incoming buried water main to serve the new building.

Provide boosted internal cold-water distribution systems to serve all outlets, served from centralized break tank / booster set.

3.10.3 SYSTEM DESCRIPTION

The existing incoming primary mains cold water supply to the building shall be retained and modified / re-routed to serve the new facility.

To cater for the shortfall in capacity between the existing incoming main, and new required flowrate imposed by the showers - an internal cold water storage tank shall be provided, with packaged booster set. Boosted (potable) cold water shall be distributed to all outlets.

The Contractor shall install and make all final connections to the sanitary fittings. All internal pipework shall be run in conventional copper.

All water services systems shall be installed in accordance with the following :-

- BS8558 Specification for design, installation and testing and maintenance of services supplying water for domestic use within buildings and their curtlilages
- BS-EN 806-2 Specification for installations inside building conveying water for human consumption
- CIBSE Guide G Public Health Engineering
- CIBSE TM13 'minimising risk of Legionnaires' disease'
- HSE L8 legionnaires disease-control of legionella bacteria in water systems - Approved code of practice and guidance
- Water Supply (Water Fittings) Regulations 1999

Distribution Pipework and Fittings

Provide and install cold water pipework distribution systems to feed all appliances and outlets, as detailed on the architectural and mechanical services tender drawings.

BCWS distribution shall serve the following

Sinks
Wash hand basins
Showers
WC's
Cold water dispensers / zip heaters / dishwashers etc.
Domestic hot water cylinder
Mechanical services heating system
External bib taps
Kitchen

Primary pipework shall generally be routed via the roof voids (and flat roof area ceiling void), dropping to low level to serve outlets. Refer to section drawing. The tender drawings indicate approximate routings, final routings shall be assessed by the Contractor at installation stage, including coordination with the roof structure / electrical services.

System to comprise boosted potable cold-water distribution to all outlets – served from centralized cold-water storage tank and pressure boosting equipment located within the main plantroom.

The Contractor shall install and make all final connections to new sanitary fittings. All internal pipework shall be run in copper.

The pipework shall be configured so as supplies to individual areas are valved for isolation. Provide drain cocks at all low points. Include a service isolation valve at each appliance or outlet.

Provide backflow protection devices where required in accordance with the requirements of the water regulations (eg. External bib taps, dishwasher).

All distribution pipework shall be concealed wherever possible generally routed within roof / ceiling voids and within accessible service risers / IPS systems where available.

Any exposed final pipework connections within rooms and at low level shall generally be exposed to view and un-insulated. Additional wall clips shall be provided for robustness.

Access panels shall be provided as necessary by the Main Contractor to details provided by the Mechanical Contractor to facilitate access to any concealed isolation valves etc., or any other item requiring maintenance access.

Any exposed shower pipework shall be stainless steel (not chrome plated) for robustness.

Refer to tender drawings for further details.

Hot / Chilled Drinks Dispenser

Provide local electric hot drinks dispenser within the kitchen.

Unit to be as Zip Econoboil, 5 litre wall mounted unit, complete with matched drip tray, overflow, and scale filtration ki (or similar and approved).

Units to be installed in accordance with manufacturers requirements.

The above selection is provided for purposes of tender. Review with Engineer prior to final procurement.

Cold Water Storage / Booster Set

Potable cold-water storage is to be provided internally within the building, sized to suit the peak domestic hot and cold-water demand of the building, and to ensure that sufficient delivery pressures are provided.

The cold distribution from the storage system shall be pressurized using a (potable quality) pressure boosting set. Pressure boosting set is to include a minimum of 2 No (duty / standby) inverter drive pumps, together with accumulator vessel to deal with the variations in demand on the cold-water system, and matched control panel.

Booster pump specification :

TYPE	Packaged, potable cold water booster set / break tank
MANUFACTURER	Flowmech (or equal and approved)
CONFIGURATION	Inverter driven, duty / standby pumps

DUTY	2.7 l/s peak flow rate @ 2.2 bar(g) head
BREAK TANK	800 litres, single compartment, external flanged, thermally insulated
ANCILLIARIES / NOTES	stainless steel impellers, accumulator vessel, matched control panel with tank low water cut-out and BMS interlink.

Note – the booster pump duty (flow rate) given above suits the future (extended) building footprint. The pump shall initially be commissioned to operate at a lower flow rate, to suit this project. Initial flow rate to be advised by Engineer.

A normally drained full-bore bypass shall be provided between MCWS to the storage tank and the booster set outlet for such occasions as loss of electrical supply to booster set or maintenance of the storage tank.

Cold water storage tank shall be potable quality, GRP insulated tank, fully compliant with water regulations.

Cold water storage tank and booster set to be located within plantroom area. The plantroom shall be ventilated to avoid risk of room overheating causing elevated stored cold water temperatures (see ventilation section of spec.).

To minimize overall footprint / plantroom space, the equipment shall consist of low level booster pumps with tank mounted above on frame. **Overall dimensions / footprint to be developed to suit plantroom setting out. Note restrictions on plantroom space.**

To progress a quotation, contact :-

Dan Shelton

Flow Mech Products Ltd,
Leicester, LE1 3UD

Mobile: 07811 348 278
Email: Daniel.s@flowmech.co.uk
www.flowmech.co.uk

Provide technical submission for Engineer review prior to final procurement.

(Or equal)

Electronic Water Conditioners

The Contractor shall supply, install and commission Water King electronic water conditioner (WK range) in each of the following locations:

- Boosted potable mains cold water discharge – wk3 type
- Domestic hot water secondary return (after pump) – Sentry type
- Incoming MCWS to building - Sentry type

The panels associated with the conditioners shall be sited locally to each conditioner and shall be powered by the BMS panel.

The units shall be manufactured by Lifescience Products, Ranger's Lodge, Cornbury Park, Oxfordshire. OX7 3HL. Contact: Darren Stacey. Tel: 01608 811707, Fax: 01608 819060, e-mail: sales@lifescience.co.uk.

Provide technical submittal for review prior to final procurement.

Incoming Mains Water Supply

The existing primary mains cold water supply to the site shall be re-used to supply the new building.

The Contractor shall include for the following works

- Retain existing primary Anglian Water incoming supply, meter, stop valve – from site boundary
- Trace / locate route of existing incoming buried supply (note – on-site buried pipework is client asset, not Anglian Water)
- Locally strip back buried supply pipework serving existing building.
- Make new connection onto existing buried pipework externally, and route new buried pipework to enter building.

The new supply shall be configured / re-routed to enter the building as per the tender drawings. The new buried supply shall avoid being routed to the south of the building (to avoid footprint of future building extension). Refer to tender drawings for details.

New buried pipework shall be run in MDPE pipework in accordance with section 2 of this specification. Include for the new supply to be run in barrier pipe / puriton spec.

Refer to tender drawings.

The Principle Contractor shall make allowance for all excavation / backfilling / making good in connection with the buried mains cold water pipework works.

The Contractor shall Contact local Water Supply Authority and co-ordinate visits by their inspector as required.

Issue Water Supply Authority acceptance of compliance with the current Water Supply Regulations.

Pressure test system and commission including all equipment as detailed in Section 2.

Flush out, cleanse and chlorinate complete system, including incoming mains and all distribution pipework as detailed in Section 2.

Water Metering

Provide line-size manual read water sub-meter on primary incoming mains cold water supply within building at point of entry. Refer to tender drawings.

Final Connections

Final connections to all items of sanitary ware (supplied and fitted by others) shall be by the Mechanical Contractor.

All final connections to outlets shall be via screwdriver operated ball-o-fix valves.

Sanitary ware / taps / traps etc is specified by the Architects, and is included within the main contract tender documentation.

Flexible connections to new sanitary-ware etc (or anywhere within the system) are not to be used.

External Water Point

Provide and install 2no. backplate mounted hose union bib tap located externally, local to the plantroom.

Outlet to be complete with service isolation valve and appropriate backflow protection device (double check valve).

All external water points shall be provided with frost protected stainless steel protective enclosure - as Arrow Valves Model HUTGT

Urinal Flush Controller

Provide water saving device, which prevent automatic flushing of urinals during un-occupied periods, at Male WC urinals.

The urinal flush controllers shall incorporate PIR detector / controller and solenoid valve and shall be suitable for 230V electrical supply.

Insulation

All domestic hot and cold water pipework shall be thermally insulated in accordance with this specification.

The only exceptions will be short lengths of exposed pipework forming appliance final connection.

Cold water insulation shall include valves, flanges etc., and shall incorporate a continuous vapour barrier. Refer to specification section 2 for further details.

Trace Heating

All cold water services pipework run within roof void shall be thermally insulated and trace heated for frost protection purposes (cold roof void)

System shall be as Raychem / Tyco XL-Trace or equal and approved and shall include XL-trace heating cable, rayClic accessories, power connection units, electronic thermostat (line sensing type), and other necessary ancillaries.

Final required configuration shall be assessed by the Contractor at tender stage.

Installation, testing and commissioning shall be fully in accordance with manufacturers requirements.

All trace heating system components shall be provided by the mechanical contractor. Electrical power supplies shall be provided to the system by the project electrical contractor. All outgoing trace heating wiring from the power supply unit / thermostat onwards shall be the responsibility of the mechanical services contractor, along with provision of containment (conduit) between the power supply unit, and nearest section of cold water pipework.

Sterilization

All domestic hot and cold water pipework shall be sterilised and flushed fully in accordance with this specification.

Sterilization certificates shall be provided prior to practical completion indicating healthy potable water available prior to handover.

Test results indicating biological counts, including legionellae, within the systems shall be made available before acceptance.

Include the following samples for bacterial and legionellae analysis at completion stage.

2 No hot outlet
2 No cold outlets

Satisfactory certification shall be required for the new systems prior to completion / handover. The Contractor shall take care to ensure that they include for this specific requirement. The Contractor shall note that the Consulting Engineer will specifically request bacterial analysis results to be provided prior to any practical completion of the project.

The Contractor shall therefore specifically identify within their program of work with the Principle Contractor this specific requirement and should note that generally bacterial analysis results take up to 10 days to be returned from external water analysts.

Heating System Supply

The Mechanical Contractor shall provide a water make up supply to the new heating system fill and pressurisation unit. The supply shall comprise a supply to the make up break tank and also a quick fill connection. The quick fill shall have a removable flexible connection, with isolating valves.

Provide appropriate back-flow prevention device in accordance with water authority requirements.

3.11 DOMESTIC HOT WATER SERVICES

3.11.1 INTRODUCTION

Provide centralized domestic hot water generation and storage, with heat input from a high temperature air source heat pump system.

Provide piped domestic hot water distribution to sanitary appliances, showers, sinks and other appliances.

3.11.3 SYSTEM DESCRIPTION

1no. storage type hot water cylinder / calorifier shall be provided within plantroom area.

New (adequately sized) domestic hot water services F&R shall be extended to serve all outlets.

To prevent the development of Legionellae bacterium the temperature of stored / distributed water shall always be maintained above 60^{O}C. Outlet temperatures at public accessed hand washing / shower facilities shall be locally controlled to 43ºC through fail-safe blending valves.

Unblended hot water outlets shall be provided with suitable warning labels.

A pumped secondary return circulation system shall be utilized to maintain supply temperature at acceptable temperatures.

All domestic water services systems shall be installed in accordance with the following :-

- BS8558 Specification for design, installation and testing and maintenance of services supplying water for domestic use within buildings and their curtlilages
- BS-EN 806-2 Specification for installations inside building conveying water for human consumption
- CIBSE Guide G Public Health Engineering
- CIBSE TM13 'minimising risk of Legionnaires' disease'
- HSE L8 legionnaires disease-control of legionella bacteria in water systems - Approved code of practice and guidance
- Water Supply (Water Fittings) Regulations 1999

Distribution Pipework and Fittings

Provide and install new domestic hot water services flow and return pipework distribution systems to feed all appliances and outlets.

DHWS distribution shall in general terms serve the following

Sinks
Wash hand basins
Showers

The Contractor shall install and make all final connections to new sanitary fittings. All internal pipework shall be run in copper.

Pressure on thermostatic and blending mixing valve hot and cold connections shall be balanced.

Primary pipework shall generally be routed via the roof voids (and flat roof area ceiling void), dropping to low level to serve outlets. Refer to section drawing. The tender drawings indicate approximate routings, final routings shall be assessed by the Contractor at installation stage, including coordination with the roof structure / electrical services.

The pipework shall be configured so as supplies to individual areas are valved for isolation. Provide drain cocks at all low points. Include a service isolation valve at each appliance or outlet.

All distribution pipework shall be concealed wherever possible generally routed within roof / ceiling voids and within accessible service risers / IPS systems where available.

Any exposed final pipework connections within rooms and at low level shall generally be exposed to view and in-insulated. Additional wall clips shall be provided for robustness.

Any exposed shower pipework shall be stainless steel (not chrome plated) for robustness.

DHWS Generation

1no. domestic hot water services storage cylinder / calorifier shall be provided, located within plantroom area.

Storage vessel requirements are detailed below.

TYPE	Stainless steel, factory insulated.
PRIMARY FLUID	LTHW (from high temperature ASHP system)
PRIMARY FLUID TEMPS	80/70degC
SECONDARY FLUID	Domestic Hot Water
SECONDARY FLUID TEMPS	65 / 10 degC
CAPACITY	700 litres
HEAT INPUT	25kW
DE-STRATIFICATION PUMP ?	Yes
ANCILLIARIES	press/temp relief valve, altitude/temp gauge, anti-vac valve, drain cock, BMS sensor pockets, inspection / cleaning port, vessel insulation, Clean finish outer casing with integral insulation, CE / BBA / WRC approvals, Manufacturers unvented kit and associated temperature / pressure safety controls

Note – the duty of the above is designed to suit the future (extended) building footprint.

Equipment shall be installed fully in accordance with manufacturers requirements and the requirements of the current Water Supply, Water Fittings Regulations.

Provide vessel de-stratification pump as detailed on the schematic drawings.

Note restrictions on plant area size. Ensure that adequate maintenance access is provided. Final cylinder selection / dimensions / configuration to be developed to suit plantroom setting out.

Provide temperature gauges and BMS immersion sensors on the primary DHWS F&R pipework local to the domestic hot water cylinder.

Provide technical submission for Engineer review prior to final procurement.

DHWS Circulation Pump

A secondary circulation pump shall be installed on the domestic hot water return pipework local to the hot water heater within the plantroom to offset distribution heat losses and maintain acceptable distribution temperatures. Pump shall be of the direct coupled type and shall be manufactured by Grundfoss or equal.

Include for temperature gauge on the main DHWS return local to the water heater.

Provide sufficient lockshield regulating valves within the system to enable effective balancing of the secondary return pipework.

REF	P.05
PURPOSE	domestic hot water primary circulation
DUTY	0.25 l/s @ 30kPa
TYPE	inverter controlled (run at fixed duty) DHWS circulator pump
MANUFACTURER	Grundfoss (or equal and approved)
ANCILLIARIES	suction / discharge binder test points and pressure gauges, flex pipework connections, differential pressure switch (to BMS), anti-vib. Mountings.

Note – the pump duty given above suits the future (extended) building footprint. The pump shall initially be commissioned to operate at a lower flow rate, to suit this project. Initial flow rate to be advised by Engineer.

Thermostatic Blending Valves

Domestic hot water blending valves shall be fitted to all basins to limit draw off temperatures to safe levels. Only supplies to kitchen and cleaners sinks shall be un-blended. Refer to tender drawings for details.

Under basin valves shall be as manufactured by Horne as their TMV3 type valve (or equal). Valves shall be located within IPS or beneath basins (exposed to view with matched plastic covers).

Thermostatic blending valves shall be provided in the following locations: -

- Changing 3 1 No. valve serving 2 No. wash basins
- Changing 4 1 No. valve serving 2 No. wash basins
- Official 2 1 No. valve serving 1 No. wash basin
- Changing Plcs 1 No. valve serving 1 No. wash basin
- Access WC 1 No. valve serving 1 No. wash basin
- Male WC 1 No. valve serving 2 No. wash basins
- Female WC 1 No. valve serving 2 No. wash basins
- Amb WC 1 No. valve serving 1 No. wash basin

All valves shall be WRC and TMV 3 scheme approved, commissioned by the Contractor to achieve the required mixed hot water outlet temperature and be complete with integral strainer and non return valves and mixer body union isolation valves.

Separate mixing valves shall be provided within shower areas, see below.

All outlets at 43°C plus shall be provided with **"Danger - Very Hot Water"** labels.

Showers

At each shower point provide Delabie sporting 2 Anodised aluminum Time flow shower panel:

In addition at each shower location provide matched Delabie premix compact thermostatic mixing valve, complete with integral Filters and non-return valves (ie. 1no. valve per shower head).

TMV's shall be located within ceiling / roof void, directly above shower panel. Length of blended pipework between TMV and shower panel to be kept to a minimum.

Coordinate maintenance access to each blending valve with Principle Contractor.

Note – any pipework exposed to view between TMV and shower panel shall be run in stainless steel pipework (not chromed plated) with stainless saddles and screws for robustness.

Provide matched system within changing places / disabled shower facilities, in accordance with Doc. M requirements – see below.

Contact – Smit Thakar, Delabie UK Ltd, 07917 867831

Final shower / TMV device selections shall be confirmed with engineer prior to ordering. Provide technical submission.

Changing Places Shower

Provide 1no. disabled / assisted shower, in accordance with Doc. M requirements. To incorporate head, fail-safe mixing valve (TMV3 type).

As RADA V12 Thermostatic Mixing Valve complete with matched riser rail, head etc (or equal and approved)

Contractor to include for all interconnecting shower pipework. Shower feed pipework shall be surface mounted within the cubicle, with the service valves exposed at high level (stainless steel 1/4 turn type) for ease of future maintenance

Exposed shower pipework shall be stainless steel (not chromed plated) with stainless saddles and screws.

The above specification is provided for the purposes of tender. Include for final review of the disabled shower equipment proposals with Engineer / Architect prior to ordering.

Final Connections

Final connections to all items of sanitary ware (supplied and fitted by others) shall be by the Mechanical Contractor. All final connections to outlets shall be via screwdriver operated ball-o-fix valves.

All final connections to outlets shall be via screwdriver operated ball-o-fix valves.

Flexible connections to new sanitary-ware etc (or anywhere within the system) are not to be used.

Insulation

All domestic hot and cold water pipework shall be insulated in accordance with this specification.

The only exceptions will be short lengths of exposed pipework forming appliance final connection.

Sterilization

All domestic hot and cold water pipework shall be sterilised and flushed fully in accordance with this specification - prior to completion and handover of each phase.

Sterilization certificates shall be provided prior to practical completion indicating healthy potable water available prior to handover.

Test results indicating biological counts, including legionellae, within the systems shall be made available before acceptance.

Include the following samples for bacterial and legionellae analysis at completion stage.

2 No hot outlet
2 No cold outlets

Satisfactory certification shall be required for the new systems prior to completion / handover. The Contractor shall take care to ensure that they include for this specific requirement. The Contractor shall note that the Consulting Engineer will specifically request bacterial analysis results to be provided prior to any practical completion of the project.

The Contractor shall therefore specifically identify within their program of work with the Principle Contractor this specific requirement and should note that generally bacterial analysis results take up to 10 days to be returned from external water analysts.

3.12 PRIMARY HEATING PLANT

3.12.1 INTRODUCTION

Supply install and commission air source heat pump plant to provide space heating and domestic hot water generation for the building.

The air source heat pump plant (ASHP) shall have the capability of operating at high temperatures (to suit the domestic hot water system) and shall consist of indoor (plantroom) mounted hydro boxes, and external ASHP condenser module.

3.12.3 SYSTEM DESCRIPTION

Air Source Heat Pump

Provide install and commission a 'high temperature' air source heat pump heating plant – to provide heat input to the domestic hot water and space heating systems.

System shall comprise

- Outdoor heat pump unit module (1no.)
- Indoor high temperature hydro-box module (2no.)
- Interconnecting DX refrigerant pipework / joints etc
- Primary LTHW pipework / pumps etc
- Buffer vessel
- Secondary LTHW pipework / pumps (serving DHWS and space heating system)
- Matched controls

Equipment shall be as Samsung VRF DVM outdoor heat pump units and indoor high temperature hydro box units, operating with refrigerant R410A.

The primary ASHP plant shall be sized to provide minimum total 45kW output to the domestic hot water / space heating systems, and shall operate at 80 / 75 degC primary system F&R temperatures.

Note - this duty is sufficient to also accommodate the future (extended) building footprint.

The following contact is familiar with the project and can be contacted to progress a quotation

Matthew Westwood
Samsung Climate Solutions
m.westwood@samsung.com
07867 372982

The air source heat pumps systems in total shall be manufactured by Samsung. The installation of the system shall be carried out by a Samsung approved Specialist Installer, employed by the Mechanical Contractor. The Mechanical Contractor shall be fully responsible for the coordination between this Specialist and himself.

If the contractor wishes to propose an alternative to Samsung this must be qualified and priced separately within the tender return.

ASHP / hydrobox units shall be provided with manufacturers matched control modules.

In addition manufacturers matched overall integrated management system controller module shall be provided incorporating BACNET interface (to enable interface to BMS – see separate controls system below)

Primary electrical supplies shall be provided to the ASHP plant by the project electrical contractor. Interconnecting controls wiring between the indoor / outdoor units and Samsung controls shall be the responsibility of the mechanical contractor.

The systems shall be installed and commissioned fully in accordance with the ASHP manufacturers requirements / instructions.

On completion the systems shall be subject to final commissioning / verification checks by the equipment manufacturer. Include for ASHP manufacturers optional 'assisted commissioning' visit.

Air source heat pump system technical submittals shall be provided to the Engineer for review / comment prior to final procurement.

Outdoor Condenser Unit

Provide 1no. externally located condenser unit in the location identified on the tender drawings (within external louvred compound, to Architects details).

Outdoor unit shall be as Samsung DVM S2 heat pump unit (AM160 size), suitable for 3 phase electrical supply.

The outdoor unit shall be so laid out to allow ease of maintenance access and conform to the manufacturer's requirements regarding air circulation.

The Contractor shall include for associated outdoor unit bases / brackets. The units shall incorporate rubber mounting feet, which in turn shall be mounted off via 12.5mm thick resilient mounts (eg. Eurovib RR1 Resilient Pads, or similar approved).

Provide provision for condensate collection / drainage local to the air source heat pump – in accordance with manufacturers requirements.

Electrical power wiring to the external condenser (and other items requiring power – controls, etc.) is included within the Electrical Contractors package. All outgoing interconnecting ASHP control wiring (and containment) shall be by the Mechanical Contractor / Specialist Installer.

Provide new DX refrigerant pipework extended between the externally mounted condenser, and the indoor hydro units within the plantroom. This shall be routed via the ceiling void.

DX pipework installation shall be fully in accordance with BS EN 378 : 2000 Parts 1-4, and manufacturers design and installation instructions.

Primary Hydro Box Units

Provide internal plantroom located air source heat pump indoor hydro box units in the locations identified on the tender drawings (plantroom). 2no. indoor hydro box units shall be provided.

Hydro box units shall be as Samsung VRF DVM high temperature hydro units, (2no. size AM250) suitable for single phase electrical supplies.

Include for the installation of suitable sized (heavy grade steel) heating water flow and return pipework between the ASHP's indoor hydro modules, and primary header / buffer vessel

The tender drawings shows an approximate plantroom arrangement of the indoor units within the plantroom. The Contractor shall be responsible for final installation stage spatial coordination within the plantroom - assessing final layouts, mounting arrangement etc – and

overall coordination with all other plantroom equipment (ensuring acceptable future maintenance access).

The Contractors attention is drawn to the plantrooms. Limited space exists, detailed final installation stage coordination / setting out will be required, including coordination with the electrical services.

Each ASHP HT hydro module to have separate primary F&R pipework, routed following the principles identified on the drawings.

Primary water F&R pipework shall be provided complete with the following (see also Samsung details).

- Flushing bypass
- Isolating valves
- Flexible connections
- Test points
- Drain cocks
- Non-return valve
- Commissioning station
- Strainers
- Circulation pump
- Temperature / pressure gauges

Note 5degC F&R temperature differentials required for the primary air source heat pump citrcuit.

Buffer Storage Vessel

Provide plantroom located buffer vessel, serving the domestic hot water / space heating systems – thermally insulated vertical cylinder type.

For purposes of tender include for total storage volume at 500 Litres.

Include for suitably sized primary side F&R header pipework between buffer vessel and 2no. hydro box circuits.

Buffer vessel to have BMS sensor pockets at differing vertical heights – see schematic.

Refer to tender drawings for details.

System Fill & Pressurization Unit

Provide and install a heating system fill and pressurisation unit comprising direct mains type fill and pressurisation unit, pressure and safety interlock controls, expansion vessel, system quick fill connection, system connection via anti-gravity loop with AAV, mains water connection.

Unit to be complete with in-built controls, with interlink to BMS.

Equipment to be manufactured by Mikrofill as their Mikrofill 3 direct type unit complete with 140 litre size MikroPro expansion vessel

Note – expansion vessel size provided for purposes of tender, final size to reviewed with Engineer prior to procurement.

Extend plantroom cold water services to serve heating pressurisation equipment.

System Dosing

Provide and install over the heating F & R pump set a suitably sized dosing pot with the necessary isolating valves.

Provide heating system dosing levels in accordance with heat pump manufacturers requirements.

Provide final testing and chemical analysis of heating system water quality in accordance with heat pump manufacturers requirements.

De-Aerator and Dirt Separator

The Contractor shall provide, install and fully commission a de-aerator and air separator unit, within the combined flow pipework on the secondary side of the buffer vessel - located within the plantroom as shown on the schematic drawings.

The unit shall be Installed with isolation valve and binder test points either side of unit.

Unit shall be complete with 1 No. automatic air vent with threaded connection for vent pipe, 1 No. releasing valve for purging through installation stage and drain valve

The unit shall be as manufactured by Flowmech as their air-dirt separator – contact :

Flow Mech Products Ltd, Abbey House,
daniel.s@flowmech.co.uk
07811 348 278

Unit to be installed fully in accordance with manufacturers requirements.

Thermal Insulation

Include to thermally insulate all primary LTHW heating pipework within plantrooms.

Refer to standard specification, section 2 for detailed thermal insulation requirements. Insulation outer finish shall be standard foil faced.

Detailed thermal insulation requirements as section 2 of this specification.

System Balancing

Provide and install correctly sized and selected commissioning sets to enable the complete heating installation to be balanced to achieve the design flow rate through each primary / secondary circuit.

Include to employ a commissioning specialist to balance the heating system.

3.13 LOW TEMPERATURE HOT WATER HEATING

3.13.1 INTRODUCTION

Provide a low temperature hot water heating system serving space heating, domestic hot water, and mechanical ventilation systems.

3.13.3 SYSTEM DESCRIPTION

Distribution Pipework and Fittings

Provide the following separate heating circuits, refer to schematic drawing.

1. Space heating - variable temp – serving radiators, pipe-coils, ventilation unit heater batteries (80 / 70)
2. DHWS primaries - constant temp (80 / 70)

LTHW flow and return distribution shall be extended from the primary air source heating plant to serve the following items

- Heat emitters (radiators / pipe-coils)
- Domestic hot water cylinder
- Mechanical ventilation systems

Primary pipework shall generally be routed via the roof voids (and flat roof area ceiling void). Refer to section drawing. The tender drawings indicate approximate routings, final routings shall be assessed by the Contractor at installation stage, including coordination with the roof structure / electrical services.

Where equipment requiring maintenance access is located within the roof voids (eg. Ventilation unit connections) ceiling access hatches and roof void walkways shall be provided by the Principle Contractor. Include for liaison with Principle Contractor to establish equipment locations and walkway setting out.

For the purposes of tender, pipework shall be heavy-grade steel as standard specification. Valves, fittings, supports, jointing methods etc., shall be as standard specification.

As an alternative the Contractor can propose cost effective alternatives (eg. copper). This shall be clarified within the returned tender, and priced as a cost saving option.

Include isolation valves at each major zone branch.

Include isolation valves at each item of heating plant or equipment.

A pair of valves (and capped / flanged) spare LTHW VT connections shall be terminated within the plantroom – for allow future extension to extended building footprint, see schematic drawing.

All distribution pipework except where deemed useful heating surface shall be insulated.

Connections to plant shall incorporate isolation and flow commissioning valve sets, together with a filtered, valved bypass installed between each flow and return to enable circulation proving and system detritus removal during initial commissioning. The bypass valves shall be locked closed during final commissioning.

Heating circuits shall incorporate variable volume 2 port / TRV control strategy, with circulation pump duties reducing automatically depending upon required load.

Radiator Space Heating

Provide radiator heating as per the tender drawings.

Distribution pipework shall generally be run in concealed accessible locations in roof / ceiling voids. Final connections to radiators at low level shall be exposed and un-insulated.

Radiators shall be standard steel panel radiators, as Stelrad Elite (or equal).

Provide low surface temperature (LST) within any disabled wc's – Stelrad LST2 type (or equal)

At each radiator provide a thermostatic radiator valve on the flow connection, and a lockshield valve on the return connection.

Allow for thermostatic radiator valves to be Danfoss code No 013G014900, with built-in sensor code 013G201000, which includes locking and limiting. (These are to be set up so that the specified room temp cannot be exceeded, but the occupants can turn the radiator off).

Before placing radiators on order the heights, length and depth of each radiator shall be checked by the Contractor for size suitability against the proposed location and furniture layout.

Radiator schedule

RAD	ROOM	HEIGHT	WIDTH	TYPE	OUTPUT
R.01	*deleted*				
R.02	*deleted*				
R.03	entrance	700H	900W	P+	1437 watts
R.04	change 3 WC	700H	700W	K1	799 watts
R.05	change 4 WC	700H	700W	K1	799 watts
R.06	chng plcs	650H	760W	LST P+	580 watts
R.07	lobby	700H	800W	P+	1278 watts
R.08	kitchen	700H	700W	P+	1118 watts
R.09	club rm	600H	1200W	P+	1916 watts
R.10	club rm	600H	1200W	P+	1916 watts
R.11	male WC	700H	500W	P+	799 watts
R.12	corridor	700H	800W	P+	1278 watts
R.13	fem WC	700H	500W	P+	799 watts
R.14	corridor	700H	500W	P+	799 watts

Heat emitters are sized to suit 80 / 70°C. heating F&R.

Pipe Coil Heat Emitters

The Contractor shall supply, install and commission heavy grade steel pipe heating coils at low level in the changing rooms and referee changing rooms, as indicated on the tender drawings.

Under-bench pipe-coils shall be formed from over-sized heavy grade steel pipework and fittings, securely fixed back to side-wall. Provide in-line thermostatic radiator valve on the flow connection, and a lockshield valve on the return connection.

The pipe coils shall be as follows: -

REF	ROOM	PIPE COIL SIZE	OUTPUT
PC.01	*deleted*		
PC.02	*deleted*		
PC.03	*deleted*		
PC.04	Changing 3	8.5m of 50dia F&R (ie. 17m total)	2295 watts
PC.05	Changing 4	8.5m of 50dia F&R (ie. 17m total)	2295 watts
PC.06	Official 2	1.8m of 100dia F&R (ie. 3.6m total)	800 watts

The low level pipe coils shall be fully coordinated with the benching installation and dimensions fully checked prior top manufacture and installation.

Air Handling / Domestic Hot Water

Extend 'constant temperature' LTHW heating F&R to serve the domestic hot water calorifier.

Extend 'variable temperature' LTHW heating F&R to serve the heating coils within 2no. changing room heat recovery ventilation units.

Connections shall incorporate flushing bypass, 2 port control valves, isolation and flow commissioning valve sets etc – see schematic details.

Pump Sets

Provide and install new heating circulation pumps, specification as follows :

Heating pumps specifications as follows :

REF	P.01
PURPOSE	primary LTHW hydro-box circulation
TYPE	inverter driven (run at fixed duty), single head, circulator pump
DUTY	1.20 l/s @ 75kPa
MANUFACTURER	Grundfoss (or equal and approved)
ANCILLIARIES	suction / discharge binder test points and pressure gauges, flex pipework connections, differential pressure switch (to BMS), anti-vib. mountings

REF	P.02
PURPOSE	primary LTHW hydro-box circulation
TYPE	inverter driven (run at fixed duty), single head, circulator pump
DUTY	1.20 l/s @ 75kPa
MANUFACTURER	Grundfoss (or equal and approved)
ANCILLIARIES	suction / discharge binder test points and pressure gauges, flex pipework connections, differential pressure switch (to BMS), anti-vib. mountings

REF	P.03
PURPOSE	secondary LTHW circulation – variable temp – space heating
TYPE	variable speed inverter pump, (duty reducing on closing TRV's / 2 port valves) twin head, circulator pump
DUTY	0.75 l/s @ 85kPa

MANUFACTURER	Grundfoss (or equal and approved)
ANCILLIARIES	suction / discharge binder test points and pressure gauges, flex pipework connections, differential pressure switch (to BMS), anti-vib. mountings
REF	P.04
PURPOSE	secondary LTHW circulation – constant temp – DHWS primaries
TYPE	variable speed inverter pump, (duty modulated according to load) twin head, circulator pump
DUTY	0.59 l/s @ 65kPa
MANUFACTURER	Grundfoss (or equal and approved)
ANCILLIARIES	suction / discharge binder test points and pressure gauges, flex pipework connections, differential pressure switch (to BMS), anti-vib. mountings

Pumps to be supplied by Grundfos as their Magna range.

Contact	Andrew Rowland GRUNDFOS Pumps Ltd
Direct:	+44 1942 263623
Mobile:	+44 07971950802

Include to adequately support pump sets.

Include main system strainer ahead of all pump sets.

The pump duties provided above are for the purposes of tender. Final pump selections to be reviewed with Engineer prior to procurement, in line with final system resistance calculations.

Note – pump duty for P.03 given above suits the future (extended) building footprint. The pump shall initially be commissioned to operate at a reduced duty, to suit this project. Initial flow rate to be advised by Engineer.

System Balancing

Provide and install correctly sized and selected commissioning sets to enable the complete heating installation to be balanced to achieve the design flow rate through each circuit.

Include to employ a commissioning specialist to balance the heating system.

Thermal Insulation

Include to thermally insulate all new heating pipework where not required as useful heating surface.

Refer to standard specification, section 2 for detailed thermal insulation requirements / spec / plantroom finish etc.

3.14 MECHANICAL VENTILATION

3.14.1 INTRODUCTION

Provide mechanical ventilation, to maintain internal conditions appropriate for the use of the spaces.

3.14.2 SYSTEM DESCRIPTION

Primary Changing Room Heat Recovery Ventilation Systems – HRU 03, 04

Supply install and commission ducted supply and extract heat recovery ventilation systems to serve main changing rooms areas.

Multiple systems shall be provided – refer to tender drawings.

Each ventilation unit shall incorporate a trimmer heater battery – with heat input from the variable temperature LTHW system.

Design air change rates as below, supply air volumes shall be 95% of extract volume.

Systems shall each comprise

- External louvre terminations
- Atmosphere side attenuators
- Ventilation unit including cross flow heat exchanger unit with trapped drain, supply and extract fans, filter elements, summer bypass, LTHW heater / trimmer battery
- Condensate drains
- System side attenuators (if required to maintain specified acoustic criteria) + cross talk attenuators
- Supply air distribution ductwork & diffusers
- Extract air distribution ductwork & grilles
- Matched stand-alone controls system

Heat recovery ventilation units shall be mounted within ground floor changing room roof voids, local to the areas served. Refer to conceptual drawings for details.

Supply and extract ventilation ductwork to be routed via the roof void, connecting to ceiling mounted supply and extract grilles.

Ceiling mounted supply diffusers shall be 4 way louvre face type as Gilberts DG type (or equal). Extract grilles shall be eggcrate type (as Gilberts GE type or equal). Refer to equipment schedules below for details.

Contractor shall pay particular attention to final locations of ventilation units within roof voids to ensure that acceptable future maintenance access can be achieved. Ceiling access hatches and roof void walkways shall be provided by the Principle Contractor. Include for liaison with Principle Contractor to establish equipment locations and walkway setting out.

Units to be provided with stand-alone manufacturers Eco-smart controls systems. Each system shall operate on constant trickle ventilation, with boost ventilation automatically activated on room occupancy via PIR detectors, and run-on timers.

A 230V Electrical supply to be provided to all ventilation units by project electrical contractor. All fans, controls, PIR sensors etc to be provided by mechanical contractor. All control wiring between fans and control equipment to be responsibility of mechanical contractor (including containment).

Provisional ceiling mounted PIR sensor positions are indicated on the drawings. To be reviewed at installation stage.

Supply and extract ventilation units shall be - Nuaire Xboxer XBC+ system. Contact Mike Waddington (Nuaire) – 07767 298 202 (or equal and approved).

Summary specification :-

~~**HRU 01**~~ **deleted**

~~**HRU 02**~~ **deleted**

HRU 03 **Changing Room 4**
Required Duty 0.150m3/s
Model XBC+ size 25

HRU 04 **Changing Room 3**
Required Duty 0.161m3/s
Model XBC+ size 25

Provide all matched ancillaries (attenuators, controls etc.) as set out above, and as per the tender drawings.

Attenuators shall be matched Nuaire units – 1050mm length.

Provide technical submittal proposals for Engineer comment / review prior to final procurement.

Secondary WC / Changing Room Heat Recovery Ventilation Systems – HRU05, 06

Supply install and commission ducted supply and extract heat recovery ventilation systems to serve WC areas

Multiple systems shall be provided – refer to tender drawings.

These ventilation units shall not incorporate trimmer heater batteries

Design air change rates as below, supply air volumes shall be 95% of extract volume.

Systems shall each comprise

- External louvre terminations
- Atmosphere side attenuators
- Ventilation unit including cross flow heat exchanger unit with trapped drain, supply and extract fans, filter elements, summer bypass, NO HEATER BATTERY
- Condensate drains
- System side attenuators (if required to maintain specified acoustic criteria) + cross talk attenuators
- Supply air distribution ductwork & diffusers
- Extract air distribution ductwork & grilles
- Matched stand-alone controls system

Heat recovery ventilation units shall be mounted within ground floor changing room roof voids, local to the areas served. Refer to conceptual drawings for details.

Supply and extract ventilation ductwork to be routed via the roof void, connecting to ceiling mounted supply and extract grilles.

Ceiling mounted supply diffusers shall be 4 way louvre face type as Gilberts DG type (or equal). Extract grilles shall be eggcrate type (as Gilberts GE type or equal). Refer to equipment schedules below for details.

Contractor shall pay particular attention to final locations of ventilation units within roof voids to ensure that acceptable future maintenance access can be achieved. Ceiling access hatches and roof void walkways shall be provided by the Principle Contractor. Include for liaison with Principle Contractor to establish equipment locations and walkway setting out.

Units to be provided with stand-alone manufacturers Eco-smart controls systems. Each system shall operate on constant trickle ventilation, with boost ventilation automatically activated on room occupancy via PIR detectors, and run-on timers.

A 230V Electrical supply to be provided to all ventilation units by project electrical contractor. All fans, controls, PIR sensors etc to be provided by mechanical contractor. All control wiring between fans and control equipment to be responsibility of mechanical contractor (including containment).

Provisional ceiling mounted PIR sensor positions are indicated on the drawings. To be reviewed at installation stage.

Supply and extract ventilation units shall be - Nuaire Xboxer XBC+ system. Contact Mike Waddington (Nuaire) – 07767 298 202 (or equal and approved).

Summary specification :-

HRU 05	**WC Core**
Required Duty	0.108m3/s
Model	XBC+ size 15

HRU 06 **Official 2 / Changing Places**
Required Duty 0.097m3/s
Model XBC+ size 15

Provide all matched ancillaries (attenuators, controls etc.) as set out above, and as per the tender drawings.

Attenuators shall be matched Nuaire units – 1050mm length.

Provide technical submittal proposals for Engineer comment / review prior to final procurement.

Cleaners Room / Plantroom Extract Ventilation – EF.01

Supply install and commission an extract ventilation system serving the cleaners room.

This shall also provide extraction to the plantroom cupboard as per the tender drawings – to provide enhanced ventilation, and avoid risk of room overheating leading to elevated cold water storage temperatures.

System shall comprise the following

- External louvre termination.
- Extract air ductwork and grilles
- In-line mounted extract fan unit (EF.01)
- Fan manufacturers matched controls

Extract fan shall be as Nuaire Dave unit, size DE.2 unit. Required air-flow = 0.06 m3/s.

Ventilation unit shall be provided with manufacturers on-board eco-smart controls. Unit shall run constantly.

Extract fan / ductwork shall be routed at roof void level.

Extract grille shall be eggcrate type (as Gilberts GE type or equal). Refer to equipment schedule for details.

Additionally – provide door air transfer grilles for the centrally located plantroom cupboard, for air make-up, and additional natural ventilation. Provide 2 sets of high and low level mounted door air transfer grilles (ie. 4no. grilles in total). Grilles shall be 300 x 200mm door air transfer grille, with integral intumescent cores. As Gilberts Series FB, or equal.

Kitchen Ventilation – EF.02

Supply install and commission extract ventilation systems to the kitchen area.

This shall comprise 1no. domestic type cooker hood unit (with associated extract ducts to atmosphere)

In addition a separate general room extract system shall be provided comprising the following

- Extract ductwork and grille
- In-line extract fan (EF.02)
- Matched fan controls

The mechanical contractor shall supply and install 1no. domestic type cooker extract hoods above each cooker hob.

Hood shall be as CDA EVP121SS stainless steel linear extractor incorporating integral fan, telescopic chimney, aluminium grease filters, user controls. https://www.cda.eu/extractors/chimney-extractors/EVP121SS/

Unit shall be configured as fully extracting, the Contractor shall provide discharge ductwork extending from the hood, to a roof mounted atmosphere termination.

Separate general room extract system shall provide general extract ventilation to the room (via a ceiling grille).

An in-line extract fan shall be located within the roof void. Extract fan shall be as Nuaire Dave unit, size DE.2 unit. Required air-flow = 0.06 m3/s.

Room extract grille shall be eggcrate type (as Gilberts GE type or equal), with removable core (for cleaning purposes) Refer to equipment schedules for details.

General extract fan unit shall be provided with manufacturers on-board controls. Unit shall operate on / off via a wall mounted remote user controller located within the kitchen.

The Mechanical Contractor shall include to provide the controls, and remote user controller, and for all control wiring between the ventilation unit and controller. A direct 230V Electrical supply shall be provided to the ventilation unit by the project electrical contractor.

Mechanical contractor shall include to provide roof mounted ventilation terminations to atmosphere. This shall be as Vent-Axis 'mushroom cowl' roof termination sets (or equal), adequality sized / selected to suit the system air flow and duct sizes.

Particular attention shall be paid to ensuring a weather / watertight finish, including provision of curb upstand. Include for liaison with Main Contractor to agree and form penetrations.

Provide sufficient access doors at regular intervals within the ductwork systems to allow future cleaning and maintenance.

The above systems are specified on the basis that the kitchen appliances will be conventional domestic hob / cookers, and not a commercial catering kitchen (as agreed with Client).

Refer to tender drawings for details.

Supply and Extract Grilles

The Contractor shall supply, install and commission supply and extract grilles as indicated on the tender drawings and indicated below: -

Ref	Duty (m3/s)	Neck Size (mm)	Type	Integral VCD ?	Conn. size (mm)
SD.01	*deleted*				
SD.02	*deleted*				
SD.03	*deleted*				
SD.04	*deleted*				
SD.05	*deleted*				
SD.06	0.032	150 x 150	4 way louvre face	Y	125
SD.07	0.129	300 x 300	4 way louvre face	Y	250
SD.08	0.055	225 x 225	4 way louvre face	Y	150

SD.09	0.040	225 x 225	4 way louvre face	Y	150
SD.10	0.040	225 x 225	4 way louvre face	Y	150
SD.11	0.057	225 x 225	4 way louvre face	Y	150
SD.12	0.129	300 x 300	4 way louvre face	Y	250
SD.13	0.027	150 x 150	4 way louvre face	Y	125
EG.01	*deleted*				
EG.02	*deleted*				
EG.03	*deleted*				
EG.04	*deleted*				
EG.05	*deleted*				
EG.06	*deleted*				
EG.07	*deleted*				
EG.08	0.045	150 x 150	Eggcrate	Y	150
EG.09	0.032	150 x 150	Eggcrate	Y	125
EG.10	0.048	150 x 150	Eggcrate	Y	150
EG.11	0.081	200 x 200	Eggcrate	Y	200
EG.12	0.040	150 x 150	Eggcrate	Y	150
EG.13	0.055	200 x 200	Eggcrate	Y	150
EG.14	0.014	150 x 150	Eggcrate	Y	100
EG.15	0.042	150 x 150	Eggcrate	Y	150
EG.16	0.027	150 x 150	Eggcrate	Y	125
EG.17	0.081	200 x 200	Eggcrate	Y	200
EG.18	0.014	150 x 150	Eggcrate	Y	100
EG.19	0.043	150 x 150	Eggcrate	Y	150
EG.20	0.040	150 x 150	Eggcrate	Y	150
EG.21	0.060	200 x 200	Eggcrate	N	150
EG.22	0.030	150 x 150	Eggcrate	Y	125
EG.23	0.020	150 x 150	Eggcrate	Y	125

Grilles shall be manufactured by Gilberts (or equal). To progress a quotation contact :-

Martin Malyon
Tel: 07770 268 979
Email: martinmalyon@gilbertsblackpool.com

Additionally – provide door air transfer grilles for the centrally located plantroom cupboard, for air make-up, and additional natural ventilation. Provide 2 sets of high and low level mounted door air transfer grilles (ie. 4no. grilles in total). Grilles shall be 300 x 200mm door air transfer grille, with integral intumescent cores. As Gilberts Series FB, or equal.

External Louvres

Refer to conceptual tender ventilation drawings for external louvre / termination requirements.

Louvres shall be supplied and installed by the Mechanical Contractor, based on the tender drawings.

Mechanical Contractor supplied external louvres shall be of metal construction, polyester painted to a (non-standard) Architect approved RAL colour and be designed by the manufacturer to discourage rain from entering the ventilation system. Bird / vermin wire meshes shall be incorporated in all perforations through external walls.

The mechanical contractor shall provide suitably sized plenum boxes on the rear of each louvre

Ductwork adjacent to intake louvres shall be waterproof sealed and arranged to reject any ingressing rainwater to outside.

Louvres shall be As Gilberts Series WG (or equal), with 38mm pitch blades. As schedule below

Ref	Purpose	Air Flow	Size
EL.01	*deleted*		
EL.02	*deleted*		
EL.03	Intake	0.150 m3/s	400 x 400mm
EL.04	Discharge	0.150 m3/s	400 x 400mm
EL.05	Discharge	0.097 m3/s	400 x 400mm
EL.06	Intake	0.097 m3/s	400 x 400mm
EL.07	*deleted*		
EL.08	*deleted*		
EL.09	Intake	0.161 m3/s	400 x 400mm
EL.10	Discharge	0.191 m3/s	400 x 400mm
EL.11	Discharge	0.108 m3/s	400 x 400mm
EL.12	Intake	0.108 m3/s	400 x 400mm

Include for final liaison with Engineer / Architect prior to installation / procurement stage to agree final louvre positions, setting out, size and colour finish.

General Requirements for Mechanically Ventilated Rooms

The Mechanical Contractor shall include to install mechanical ventilation systems as follows including all louvres, ductwork & supports, ductwork insulation, regulation devices, fire dampers and access doors, air movement equipment, grilles and diffusers, and control systems.

Ventilation services shall generally be routed via the roof voids (and flat roof area ceiling void, where roof void does not exist). Refer to section drawing. The tender drawings indicate approximate routings, final routings shall be assessed by the Contractor at installation stage, including coordination with the roof structure / electrical services.

Supply and extract ductwork shall be concealed within the roof voids, diffusers shall be connected to main ductwork via short flexible connections and concealed diffuser plenum boxes.

All grilles and diffusers shall be complete with OBD and RAL 9010 20% gloss white powder coated finish.

Each branch duct shall be complete with volume control damper.

Final grille location shall be coordinated with the electrical services / lighting.

Distribution ductwork shall be sheet metal constructed in accordance with DW 144.

An adequate number of access doors shall be provided to facilitate future hygienic cleaning of ductwork installations and access to any fire dampers.

Ductwork attenuators shall be provided where indicated to achieve the suitable internal and atmosphere side noise levels.

Specific fan power - Ensure the specific fan power of the ventilation system meets the requirements of the Building Regulations and SBEM calculations.

General Natural Ventilation

General occupied areas of the building (ie. club room) shall make use of passive natural ventilation (opening perimeter windows), to provide adequate ventilation for occupancy and to control summertime overheating.

Opening windows shall be provided (installed by main contractor, specified by Architect) for provision of rapid / purge ventilation. Window trickle ventilators shall provide background ventilation – all in accordance with Building Regulations Part F.

3.15 MECHANICAL SERVICES CONTROLS / BMS

3.15.1 INTRODUCTION

The scope of the works will include the supply installation and commissioning of a simple Controls / Building Management System (BMS) for the project in order to provide control and monitoring of the space heating and domestic hot water systems.

3.15.2 SYSTEM DESCRIPTION:

The BMS shall be a software driven intelligent DDC BMS and shall be installed and commissioned by a suitable Controls Specialist.

The BMS will control and monitor the space heating, domestic hot water, and air source heat pump plant only.

A simple stand-alone software based intelligent (BMS based) controls system shall be provided – consisting of plantroom mounted control panel incorporating software driven intelligent outstation – designed, installed and commissioned by a suitable controls specialist.

The BMS shall be self contained, associated with this building only.

The controls specialist shall also provide web-browser based interface to the control system – to allow the client to remotely set / alter heating system user programable occupancy periods (either from a PC within the building, or from a remote off-site PC, via the internet).

Note that control panel will be located in the left hand side plantroom, and shall connect to mechanical plant and equipment within both plantrooms.

Control Panel Philosophy

A wall mounted combined power and outstation control panel shall be provided within the plantroom.

The control panel shall contain the power supplies, starters, circuit protection etc. required to connect the plant items and supply them with the correct power requirements. The panel shall be provided with a door-interlocked isolator to ensure that internal power supplies are isolated when the door is open.

The panel shall also contain the necessary devices to control and interface with the power section of the panel.

Generally the control panel shall be complete with the following (in addition to other necessary equipment):-

- Mains supply to all required plant and equipment.
- Fascia mounted 'Hand / Off / Auto' switches for the various plant items.
- Indicator lamps for each control switch showing 'Run / Trip', 'Selected / Off', 'Common Alarm' etc. Facility to manually change over pumps etc.
- Lamp test facility.
- Display panel / keypad / outstation for BMS user access

Data network point shall be provided by the Electrical Contractor local to the control panel / outstation location.

The Contractor shall note the limited available space within the plant room, and size the control panel accordingly.

3.15.3 CONTROL REQUIREMENTS:

The control provisions / strategy shall be as follows:

Space Heating

Optimised start and stop of space heating system (via external / internal temperature sensors)

Outside weather compensation of LTHW flow temperatures (variable temp. space heating circuit), with influence from internal space temperature, monitored via 2no. averaging sensors. To be achieved via 3 port mixing valve.

User programmable time schedule with weekday, weekend, holiday operating times.

Space heating shall operate in set-back mode outside of occupied hours (set back temp to be agreed).

Full BMS interface (BACnet type) to packaged air source heat pump plant.

Control of ASHP modules, fault monitoring, etc. Controls to maintain required system flow temperature as measured within the buffer vessel (via 3no. BMS temp sensors within buffer vessel, at different heights).

Control of LTHW pumps to suit. Automatic load share and fault changeover of duplex twin head pumping sets.

Three stage frost protection of building / heating system

Interlinks with pressurisation system for control and safety interfaces.

Allow for 2no wall mounted internal BMS temperature sensors – see tender drawings.

Domestic Hot and Cold Water Services

Control of storage calorifier stored water temperature, control of primary LTHW circuit, control valve etc to suit.

Control of vessel destratification pump.

Time control of domestic hot water generation.

Control and fault monitoring of secondary circulation domestic hot water circulation pump.

Temperature monitoring of stored domestic hot water, temperature monitoring of domestic hot water flow and return circulation local to plantroom.

Control of routine (weekly) calorifier pasteurization cycle – to provide 1 hour increased in stored water temperature to 70degC, initially set to operate Sunday @ 23.00hrs. During this mode the secondary return pump shall not be run.

Electrical supplies to Water-King units.

Miscellaneous

Provision of all necessary ancillary controls items / hardware to facilitate the above (eg. pipework immersion sensors, vessel temp sensors, control valves, valve actuators, dps's, external temperature sensors, internal room sensors etc)

Provision of all control and power wiring between the control panel and all items of mechanical plant / equipment / sensors etc, and containment systems.

Power supply to 'water-king' water conditioner units within plantroom.

Provision of common alarm indicator / time extend panel (with lamp, audible alarm, mute, and 3 hour space heating time extend boost button) within kitchen

Provision of web based 'head end' BMS graphical interface – to allow the client to remotely set / alter heating system user programable occupancy periods (from a remote off-site PC, via the internet).

The control panel shall provide controls interface only to the air source heat pump plant. This equipment shall received direct electrical supplies from the Electrical Contractor.

Note the following mechanical services items having direct electrical supplies by the project electrical contractor

- Air source heat pump plant
- local extract fans / ventilation units
- water heaters
- hot drinks boilers
- cold water booster set
- Trace heating

All other electric power and control wiring to emanate from mechanical services control panel.

Note – control of ventilation unit heater battery outputs / 2 port valves is achieved locally, not via BMS

Commissioning - General

In addition to the commissioning procedures described elsewhere within this specification, the Contractor shall include in his price for the Controls / BMS Specialist to be closely involved in the setting up, initial commissioning and ongoing fine-tuning of the BMS. Included will be all engineering and systems programming at site.

The controls specialist shall include for providing a final user tuition session to the client onsite at completion

The Controls specialist shall include for returning to the building 3 months after handover to review the BMS operation and for making any necessary adjustments should they found to be necessary.

3.15.4 ELECTRICAL WIRING

General

An electrical feed shall be provided to the new control panel by the Electrical Contractor. All control and power wiring between the panel and all equipment/sensors shall be carried out by the Mechanical Contractor/Controls Specialist.

The Automatic Controls Contractor shall undertake all necessary Electrical Wiring and Services in strict accordance and compliance with the BS7671 / Current Edition of the IEE Wiring Regulations, other relevant British Standards and Codes of Practice.

The Contractor shall liaise and co-ordinate all containment and wiring routes with the Electrical Contractor prior to installation ensuring an aesthetically pleasing and fully co-ordinated installation is provided.

The Automatic Controls specialist shall ensure the following:

Circuit fuse protection.

Correct single or three-phase power supplies as required to all motors, prime movers etc

Correct interface with all analogue-measuring devices.

Correct interfacing with all packaged plant items including that all packaged plant is provided with volt free contacts or relays as necessary.

All materials shall be in accordance with a British Standard, where such exists. The Consultant Engineer may request samples of proposed fittings, materials and workmanship. When requested the Contractor shall submit these without delay.

The Automatic Controls Specialist shall also provide full details of the following:

- Containment proposal throughout including the support mechanism
- Materials details throughout
- Final connection and termination details to plant and equipment
- Wiring type

As part of the Contractor design of the systems, the Automatic Controls Specialist shall determine the types of cable and the compatibility of grouping the wiring for the various types.

The following types shall be installed in segregated compartments of trunking etc:-

- Mains Voltage
- Analogue and digital signal

Where utilized, BMS cabling shall not share trunking or cable trays with any other Electrical System Containment shall be provided throughout the length of run of cable, inclusive of service voids, plant rooms and where cables rise and fall between floors (refer to architectural sections for clarity).

Where cable containment passes into and out of the building fire compartmentation, the Contractor shall install fire stopping around the cable containment.

The primary routes shall be utilised as much as possible and the number and length of final connections kept to a minimum

Protection against Electric Shock

The Contractor shall include to fully comply to provide the following:

The Current Edition of the I.E.E. Wiring Regulations allows alternative methods of protection against electric shock. For the purpose of this Specification, protection against direct contact with live parts shall generally be by the use of the following measures:-

- Protection by insulation of live parts.
- Protection by enclosures.

The basic protection measure for protection against indirect contact shall be by earth equipotential bonding and automatic disconnection of the supply. All necessary earth bonding as is detailed in the Wiring Regulations (Section 413) shall be carried out.
Protection devices providing automatic disconnection shall generally be fuses to B.S. 88, Part II, and/or miniature circuit breakers to B.S. 3871. The characteristics of these devices, the earthing arrangement and the circuit impedances shall be coordinated to provide protection against indirect contact with live parts.

Where residual current devices are specified, they shall be to B.S. 4293.

Protection against Thermal Effects

The Contractor shall include to fully comply to provide the following:

The Contractor's attention is drawn to Chapter 42 of the Wiring Regulations, which outlines measures to be taken in respect of protection against thermal effects.

Protection against over current

The Contractor shall include to fully comply to provide the following:

1. With the exception of electric motors and associated circuits, circuit protection against overload and short circuit current shall be provided by a single device.

2. The overload and short circuit characteristics of each device together with circuit impedance shall satisfy the Wiring Regulations in respect of overload and short circuit protection, discrimination and circuit disconnection times in the event of earth fault conditions. Ensure that no alterations, howsoever caused, will negate this co-ordination procedure.

Earthing

The Contractor shall include to fully comply to provide the following:

1. At switch panels and other metallic electrical enclosures, reliance shall not be placed on the enclosure to form part of the protective conductor. Earthing tags or clamps and continuity conductors in conjunction with a suitable earthing bar shall be employed.

2. For the purpose of this Specification, conduit and/or trunking systems shall not be relied upon to form the protective conductor. Earth continuity or protective conductors shall be installed for each final circuit, which shall comply with Regulation 543.

3. The resistance between any point of the conduit/trunking installation and the local distribution board shall not exceed 0.1 Ohm. Conduits shall be earthed by means of

earth continuity sockets to the distribution gear.

Wiring of Plant and Equipment

The Contractor shall include to fully comply to provide the following:

1. Equipment shall be wired in accordance with manufacturers approved connection diagrams. Ensure that the drawings have been approved before associated wiring commences.

2. Where cable connections are made into equipment, a numbered marker sleeve shall be fitted to each cable core, which shall correspond to the manufacturers wiring diagram.

3. Ensure that all wiring connections are correctly made before any equipment is set to work.

4. For three phase equipment cable insulation is to be in phase colours, (Brown, Black, Grey). Phase rotation shall be corrected at the motor drive only.

5. Cable tails to terminals shall be of sufficient length and be neatly dressed and arranged to prevent development of tension in the cable or on the terminations.

SPECIALIST CONTROLS / BMS SUPPLIER / SUB-CONTRACTOR

The Contractor shall appoint a suitable Controls Specialist to undertake to project.

The Mechanical Contractor shall be fully responsible for the coordination between this Specialist and himself.

APPENDIX A

TENDER DRAWINGS

Refer to drawing issue sheet

APPENDIX B

TENDER RETURN DOCUMENTS

TENDER SUMMARY

GREEN FIELD SPORTS – SAWTRY, HUNTINGDON

PROJECT REF. AX1937 – MECHANCAL SERVICES

ITEM	DESCRIPTION		COST
1.	Preliminaries	£	
2.	Coordination	£	
3.	Removals / Isolations	£	
4.	Domestic hot and cold water services	£	
5.	Air Source Heat Pump Plant	£	
6.	LTHW Heating	£	
7.	Mechanical Ventilation	£	
8.	Controls / BMS	£	
9.	Testing and Commissioning	£	
10.	Handover Procedures		
A	As Installed Drawings	£	
B	O & M Manuals	£	
C	Client Tuition	£	
D	Building Log Book	£	
F	Energy Performance Certification (EPC)	£	
11.	Provisional Sums		
A	Additional client requirements	£	2,000.00
B	Additional controls	£	3,500.00
C	Additional kitchen requirements	£	3,000.00
12.	**TOTAL FIXED PRICE TENDER SUM**	**£**	

This form is to be completed in full and duly returned with your tender submission.

We, the undersigned, commit to carry out the forgoing works in compliance with the specification, room data sheets, drawings and other contract documentation

Signed: ..... Date: .....

Witnessed: ..... Position: .....

For and on behalf of:.....

.....

Address: ……

……

……

……
(To be completed at time of Tender)

SCHEDULE OF SUB-CONTRACTORS

GREEN FIELD SPORTS – SAWTRY, HUNTINGDON

PROJECT REF. AX1937 – MECHANCAL SERVICES

The Tenderer shall state the name of any Sub-Contractor whom he proposes to employ :-

SUB-CONTRACT	NAME OF SUB-CONTRACTOR
Thermal insulation	
Controls / BMS	
Testing & Commissioning	
Ductwork / ventilation	
Air source heat pumps	

Signed: .....

For and on behalf of: .....

.....

…….....

…….....

…….....

Date: …….....

(To be completed at time of Tender)

SCHEDULE OF DAYWORK RATES

GREEN FIELD SPORTS – SAWTRY, HUNTINGDON

PROJECT REF. AX1937 – MECHANCAL SERVICES

Labour, Materials and Plant are to be provided for such works as the Engineer may instruct to be executed as dayworks, (anticipated none).

The rate for labour shall be based on the rates of wages, travelling time, fares and subsistence payable by the Contractor and are to include in addition for the provision and use of all plant and tools required, all necessary supervision, all liabilities as an Employer (including any payment for working on overtime) and insurance, 'holidays with pay', contributions, overheads and profits as detailed in the Specification submitted with the Invitation to Tender.

The value of materials and plant used will be ascertained on the basis of the actual cost to the Contractor of the materials and plant used after deduction of all trade discounts, rebates, allowances and all cash discounts in so far as such discounts exceed 2½%.

The Contractor shall state below the rates for Labour, Materials and Plant in dayworks which will be applicable to works so ordered by the Engineer to be executed as dayworks.

TRADE

Foreman ……. per hour

Senior Craftsman ……. per hour

Craftsman ……. per hour

Apprentice ……. per hour

Labourer ……. per hour

Specialist Sub-Contract ……. per hour

Percentage profit required to be added on Labour, Material in Dayworks

Labour - Plus …… %

Materials - Plus …… %

Plant - Plus …… %

Signed:……..

For and on behalf of: ……

……..

……..

(To be completed at time of Tendering)

SCHEDULE OF TENDER REDUCTION OFFERS / ALTERNATIVES

GREEN FIELD SPORTS – SAWTRY, HUNTINGDON

PROJECT REF. AX1937 – MECHANCAL SERVICES

Tenders must be priced on the basis of the Specification and Drawings but the Contractor may indicate below any cost reductions that he wishes to be considered. Reductions offered for alternative manufacturers will be considered by the Engineer, however, the Engineer's decision shall be binding as to whether the saving is to be implemented or not.

Contractor to Note: Demonstrate that any alternative equipment offered fully complies with the specification and drawings. Any additional costs, builders work, co-ordination of services, engineers time in looking at proposed changes, etc. resulting from such changes are to be wholly the Contractor's responsibility.

Where the phrase 'or equal and agreed' appears in the Specification, the named body shall be included in the Tender Sum and any 'equal' offer shall be detailed on this page.

Equipment	Specified Make	Alternative	Cost Change

Signed: ……

For and on behalf of:……

……

Date: ……

(To be completed at time of Tendering)

APPENDIX C

DESIGN STAGE PART L SBEM / BRUKL CALCULATIONS

(NEW BUILD PART)