SHRUB END CLINIC, COLCHESTER

PHASE 2

Iceni Way, Colchester CO2 9BY

REVISION – P1.0

Mechanical, Electrical & Public Health
Scope of Works Specification

Prepared By

Create Consulting Engineers Ltd

November 2017

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1.0 PROJECT PARTICULARS

1.1 INTRODUCTION

This Preliminaries / General Conditions section of this document describes the building engineering systems installer's obligations in relation to the management of the works, production of information, design responsibility and other matters not directly related to the technical content of the works, insofar as they relate to the building engineering systems sub-contract(s). Nothing in this documents overrides any requirement of the main contract preliminaries; this document should be read in conjunction with the main contract preliminaries.

1.2 TITLE AND NATURE OF PROJECT

The project involves the strip out of existing mechanical, electrical and public health services within the building and supply, installation and commissioning of new mechanical, electrical and public health services within the re-modelled office building. This will provide open plan office space, meeting rooms, toilets, kitchen/kitchenette, reception and exam room.

Additionally, a garage building will be built under Phase 2 (Phase 1 being the re-model of the office building) and some services will be provide under Phase 1 for extension to Phase 2.

The site address is as follows **Shrub End Clinic**
Iceni Way,
Colchester
CO2 9BY
Tel: C/O Hartnell Taylor Cook LLP - Guy Davies 020 7788 3831

The scheme involves the MEP Contractor providing a supply, install and commission of appropriate services to meet the requirements covered by the design drawings and this document.

The works shall be undertaken in accordance with the Main Contract Project Programme. It should be noted that the contract period should be confirmed with the Contract Administrator at the point of tendering.

1.3 DEFINITIONS

The following definitions apply throughout this specification.

Installer/Tenderer/MEP Contractor: The tendering trade contractor appointed to undertake Mechanical, Electrical, Lift, or other building engineering system installation work in any single or combined sub-contract as defined by the main contract documentation

Contract Administrator: The party named as such in the main contract preliminaries or others acting on his behalf.

Submit: Issue documentation in accordance with the contract (i.e. the specified number of copies, to the contract administrator and / or other members of the project team as required).

Works: All building engineering systems shown on the drawings and described in the specification.

Drawings:	The tender drawings (or tender Building Information Model where applicable).
Elsewhere:	Detailed or specified in other clauses, sections, shown on the drawings or contained in the specification or main contract documentation.
System:	All equipment, accessories, controls, supports and ancillary items, including supply, installation, connection, testing, commissioning and setting to work necessary for that section of the Works to function.
Competent person:	A person who, by reason of theoretical and practical training or actual experience or both, is competent to perform the task or function or assume the responsibility in question and is authorised to perform such a task or function.
Trench:	A covered horizontal service space in the floor or ground with access from above.
Cavity:	A space enclosed within the elements of a building within which services are installed, e.g. the space between ceiling and floor above.
Concealed services:	In relation to installation requirements, a pipe which is a Water Fitting must be located in compliance with the definitions and requirements of the WRAS Guide to The Water Supply (Water Fittings) Regulations. Other pipework is “concealed” if it is behind a structural or finishes element, other than a single sheet of plasterboard, that would need to be removed or damaged in order to replace or repair the service and does not contain sufficient easily removable / openable access panels / hatches to obviate this need. In relation to inspection requirement, a service is “concealed” if it is located behind a structural or finishes element that does not contain sufficient easily removable / openable access panels / hatches to allow the service to be inspected along its entire length.

Terminal units:	Units such as radiators, convectors, fan coil units, induction units, variable or constant volume air boxes and other like equipment.
Ancillaries:	All specified fittings, accessories, inserts, test points, bracketing, terminal equipment connected to and installed in the engineering services system.
Equal and accepted:	The Contract Administrator will be the sole arbiter of whether any alternative product to that specified is acceptable.

1.4 EMPLOYER/ PROFESSIONAL TEAM

Names, postal addresses, e-mail addresses, telephone and facsimile numbers of parties involved in the design and construction of the project and its administration:

Employer	Shall Mean:	**Maritime & Coastguard Agency** Bay 3/08, Spring Place, 105 Commercial Road, Southampton, SO15 1EG
Project Architect	Shall Mean:	**Hartnell Taylor Cook LLP** 7-10 Chandos Street Cavendish Square W1G 9DQ Tel: 020 7491 7323 Fax: 020 7491 3032
Contract Administrator	Shall Mean:	**See Main Tender Preliminaries**
Building Services Engineer	Shall Mean:	**Create Consulting Engineers Ltd** 15 Princes Street Norwich Norfolk NR3 1AF Tel: 01603 877010
Structural Engineer	Shall Mean:	**Create Consulting Engineers Ltd** 15 Princes Street Norwich Norfolk NR3 1AF Tel: 01603 877010

1.5 CONTRACT CONDITION AND DOCUMENTS

The successful Tenderer (Main Contractor) will appoint a Sub-Contractor to work under the terms and conditions imposed by the Main Contactor and the contract will be between the Authority (Maritime Coastguard Agency) and the Main Contractor.

The Contract Documents shall comprise these conditions, with this Specification and the accompanying tender drawings, together with any other contract documents issued by the Main Contractor or Employer at the time of tender, or stated by them as forming part of the Contract Documents at the time of tender.

The MEP Contractor shall have satisfied himself as to the location and access conditions prevailing to the Contract, and shall enquire of the Building Services Engineer for any further details and necessary provisions affecting the costs before submitting his Tender. No extra will be allowable on account of inadequate provisions or inaccurate measurement on the part of the MEP Contractor.

1.6 SCOPE OF WORKS AND RESPONSIBILITIES

The Building Services Engineer is responsible for the design and initial co-ordination of the Mechanical, Electrical and Public Health (MEP) services. The MEP Contractor shall be responsible for the development of the design, preparation of working drawings, supply, delivery, fully detailed on-site co-ordination, installation, testing, commissioning and putting to work all of the systems described in this document.

The MEP Contractor shall be responsible for checking the proposals put forward in the tender documents, and shall bring to the attention of the Building Services Engineer any discrepancies, anomalies or errors contained therein that may reasonably be found within the tender period, so that any necessary alterations may be included within the tender sum.

The MEP Contractor shall be responsible for the preparation of all builders work information necessary for the installation of the services that he is to install, and for the preparation of drawings for approval of any necessary primary and secondary containment, wiring and any other item requiring site dimensions or specialist manufacture.

On completion of the works, he shall be responsible for instructing the Employer in the full use of the services that have been installed, and for producing a complete set of Construction Record Drawings, Operating Instructions and Maintenance Manuals which shall be approved by the Building Services Engineer before issue to the Employer. See further guide on Construction Record Drawings and Operation and Maintenance Manual requirements within the specification.

Should the MEP Contractor require additional design information to complete his installation, he shall notify the Building Services Engineer in reasonable time in order for this to be produced with sufficient time to meet the installation programme. No delays for late receipt of design information will be accepted if the MEP Contractor fails to allow sufficient time for this operation.

Elements of work to be provided by the MEP Contractor are as follows (but not limited to);

- Above Ground Foul Drainage Systems.
- Hot & Cold Water Services.
- Electrical Underfloor Heating systems.

- Thermal Insulation, Load Bearing Supports and Identification to BS1710.
- Ventilation (Local Extract Ventilation)
- Small and Fixed Power Systems
- Main Electrical Distribution
- Lighting and Emergency Lighting.
- Data Outlets and Wiring Installation
- Fire Alarm & Detection Installation
- Inspection, Testing, Commissioning and Certification of all installed and modified systems
- Provision of Construction Record Documentation
- Provision of Hand Over Documentation inc. Operation & Maintenance Manuals.

2.0 GENERAL CONDITIONS, STANDARDS AND REGULATIONS

2.1 INTRODUCTION

The GENERAL CONDITIONS, STANDARDS AND REGULATIONS section of this Specification is common to all Building Services Specifications prepared by Create Consulting Engineers Ltd.

The GENERAL CONDITIONS, STANDARDS AND REGULATIONS section of this Specification amplifies and supplements the Main Contract Preliminaries for the Engineering Services sub-contract. Where the Technical Preliminaries and the Main Contract Preliminaries are duplicated, the more stringent of the two shall be implemented by the MEP Contractor.

All sections of this Specification shall be read in conjunction with the drawings prepared by Create Consulting Engineers Ltd for the applicable building services installations, as well as all other documents and drawings issued with the Tender documentation for the Building Services Engineering Installations.

Any items of plant and equipment shown on the drawings but not described in the Specification, or described in the Specification but not shown on the drawings, shall be provided as part of the Contract Works, and be deemed to be included in the Contract price.

If there is a difference between the requirements of the Specification and the drawings, the difference shall be clarified before tendering and ordering.

Where “shall” is used to give instructions in respect of a part of the works, all costs arising from such instructions shall be deemed to be included within the Contract price.

Since the Tender drawings are only representative of the work to be undertaken, they do not fully indicate every change of direction, bend or offset required in the services for their complete installation and co-ordination with other services and the building structure. It shall be deemed that all aspects of the works have been examined, and the particular Services Works shall include for all labour and materials necessary to achieve a full and co-ordinated installation of the work covered by this Specification.

It shall be deemed that the site, the Conditions of Contract, Specification, Schedules, Associated Architectural and Structural Drawings, plans, etc. have all been examined. If all the particulars required cannot be obtained from this examination, application for further information shall be made to the Building Services Engineer, through the appropriate channel.

Any claims because of want of knowledge in respect of the section of the works included in this Specification will not be considered.

It is advised that a site visit be made prior to submitting a Tender to determine the nature and location of the site, means of access, availability of space for huts and storage, and existing services, as no claim will be considered on the grounds of ignorance of conditions under which the Works will be constructed. Before making the visit, prior approval MUST be obtained.

The Tenderer shall be deemed to have satisfied himself with regard to access to the site, the various working heights, the extent and nature of the scaffolding, protective sheeting or boarding (if required), and generally the

conditions under which the work will be required to be carried out. They shall have obtained all information on all matters affecting the execution of the work.

2.2 COMPLETING THE DESIGN

KEY DESIGN CRITERIA

The following key design criteria have been referred to for the design of the mechanical, electrical and public health engineering services.

Brief	Criteria	Source
External Design Conditions	-4 °C Winter	CIBSE Guide J
	29 °C Summer	CIBSE Guide J
Internal Design Temperatures Winter	Toilets 19-21°C Office and similar 21-23°C	CIBSE Guide A
Internal Design Temperatures Summer	Toilets 21-25°C Office and similar 22-25°C	CIBSE Guide A
Ventilation	Toilets 6l/s/toilet Shower 15l/s/shower	BR AD Part F
Lighting	Toilets 100 Lux Office 300-500 Lux	CIBSE Guide A
Occupancy		Architects Layouts

2.3 SETTING OUT & BUILDERS WORKS

All necessary builders work required for the installation, including the formation of holes, chasing, reinstatement, making good, etc., will be carried out by the Main Contractor, unless otherwise stated. The MEP Contractor shall set out all holes and chases required for the installation of plant, equipment and accessories and supply all foundation bolts, nuts, washers, packing pieces, brackets, supports, etc.
The MEP Contractor shall accurately mark out onsite, all such builders work to ensure that it is suitable for the installation. Should holes need to be cut through walls, these must be cleanly cut and no larger than necessary to allow services, cables, etc., to pass through the appropriate sleeve. All holes are to be fire stopped on completion of the works.

The MEP Contractor must, due to the nature of the building and the fabrics/materials used in its construction, obtain approval from the Designers/Employer to form holes and chases and to fix to building structural elements, fixtures and fittings. Any builders work carried out by the MEP Contractor that the Designers/Employer has not given approval to be carried out, will be re-instated to its original condition, with any costs incurred by the Employer deducted from the MEP Contractors tender at the end of the contract. The MEP Contractor is advised that the Employer will employ third party specialist contractors, if deemed necessary, at the recommendation of the Designers, to reinstate any item of works that have been carried out without approval, should specialist contractors be required to perform works that the Employer/Designer deems the MEP Contractor has not adequate experience to carry out.

The MEP Contractor shall be deemed to have inspected the site prior to submitting his price and no subsequent claim arising from any reason which could have been foreseen from a visit to site will be entertained.

2.4 QUOTATIONS & PLACEMENT OF ORDERS

In obtaining quotations for specified plant, equipment, materials, accessories, sub-contract services, etc, the MEP Contractor must obtain quotations based upon the tender documentation. Obtaining quotations direct from nominated or specified manufacturers/suppliers/sub-contractors without providing the manufacturers/suppliers/sub-contractors with copies of the relevant tender documentation, will be at the MEP Contractors own risk.

No claims by the MEP Contractor, for loss or delay, will be considered, should it be ascertained that nominated manufacturers/suppliers/sub-contractors have not been provided with sufficient tender information by the MEP Contractor, to allow them to provide accurate tender quotations.

Quotations obtained from manufacturers/suppliers/sub-contractors, by the Building Services Engineer for pre-tender budgetary purposes, will not be permitted to be used for tender preparation.

The MEP Contractor will place orders for specified plant, equipment, materials, accessories, sub-contractors, etc, within two working days upon official receipt of contract award, unless otherwise notified by the Employer/Building Services Engineer within the contract award notification. Where required to meet contract programme, the MEP Contractor will be required to place orders for plant, equipment, materials, accessories, sub-contractors, etc, prior to the official start-on-site date.

The MEP Contractor must ensure at tender stage, that all specified plant, equipment, materials, accessories, sub-contract services, etc., will be available to meet the contract programme. Any item of specified plant, equipment, material, accessory, subcontractor service, etc., ascertained at tender stage not to be available for inclusion within the contract programme, must be identified to the Building Services Engineer prior to or at the very latest, at tender submission. No notification to the Building Services Engineer/Employer will be deemed to mean that all design requirements can be accommodated by the MEP Contractor to meet the contract completion date.

To avoid delays due to late or non-delivery of materials and equipment, the MEP Contractor shall place orders immediately instructions have been received by him to proceed with the work. Delay in the delivery of materials will not be accepted as a valid reason for extending the completion of the Works.

2.5 STANDARDS AND REGULATIONS

All mechanical and associated equipment shall be installed and tested in accordance with the latest revision as of date of tender, of the relevant regulations and standards, and in particular the following (inc. all amendments) as appropriate:-

- 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, however, the MEP Contractor shall advise the Contracts Administrator of any changes in specific requirements post tender date.
- Notify all authorities in accordance with their regulations and obtain any required approvals for the installation.
- Comply with the requirements of the Local Authority Building Inspector.
- Comply with all Statutory Obligations arising from current legislation and regulations, together with other requirements, including, but not limited to, the following:-

- Plumbing Engineering Services Design Guide.
- Health and Safety at Work etc. Act 1974
- Management of Health & Safety at Work Regulations 1999
- The Working Time Regulations 1998
- Gas Safety (Installation and Use) Regulations 1998
- Gas Safety (Management) Regulations 1996
- Building Regulations 2000 and current amendments
- Building Standards (Scotland) Regulations 1990 and current amendments
- Public Health Acts
- Electricity Acts
- Electricity at Work Regulations 1989
- Gas Safety (Installation and Use) Regulations 1998
- Factories Act 1961
- Clean Air Act 1993
- The Control of Pollution Act 1974 and Amendment Acts Clean Air Act 1993
- The Workplace (Health, Safety and Welfare) Regulations 1992
- The Construction (Design and Management) Regulations 2015
- The Workplace (Health, Safety and Welfare) Regulations 1992
- The Health and Safety (Display Screen Equipment) Regulations 1992
- The Clean Air (Arrestment Plant) (Exemption) Regulations 1969
- The Control of Substances Hazardous to Health (COSHH) Regulations 2002
- The Control of Substances Hazardous to Health (Amendment) Regulations 2003
- The Health and Safety (Display Screen Equipment) Regulations 1992
- Control of Asbestos at Work Regulations 2002
- The Provision and Use of Work Equipment Regulations 1998
- Personal Protective Equipment at Work Regulations 1992
- The Construction (General Provisions) Regulations 1961
- The Lifting Operations and Lifting Equipment Regulations 1998
- ACOP L8 – Legionella
- ACOP L25 - PPE at Work
- ACOP L21 - Management of Health & Safety and Work
- ACOP L5 – COSSH
- Other relevant Safety Regulations Public Utility Company and/or Statutory Authority regulations, specifications, and requirements.
- Other Requirements British Standards and Codes of Practice.
- BS6700 - Water Services.
- BS 7671 - Requirements for Electrical Installations (IEE Wiring Regulations).
- BS EN 50110. Insurance Company Requirements.
- LDSA Fire Safety Guides.
- IEC Standards.

Notify all authorities in accordance with their regulations and obtain any required approvals for the installation. Where no specific design, performance or installation standards are quoted the following shall apply;

- CIBSE Guide Books

- Electricity at Work Regulations 1989
- Code for Lighting.

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. Supply plant and equipment to achieve the specified design conditions and to provide stable control.
In the event of there being differences between standards, regulations, etc, then the MEP Contractor shall consult the Project Manager for clarification.

2.6 COSSH REGULATIONS

The MEP Contractor shall ensure that the provisions of the Control of Substances Hazardous to Health Regulations 1988 (COSHH Regulations) are observed.

Where the use of substances falling within the scope of the Regulations forms part of the works or future maintenance, this shall be notified in writing to the Contract Administrator, together with recommendations for the use of alternative “non-hazardous” options.

Where the uses of substances falling within the scope of the Regulations are required for the operation and maintenance of the completed works, the MEP Contractor shall ensure that;

- Suitable facilities are available for the on-site storage of such substances, and that warning/instruction notices are provided at the point of their storage and use
- An initial issue of any special protective clothing, (e.g. eye protectors and similar safety equipment) is sufficient for one year’s operation and maintenance of works shall be provided
- Maintenance staff have been fully trained in the use, handling, storage, transport and disposal of the substances concerned, prior to handover
- The type, use and control of the substances have been fully and correctly identified in the Operating & Maintenance Manuals.

2.7 QUALITY OF WORKMANSHIP

All workmanship and materials used shall be of their best respective kinds and shall comply in all relevant respects with the most recent revisions of the appropriate regulations and standards.

2.8 ELECTROMAGNETIC CAPABILITY

All equipment and systems shall be installed to provide electromagnetic compatibility within the system and with any other systems installed in the same area. All systems and buildings shall be assessed for protection to, and that such protection meets, the requirements of BS EN 50081 & BS EN 50082, and as generally referenced within BS 7671 Requirements for Electrical Installations (Regulation 515.2). All equipment shall meet the requirements of the appropriate electromagnetic compatibility standard including draft standard IEC 654-5 Operating conditions for industrial-process measurement and control: electromagnetic compatibility.

2.9 DEFECTIVE WORK OR EQUIPMENT

Any faults in the work performed by the MEP Contractor, or in the materials or equipment supplied by the MEP Contractor shall be corrected or replaced by the MEP Contractor to the satisfaction of the Project Manager, at the MEP Contractors expense.

2.10 SITE MEASUREMENT

All dimensions and clearances affecting the installation of work shall be verified on site in relation to established datum's, to building openings and to the work of other trades.

Should interferences occur which will necessitate deviations from the layout or dimensions shown on the Drawings, the Building Services Engineer shall be notified and any changes approved before proceeding with the work.

The MEP Contractor shall prepare Working Drawings for services based on checked site dimensions, and actual Working Drawings prepared by other disciplines. All dimensions and levels on services Drawings have been based on information to hand at the preparation of these Drawings and may need adjustment before ductwork can be manufactured or pipework prefabricated. Should any such adjustments be necessary, the MEP Contractor shall notify the Building Services Engineer.

Where necessary, and in the case of all components of proprietary origin, including ductwork, switchgear and control panels, Working Drawings of components or equipment shall be provided by the MEP Contractor at his own cost. All such Drawings shall be subject to the approval of the Building Services Engineer, and no work contained on such Drawings shall be executed until approval of the drawings has been obtained. Such approval shall not relieve the MEP Contractor of his full responsibility for the work carried out.

Such Drawings shall include complete data on the equipment, including physical dimensions and other information required for installation, performance capabilities and limitations, and schedules indicating locations when more than one type of an item is to be used. All Working Drawings must be certified as being correct for the proposed work.

Working Drawings, brochures or catalogue sheets showing more than one size shall be marked to indicate the size or model proposed for the particular application. Prior to submittal, Working Drawings shall be fully co-ordinated with the work of all other trades.

Working Drawings submitted for approval shall be identified as to the specific equipment for which the Working Drawing relates. Identification shall be by reference to equipment numbers as shown on the Drawings or by reference to the appropriate clause of the Specification in which the equipment is specified.

The MEP Contractor is advised that the drawings have been based on known equipment selected at the design stage to meet the technical requirements of the systems, and he shall therefore only base his Working Drawings on the equipment selected by him and make the necessary modifications to ductwork and pipework services.

The MEP Contractor shall record all Variations and Omissions on duplicate sets of the Contract drawings, one copy of which shall be kept on Site. The MEP Contractor shall be responsible for any discrepancies, errors or omissions in the drawings and other particulars supplied by him whether such drawings and particulars have been approved by the Architect or not, provided that such discrepancies, errors and omissions be not due to inaccurate information or particulars furnished in writing to the MEP Contractor by the Design Team.

2.11 APPROVED MANUFACTURERS

Approved manufacturers shall be as indicated, but not limited to, those named on the various sections of this Specification. However, the tender must be based on the specified manufacturers, and alternatives offered must

be detailed in the 'SCHEDULE OF ALTERNATIVE MATETIALS OR MANUFACTURERS' found within the Summary of Tender sections of this Specifications.

Alternatives to those manufacturers named may be considered provided the MEP Contractor can show to the Services Consultant that the alternative proposed will meet exactly the technical and aesthetic requirements of the equipment selected and be of comparable quality to that called for in this Specification and Drawings.

The MEP Contractor's attention is drawn to the possible physical limitations which may restrict the use of some alternative equipment brought about by the building structure, with respect to height, width, length and access required for routine maintenance of the equipment concerned.

2.12 ASBESTOS REGULATIONS

The MEP Contractor shall ensure observance with the Health and Safety at Works Act, the Control of Substances Hazardous to Health Regulations 2002 regulations and the Control of Asbestos Regulations 2012 concerning asbestos containing materials.

The MEP Contractor shall be responsible for ascertaining the presence of all asbestos containing materials, issuing the statutory notice to the Health and Safety Executive, ensuring the safety of the general public and the protection of all operatives under his direction by proper protective clothing, respirators etc., and correct disposal arrangements.

The MEP Contractor shall be responsible for ascertaining the presence of all asbestos containing materials. Before carrying out any works, a Refurbishment / demolition survey will need to be carried out by a 'Competent Surveyor'

The MEP Contractor's Tender for this Contract shall be deemed to include all costs associated with compliance with the above Asbestos Regulations.

Before commencement of any intrusive construction works, it should be assumed that there will be asbestos containing materials (ACM's) present in the existing buildings.

A suitably trained person should conduct a refurbishment / demolition survey to identify ACM's. This may involve opening up works at the time of the survey. Any ACM's that will require disturbance or removal by these construction works will need to be removed by a licensed contractor and records kept.

2.13 PROGRAMME OF WORKS

The Building Services Work Package Installations shall be required to be integrated into the Main Contractor's or Construction Manager's Programme of Works. The MEP Contractor's Tender must include all necessary shift working/ overtime to comply with the required programme, as detailed in the main project Preliminaries document.

In his Tender, the MEP Contractor will allow for the purchase of all materials and equipment from stockist and other suppliers at such time and in such a manner as may be necessary to allow for the completion of the work, in accordance with the Contract Programme.

The MEP Contractor shall prepare a detailed Programme for the works and submit it for comment within two weeks of commencement of the Contract. The Programme shall fully co-ordinate with the Main Contract

Programme, materials procurement and the needs for liaison with other Work Package Contractors. Three copies of the Programme shall be issued to the Main Contractor for approval.

The MEP Contractor shall review the Programme on a weekly basis and update the Programme as necessary. If any circumstances arise that affect the progress of the works, the MEP Contractor shall immediately notify the Main Contractor and advise solutions to resolve the issues.

Additional costs resulting from non-compliance with the above shall be borne by the MEP Contractor.

The works covered by this Specification shall be carried out in whole or in part, as may be required, either to suit the building programme or to the specific requirements of the Employer, as stated on the Tender Form.

The MEP Contractor shall visit the Site when called upon to do so, for setting out details and/or carrying out of works, whether his men are employed at the Site or not, at the time.

The MEP Contractor shall, before tendering, examine the drawings, Specification, Conditions of Contract, Schedules etc., and shall fully acquaint himself with local Site conditions.

Detail drawings and sections of the building may be inspected at the offices of the Architect by appointment. The MEP Contractor shall have no claim because of want of knowledge in any respect of the Sub-Contract.

2.14 DELIVERY OF MATERIALS

The MEP Contractor shall be responsible for the cost of unloading, placing in and removal from store, carnage and hoisting of materials and plant for which he is responsible.

The MEP Contractor shall allow, where necessary, for protecting the building where hoisting and lifting of plant and materials takes place.

Should any of the materials specified for this Contract be subject to delivery delays outside the control of the MEP Contractor which do not suit the programme of Works, the MEP Contractor shall submit to the Services Consultant details of those delays, and details of alternative equipment obtainable within the required Programme.

2.15 CO-ORDINATION

The MEP Contractor shall be entirely responsible for co-ordinating his site works with other trades. This includes the provision of precise details of the electric wiring required to equipment under this Contract, where such wiring is to be carried out by others.

The costs of any delays to any other party to this Contract, occasioned by the MEP Contractor's failure to satisfactorily co-ordinate and liaise his works, shall be borne by the MEP Contractor.

Where drawings or details relating to such co-ordination have been prepared by the Building Services Engineer, the MEP Contractor shall check these and notify the Building Services Engineer of any errors in these drawings or details. Failure to do so will not alleviate the MEP Contractor's responsibility for co-ordination.

All aspects of the works require detailed coordination to avoid any possible clash or conflict with other trades and disciplines. The MEP Contractor shall undertake such coordination in relation to the works described in this specification and/or the drawings.

No extra cost or claim will be allowed due to conflict of works or installations where full liaison with other trades and disciplines would have prevented such an occurrence.

When any new, revised or updated architectural, structural or services information is issued by the Building Services Engineer under the authority of an instruction, the MEP Contractor shall examine such information and, if necessary, modify the works accordingly to prevent any clashes or abortive work due to such instruction.

No extra cost or claim will be allowed to cover any clashes or abortive work that results from not requesting an explanation or seeking clarification in respect of any such revision.

Where minor clashes of services occur on site that were not foreseeable at the design or co- ordination drawing stage, these clashes or minor coordination matters shall be resolved by discussion and agreement with other trades and disciplines. The Building Services Engineer shall be informed of the action to be taken by an approved means. No instructions will be issued to cover such minor clashes.

2.16 WORKMANSHIP

The MEP Contractor shall ensure that only the highest standard of workmanship is used for these works. The achievement of this standard shall be at the sole discretion of the Building Services Engineer, whose decisions in these regards shall be final.

Should the Building Services Engineer decide that the required standard of workmanship has not been provided; the MEP Contractor shall arrange to correct the shortcomings and replace defective material or labour at his own expense and without delay to the progress of the works.

All welding shall only be carried out by operatives who hold current Certificates of Competency as issued by the Heating, Ventilating and Domestic Services Consulting Employers' Association.

The MEP Contractor shall be deemed to have read and examined carefully all the Contract Documents, to have visited Site and to have taken any action necessary to fully inform himself regarding the full requirements for the proper working of the installation, whether specifically mentioned in the Contract Documents or not.

The whole of the works specified shall be carried out to the highest standards of good practice and workmanship.

Where the actual manufacturer of any equipment or accessory is not specifically mentioned, it is intended that only equipment of the highest quality be used.

2.17 SUPERVISION OF WORKS

The MEP Contractor shall ensure that the works are under the direct supervision from start to finish of a competent Supervisor, Foreman or Charge hand, and the Building Services Engineer shall have the right to require the withdrawal from Site of any such persons whose general conduct or handling of the job is, in their option, not satisfactory.

2.18 MATERIALS

All materials and equipment used in the installation shall be new, rust and corrosion free, and of the best quality and type most suitable for the purpose specified.

The make and type of the principle items of materials and equipment are stated in the specific Clause, and the MEP Contractor shall not deviate from the Specification without the written authority of the Building Services Engineer.

The dimensions of all materials and equipment supplied, and their performance and operation, shall comply with all relevant British or European Standard Specifications. Corresponding parts of similar equipment throughout the Contract shall be interchangeable.

2.19 MODIFICATION TO THE WORKS

The MEP Contractor shall be solely responsible for allowing in his Contract Sum for the correct quantities of materials from measurements taken by himself either from Drawings or, wherever possible, from the site, and no variation in cost will be approved unless the works are modified. The positions of all equipment shown on the Contract Drawings may be varied by the Building Services Engineer before work is commenced, and the MEP Contractor shall carry out any modifications not involving additional labour or materials without extra charge.

No modifications to the works shall be carried out without prior written approval, and all such modifications which will increase or reduce the works shall be priced and a quotation submitted to the Building Services Engineer within seven days of the date of authorisation.

Upon receiving written confirmation that his tender has been accepted, the MEP Contractor shall, within 14 days, produce a detailed Schedule of Rates for the complete installation. This shall include all quantities and rates used in his tender make-up, and the correct aggregate of all such quantities and rates shall equal his tender sum.

The Building Services Engineer may request the breakdown of the Schedule of Rates to be modified, providing that the Tender Sum is unaffected if, in his opinion, the rates are unreasonable.

Any variations to the project for items for which no agreed Schedule has been made shall be assessed at Rates to be agreed with the Building Services Engineer, and these Rates shall be added to the original Schedule for future variations.

Where possible, all modifications will be priced at the agreed Schedule of Rates. When required by the Building Services Engineer, measurements of such modifications shall be made jointly by the MEP Contractor and the Building Services Engineer, and shall be to the nearest unit for which a rate is quoted in the agreed Schedule of Rates.

2.20 DISCREPANCIES

No allowance shall be made for discrepancies between the information shown on the Contract Drawings and the Specification, and the MEP Contractor shall be deemed to have satisfied himself of any such discrepancy at the time of tendering.

The MEP Contractor shall allow for all work either shown on the drawings or detailed in the Specification. No claim for extra costs can be considered for work which has only been shown on the drawings or only within the Specification and the MEP Contractor shall be deemed to have included for all such work in his tender price.

Should any portion of the works which would reasonably and obviously be inferred as necessary for the complete safe and satisfactory operation of the installation as a whole, not be expressly described or specified, the MEP

Contractor shall provide and execute such works as part of the Contract and shall not yet be entitled to any extra payment on that account.

2.21 PROJECT QUALITY PLAN (PQP)

The MEP Contractor will be required to produce a Project Quality Plan for the building services works within four weeks of Contract appointment. The plan will, as a minimum, contain the following information:

- A statement on how the quality plan will be controlled, i.e. the revision and update mechanism
- Quality auditing procedures.
- A Key staff contact list. The names, addresses, telephone numbers and email addresses of the key staff involved in carrying out the building services work including the MEP Contractor's staff, Consultants, building services MEP Contractor's staff and all the Specialist Suppliers' and manufacturers' staff.
- A statement allocating responsibilities for the key staff involved in project work.
- Corporate structures of all the Contractors, Consultants and Specialist Suppliers project teams.
- A programme for the engineering works. The initial submission shall contain a high level programme with series of separate work activity programmes behind it that highlight the trade activities and milestones associated with the system or the works. The programme shall be integrated with the Main Contract Programme. The commissioning programme shall be prepared and agreed with the Main Contractor's Commissioning Specialist
- A Method Statement breakdown structure, e.g. general activities, pipe work installation, insulation installation, etc.
- A schedule of all meetings associated with the engineering services works.
- The design management procedures and description of the design development process.
- A construction design information submission programme.
- The engineering services work package breakdown structure.
- A pack of standard forms, e.g. requests for information, test certificates, inspection certificates, etc.
- Procedures for all the main construction activities, including:
    - Procurement, including a work package breakdown
    - Off-site manufacturing, inspection and testing
    - Packaging, delivery and storage on site
    - Protection of the works
    - Requests for Information
    - Site supervision
    - Site inspection
    - Testing
    - Commissioning
    - Progress payments
    - Handover.

The Project Quality Plan will remain a "live" document throughout the construction period, with all the Sub-Contractors and Specialist Suppliers adding to it.

The document will be "owned" by the Contractor's Work Package Project Manager, and it will be that person's responsibility to update the document and ensure that all copies in circulation are current. Current copies of the Project Quality Plan shall be issued to the Main Contractor Engineering Services Manager, and form part of the Project PQP.

2.22 ACCESSIBILITY

All work shall be installed so as to be accessible for operation, maintenance and repair with particular attention given to locating valves, controls and equipment requiring lubrication, cleaning, adjusting or servicing of any kind. Access panels shall be provided as specified and located on the drawings when work is built in or concealed. If, in his opinion, insufficient access has been allowed for routine maintenance, the MEP Contractor shall bring this to the attention of the Building Services Engineer at the start of work on site.

2.23 QUALITY STANDARDS

All materials and equipment furnished under the Sections of this Specification shall be new and to the extent possible, standard products of the various manufacturers except where special construction or performance features are called for. Where more than one of any specific item is required, all shall be of the same type and manufacture.

The MEP Contractor shall submit for approval satisfactory evidence of the type and quality of equipment and material he proposes to use in the work. Proof of quality may be established by manufacturer's established trademarks or by certification by the manufacturer or an approved testing laboratory of compliance with required standards, or by physical tests, when so required.

2.24 EQUIPMENT GUARDS

All rotating equipment including couplings, flywheels, gear trains and belt drives shall be provided with adequate guards for personal protection. Fabricated guards shall consist of flattened expanded metal mesh with an angle iron frame, and small guards may be formed solid sheet metal. Guards shall be removable, and the MEP Contractor shall ensure that following trades do not prevent reasonable removal of equipment guards.

2.25 PROTECTION OF EQUIPMENT AND WORK

Equipment openings and connections shall be provided with adequate cover at the factory to protect the equipment during transit. Such covers shall be removed by the MEP Contractor prior to connection of the equipment.

During the progress of the work all open ends of installed pipework and fittings shall be kept sealed off with either malleable iron plugs or plastic caps. Under no circumstances shall paper or wooden plugs be used.

All plant shall be suitably protected during storage and building operations. Extreme care shall be taken to protect the building, internal partitions and floor finishes.

All damage by the MEP Contractor during installation shall be remedied to the satisfaction of the Architect/Contract Administrator/Building Services Engineer or replaced with new, and the cost of this work shall be borne by the MEP Contractor.

2.26 NAME PLATE

All proprietary equipment shall have factory-applied permanent name plates indicating the manufacturer's names, model and serial numbers, temperature and pressure design, duty rating and other data necessary to conform with specified requirements, all as relevant to that item.

2.27 PAINTING AND FINISHING

All purchased equipment shall have a factory-applied manufacturer's standard finish of the manufacturer's standard colour, unless otherwise specified. Finishes which are marred during shipping, handling or installation shall be touched up to match the original finish. Where special colour finishes are required, the MEP Contractor shall notify the Building Services Engineer and Architect of the latest date by which he requires those finishes to be confirmed.

Field fabricated bare iron or steel items required for installation of work under this section shall have rough or sharp edges removed, be thoroughly cleaned of dirt, rust, weld slag, grease and oil, and be prepared and painted to an approved standard.

2.28 START UP

Before starting up any system, each piece of equipment comprising a part of the system shall be checked for proper lubrication, drive rotation, belt tension, correct wiring, and any other condition which may cause damage to equipment or endanger personnel. Competent engineers shall be present to supervise the start-up and testing of equipment, and trained in servicing the respective equipment, to the extent that the manufacturers of imported equipment shall furnish the services of their own specialist engineers.

2.29 SILENCE OF THE WORKS

In default of more specific requirements in the Mechanical and Electrical Services Specifications, the following shall apply to the whole or parts of the plant, equipment and apparatus.

The MEP Contractor shall be responsible for the silent operation of any equipment installed by him, and shall make all necessary allowances and provide and fix any materials required to eliminate noise or vibration, and prevent causing any annoyance to the occupants of the building, to the complete satisfaction of the Building Services Engineer.

All plant, equipment and apparatus, or parts thereof, shall be selected and installed with due care, such that it is reasonably silent in operation under all conditions under which it may have to operate, having regard to the building and works. In particular, no rattles, vibrations or discrete tones shall be noticeable in occupied areas outside the plant rooms, apparatus rooms or equipment enclosures.

Where the passage of air past, or through, components in a ductwork system regenerates noise, the MEP Contractor must ensure that the regenerated noise is either below the fan noise at the point, or that the noise criteria specified for the rooms which the duct system passes or in the rooms served by the duct system are met.

If, after commissioning and/or adjustment, noise criteria specified are not achieved to the approval of the Services Consultant, the MEP Contractor shall without extra charge take remedial action to the approval of the Services Consultant to achieve and maintain a satisfactory degree of silence. A satisfactory degree of silence shall be judged to be that the noise is not discernible above the noise of the correct operation of plant in any occupied area.

The Building Services Engineer`s decision as to what constitutes a satisfactory degree of silence within the terms of the Specification shall be final.

2.30 TESTING

Mechanical

The whole of the systems shall be tested, and the successful results of those tests shall be recorded on Certificates signed by the MEP Contractor and provided in duplicate for the Building Services Engineer.

Any LTHW Heating, MTHW Heating, HPHW Heating, chilled water, and domestic hot water supply systems shall be tested by hydraulic pressure and heat tests.

Cold water and drainage systems shall be tested by hydraulic pressure.

Ventilation and Air Movement systems shall be tested by operational air pressure and quality measurements.

Before any tests are carried out, 72 hours' notice of such tests shall be given to the Building Services Engineer, in order that he or his representatives may be present.

Should any section of the work be tested without notice having been given to the Building Services Engineer, such tests shall be again carried out in his presence, and if the work has been covered up it shall be uncovered at the expense of the MEP Contractor.

Pressure tests shall be carried out, as and when required, and before any thermal insulation or non-conducting composition or paint is applied.

The MEP Contractor shall supply all instruments to conduct the tests, and such instruments shall each have test calibration certificates establishing the accuracy of that instrument. The MEP Contractor shall provide all necessary test holes in ductwork etc., and for permanently sealing holes after use. 'Binder' or similar test points shall be provided on either side of each plant item, control or commissioning valve and on flow and return connections to heating and cooling coils such that pressures and temperatures can be clearly identified at all relevant points of each system.

The MEP Contractor shall provide the necessary water or air pressure pumps and also the necessary plugs, blank flanges and temporary filling connections etc., for the sealing of open ends in order that the installation may be tested in sections as required by the progress of the building operations.

All plant items on wet systems for which specific tests instructions are not given elsewhere in the Contract Documents shall be isolated and tested separately by hydraulic pressure of 1.5 times the working pressure on that item.

All piping and distribution on wet systems for which specific instructions are not given elsewhere in the Contract Documents shall be isolated and tested separately by hydraulic pressure to 2 times the maximum working pressure on the system.

All hydraulic pressure tests shall be of 60 minutes duration, during which time no loss of pressure shall occur.

Upon completion of the installation and hydraulic pressure testing of any LTHW heating, MTHW heating, HTHW heating, chilled water and domestic water supply systems the equipment shall be put into operation, the systems

set to work, all valves regulated and appliances set to render the systems fully operational under design load conditions. The complete systems shall then be kept in continuous use of a minimum of two days, during which time performances tests on all items shall be carried out as necessary to prove the satisfaction of the design requirements, and appropriate Certificates shall be prepared by the MEP Contractor.

Tests shall be performed, and approval of tests obtained in writing prior to backfilling, insulating, painting or concealing any pipework and/or ductwork from view.

Operational and performance tests on equipment which normally operate only during certain seasons of the year shall be made during the appropriate season where possible, and/or at such time as its ability to perform at its rated capacity can be demonstrated.

Upon completion of the installation and hydraulic pressure testing of all hot and cold water and drainage systems, the systems shall be operated at the design probable simultaneous demand condition to demonstrate the required outflow rates and temperatures, discharge rates etc., as appropriate.

Upon completion of the installation of all ventilation and air movement systems, these systems shall be set to work and all dampers, regulations etc., adjusted to provide correct air quantities and velocities within all distribution systems. All air outlet and inlet points shall be regulated and adjusted for correct air quantities, velocities and flow patterns.

The correct satisfaction of the design requirements for these systems shall be recorded by Certificates prepared by the MEP Contractor.

Should any of the systems fail to withstand tests or operate properly due to faulty materials or workmanship, the cost of any removals or reinstatement shall be borne by the MEP Contractor. At an appropriate date, to be determined by the Building Services Consultant, the MEP Contractor's representative shall return to the Site to instruct the Employer or his representative in the proper operation, regulation and maintenance of the entire installation.

Electrical

The whole of the electrical installation shall be tested on completion in accordance with the appropriate section of the BS7671:2008 incorporating amendment 3:2015. An Electrical Installation Certificate, Schedule of Inspection and Schedules of Test Results, as prescribed by this shall, be submitted in triplicate to the Building Services Engineer.

In the event that a section of the works is to be completed and operated prior to final handover, then Completion and Inspection Certificates shall be submitted for that section.

When required by the Building Services Engineer, tests shall be carried out in his presence.

Continuity tests shall be made during the erection of conduit and cables and finally on the complete installation. The resistance of any length of earth return path comprising cable, conduit, gland connection boxes and fittings shall not exceed the resistance of a similar length of cable sheathing or conduit.

Insulation resistance tests on PVC cables shall be made on the complete installation. The test voltage shall not be lower than 500 volts or higher than 1000 volts and the insulation resistance for a complete section connected to a distribution board shall not be lower than one mega ohm.

A complete record of all continuity and insulation resistance tests shall be made and a copy kept on Site. On Practical Completion a Schedule of Test Results shall be handed over to the Building Services Engineer.

When required by the Building Services Engineer, the MEP Contractor shall prove the interchangeable of similar parts by actually interchanging the various parts.

The MEP Contractor shall supply all equipment necessary for the carrying out of the test without charge.

Where "connection only" of electrical equipment is specified the MEP Contractor shall include for all tests necessary to verify that his own work is satisfactory.

2.31 COMMISSIONING

The MEP Contractor shall demonstrate the correct operation of all parts of the systems specified herein, to the satisfaction of the Building Services Engineer.

The MEP Contractor is advised that his responsibility shall cover the commissioning of complete systems, inclusive of pipework, ductwork, packaged plant, individual plant items, controls etc. Where packaged plant forms part of the system, and such plant is "tested" at works, the MEP Contractor, if instructed, shall ensure that the suppliers commissioning Engineer attends site to check out the plant when introduced into the system. Notwithstanding, the responsibility for the work carried out by the suppliers Commissioning Engineer shall remain the MEP Contractors.

Commissioning shall be carried out in accordance with recognised CIBSE & BSRIA guide/codes and manufacturers requirements. The MEP Contractor shall, prior to the commencement of any commissioning, advice the Building Services Engineer in writing of the programme and method of commissioning to be adopted for his approval.

The MEP Contractor shall advise the Building Services Engineer of the need for additional pressure tapping, balancing dampers (other than those shown on the drawings), or detailed in other clauses etc., required by him to carry out full commissioning and balancing of the systems, in sufficient time such that any such provision can be made before the systems are filled, avoiding the need for draining down. The MEP Contractor shall be fully responsible for any failure to fully commission the system for lack of commissioning facilities.

The MEP Contractor shall provide attendance during the commissioning of all plant and apparatus connected under this Contract, whether or not the plant and apparatus were supplied under this Contract.

The MEP Contractor shall provide for within their tender, allowance for client training on all MEP systems either directly or via the Specialist Sub-Contractor responsible for the installation of the system i.e. Air Conditioning or Access Control. This is to ensure that clients and end users are fully capable of programming, operating and/or controlling the systems via the user controls in order to reduce call backs post-handover. Simple, plain English, user instructions must also be included within the O&M Manuals which may extend beyond that provided by the manufacturers if deemed necessary by the Client.

2.32 OPERATING & MAINTENANCE INSTRUCTIONS

Unless otherwise agreed in writing with the Employer the whole of the Contract works will only be included in a Taking Over certificate, when the MEP Contractor has issued to the Building Services Engineer two final copies of the approved operating and maintenance manuals contained in stiff backed ring binders, individual sheets to be contained in clear plastic wallets accompanied by two copies electronically in PDF format.

Prior to the above mentioned final issue, the MEP Contractor shall provide a draft copy of the manual to the Building Services Engineer for comment upon the format and general content, allowing 5 days for comment.

Each operating and maintenance manual shall include the following:-

- Contents list
- General description of all installations, equipment installed and method of operation.
- Description of equipment giving details of operating sequences (plain English).
- Handbooks, maintenance instructions, drawings and spare parts list for all components, plant and equipment used.
- Line diagrams indicating the main features of the plant.
- Schedule of routine maintenance.
- Schedule of periodic and preventative maintenance for installed equipment.
- Schedules of methods of adjustments and typical fault finding routines.
- Wiring diagrams of plant.
- A description of the method used for compliance with Regulation 413-3 of the IEE Wiring Regulations together with time/current characteristics for all protective devices for automatic disconnection of supply.
- Schedule of names, addresses and contact numbers for the suppliers of all plant and equipment, together with the type, model reference and duty.
- Testing and commissioning sheets, including plant/equipment setting values.
- Test certification for each installed service, where applicable.
- A complete set of as installed drawings.

2.33 CONSTRUCTION RECORD DRAWINGS

Throughout the execution of the works, the MEP Contractor shall keep on site a complete set of up to date prints, marked with the construction record details. These prints shall be available at any time for inspection by the Building Services Engineer. The drawings shall be produced such that they remain legible when reduced to A3 size.

Unless otherwise agreed in writing by the Employer, the contract works will only be included in a Taking over Certificate when the approved construction record drawings have been issued to the Building Services Engineer. These shall consist of paper copies inserted in the operating and maintenance manuals, and one set of AutoCAD 2010 DWG files issued on CD-ROM complete with all references/embedded images, pen settings and styles necessary to read the drawings un-edited.

Prior to issue of the approved drawings, the MEP Contractor shall send two paper copies of the draft drawings to the Building Services Engineer for approval of format and general content, allowing 5 days for comment.
The MEP Contractor should note that great importance will be placed on receipt of the construction record drawings and the operating & maintenance manuals. In this respect a Taking Over certificate will not be issued until three copies of approved drawings and manuals have been received by the Employer.

The construction record drawings shall include but not be limited to the following, in as far as they are the subject of the Contract works:-

- The location and depth of Public Authority supplies, whether installed by the MEP Contractor, a Specialist Sub-Contractor or by the appropriate Authority, together with the points of origin and termination, size and materials of pipe, line pressure and other relevant information.
- The layout, location and extent of all piped services showing pipe sizes throughout, together with all valves for regulation, isolation, etc. shown numbered in accordance with the actual installation.
- The layout, location and extent of all air ducts, including those formed in builders work or otherwise outside this contract but forming part of the systems, showing all dampers, attenuators, grilles, diffusers, louvers or other terminal components. Each duct and each terminal component shall be marked with its size and the air regulation of the system and air quantities.
- Single line and schematic wiring diagrams of the whole of the contract works showing all terminal references and cable sizes.
- The location and identity of each room or space housing plant, machinery or apparatus.
- The detailed general arrangement to a scale of 1:20 of all switch rooms, boiler rooms, machinery spaces, air handling plants, tank rooms, meter rooms, toilet cores and other plant spaces, including the location, identity, size and details of each piece of plant and equipment.
- The detailed general arrangement to a scale of 1:20 of other special sections of the work where, in the opinion of the Engineer, small scale drawings cannot provide an adequate record. Each drawing shall be noted `CONSTRUCTION RECORD` using 20mm block letters adjacent to the title block which shall include the names of the Employer, Building Services Engineer and the MEP Contractor, the date of completion, drawing title, drawing number and the contract number.

2.34 POSITION OF ELECTRICAL PLANT AND APPARATUS

Unless otherwise indicated on the drawings, the routes of cables and the positions of electrical apparatus such as distribution boards, lighting points, socket outlets, switches etc. are approximate, and their exact positions shall be determined on site by the MEP Contractor in consultation with the Building Services Engineer. The positions of socket outlets and lighting points and switches shown on the drawings shall be assumed to be correct for the purpose of tendering, but they may be reasonably varied without extra costs unless alterations are made after the conduits/cables are in position. The MEP Contractor shall ascertain on site that his work will not foul other engineering services or furniture. Any work which has to be dismantled and reinstated due to negligence in this respect shall be his responsibility.

2.35 ARRANGEMENTS OF WALL AND CEILING MOUNTED EQUIPMENT

The installation shall be arranged to secure the maximum accessibility of all parts for connecting up, inspecting, cleaning, and maintaining. Particular care shall be taken to obtain uniform and tidy arrangements of wall and ceiling mounted equipment. The precise positions of equipment shall be determined as follows:-

- Single items of equipment which are visually remote from other electrical and mechanical equipment shall be positioned at the mounting heights stated in the General Specification or on the drawings

- Two or more items of equipment, whether electrical or mechanical, or both, which are to be erected on the same wall or ceiling, or which will be otherwise visually close to each other, shall be arranged in a neat and symmetrical group

- Symmetry of arrangement shall be obtained by horizontal and vertical alignment through the centre lines of the equipment and for this purpose the mounting heights stated in the General Specification or on the drawings may be slightly varied

- The routes of all surface runs of conduits, cables and trunking shall be approved by the Building Service Engineer before installation.

2.36 FROST BURSTS

The MEP Contractor will be held responsible, until he has received the Certificates of Completion, for any damage to the works, buildings and the contents thereof, due to frost burst in the works.

2.37 INTERFERENCE

The MEP Contractor shall provide and install all necessary equipment to prevent interference to radio, television and telephone by the electrical plant and equipment included in this Contract.

2.38 FUEL AND WATER

Water, fuel and electricity for testing shall be provided by the MEP Contractor.

2.39 PRESSURES

All pressures referred to in this Specification shall be gauge pressure unless otherwise stated.

2.40 MAINTENANCE

The MEP Contractor shall at his own expense, make good any defects due to faulty materials or workmanship which may appear during the progress of the work and during a period of 12 calendar months after the installation has been handed over.

3.0 STANDARD CLAUSES – MECHANICAL SERVICES

3.1 PIPEWORK

3.1.1 The installation shall be formed from tubing of the following types and qualities:

Copper: Copper tube to EN 1057:1996 Black label
Polyethylene: Blue polyethylene to BS 6572,
PVC: Unplasticised PVC to BS 3505: 1986 with solvent welded joints

3.1.2 All pipe fittings, valves, equipment and accessories shall have factory applied markings, stampings or nameplates with sufficient data for identification to prove that they conform to specified requirements.

3.1.3 All necessary care shall be exercised at every stage of storage, handling, laying and erection to prevent entry of foreign matter into piping, fittings, valves equipment and accessories. No item which is unclean shall be erected or installed.

3.1.4 Pipelines shall run straight and true, parallel to building lines with a minimum use of offsets and couplings. Offsets shall only be provided as required to allow necessary headroom or clearance and to provide necessary flexibility in pipework lines. Changes in direction of pipelines shall be made only with fittings or pipe bends. Changes in size shall be made only with fittings. All fittings shall be off the long radius type, unless noted otherwise. Flanges or unions shall be provided and installed at all final connections to equipment, traps and valves, to facilitate dismantling. Pipe and piping connections shall be arranged so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shut off valves.

3.1.5 All supply piping, including shut-off valves and strainers shall be installed to coils, pumps and other equipment, at line size with reduction in size being made only at inlet to control valve or pump. All pipe shall be cut to exact measurement and installed without springing or forcing. Particular care shall be taken to avoid creating, even temporarily, undue loads, forced or strains on valves, equipment or building elements with piping connection or piping supports.

3.1.6 Pipework shall be installed with sufficient clearance from the building structure and other services to allow easy removal and to allow sufficient clearance to other services. The MEP Contractor shall locate and remove any stoppage due to foreign matter or air lock which is found to impede the flow of fluid, either before or after the systems are in operation. The MEP Contractor shall bear the cost of making good all pipework supports, insulation, builders work, building decoration and any other damage caused in locating and rectifying such defects. (All open ends of pipework left during construction shall be covered using purpose made caps, plugs or blank flanges.) Plugs or blank flanges to be of a design and material best suited of the size and type of pipe end. Timber, paper or rag materials shall not be permitted.

3.1.7 Where pipework is to be installed in floor ducts, these ducts shall be purpose made with removable covers to give access to the pipework at all times.

3.1.8 The pipework systems shall be installed where practical to allow thermal expansion to be accommodated by the natural flexibility of the pipework system. Pipework anchors shall be provided, with guides as shown on the drawings and as necessary to control pipe movement.

Unless otherwise specified or detailed on the drawings, or as required by the written approval of the Services Consultant, gradients of all pipes carrying liquids shall not be less than 25mm in 6.0m. Pipework should be installed with gradients to ensure efficient air removal, venting and drainage for the whole of the system and parts thereof as required to provide these facilities to the whole system. Where the pipework for the services shall be galvanised finished mild steel tube, pipework shall be fabricated using screwed connections and galvanised fittings and galvanised unions. No un-galvanised pipework or fitting shall be allowed.

3.1.9 Unions shall be used on all pipework up to and including 50mm nominal internal diameter. Unions shall be of galvanised malleable iron and shall have ground bronze spherical seats. Flanges shall be used on pipework of 65mm nominal internal diameter and above. Flanges shall be bolted together with hexagonal bolts and nuts. Each bolt shall have two washers and shall be cropped so that one thread only protrudes above the nut, when tightened down. Nuts, bolts and washers shall have the same finish as the flanges.

3.1.10 Where pipework shall be copper tube suitable for non-standard bending and off-set work, joints on pipework 54mm and under shall be made using solder ring fittings and joints on pipework 67mm and above shall be fabricated couplings, fittings and flanged joints.

3.2 PIPE SLEEVES AND PLATES

3.2.1 Sleeves shall be provided and installed for all pipes passing through floors, walls, partitions, slabs, ground beams and foundations.

3.2.2 All sleeves shall be laid out sized and located such that they be set and/or installed prior to pouring concrete or when masonry is being constructed. In event of sleeves being placed after floor, wall, ground beam etc., has been constructed, the MEP Contractor shall submit in writing to and obtain approval from the Services Consultant on location, quantity and proposed method of core drilling and installing. Cored openings shall be clean and neat without cracking or spalling. Sleeves shall be of the same material as the pipes passing through them.

3.2.3 Sleeves shall be standard weight steel or copper pipe having square cut ends with anchoring lugs welded on, or fabricated from mild steel plate, rolled and butt welded, having a minimum thickness of 3mm. Horizontal sleeves through walls, ground beams, foundations and partitions shall be flush with finished wall faces. Vertical sleeves though floors shall extend 50mm above finished floor and be flush on ceiling or under side.

3.2.4 Sleeves shall be sized such that the gap between the internal diameter of the sleeve and the external diameter of the bare pipe (where pipe insulation is not carried through the sleeve) or the external diameter of the pipe insulation (where pipe insulation is carried through the sleeve), shall be large enough to allow adequate packing of the sleeve and/or adequate clearance to accommodate pipe movement (lateral or axial) due to thermal expansion of the pipe or movement of the building.

3.2.5 On all pipework passing through fire walls and floors, the annular space between the pipe and the sleeve shall be fire stopped. The material must be applied in the manner recommended by the manufacturer for each particular application, and the MEP Contractor shall bring to the Services Consultants attention, any situation

where that procedure cannot be adopted. Pipes shall not under any circumstances be built solidly into walls or plaster. Pipe joints shall not be positioned within the thickness of the structure.

3.3 DRAINING AND VENTING

3.3.1 Unless otherwise indicated on the drawings, all horizontal water, compressed air, steam and condensate lines, including runouts and branches, shall pitch or slope to low points to provide for complete drainage, removal of condensate and allow for venting. Pitch, unless otherwise indicated, shall not be less than 1 in 500. Accurate grades shall be maintained where lines are pitched or sloped for venting or drainage. No lines shall have pockets due to changes in elevation, unless indicated on the drawings, and only then with proper provisions for draining and venting.

3.3.2 Gland cocks shall be fitted with hose thread adapter at all low points of piping systems or where indicated on drawings to permit complete or sectionalised draining.

3.3.3 Drain pipework shall be provided from pumps, cooling coil drain trays, drip glands etc., and taken to the nearest gully as specified herein or as indicated on the drawings. Drain tundishes shall be provided at each drain boss of the item or equipment. Each drain pipe shall not be less 22mm or as indicated on the drawings. All necessary rodding points shall be provided in the drain pipework for maintenance and removal of stoppages.

3.3.4 At all high points and where ever else required in all water piping systems, provisions shall be made for the elimination of air. On Water Supply Systems all high points not vented by draw-offs shall be provided with air bottles and vent lines carried to an acceptable position. Air bottles shall be 200mm long and be of line size diameter on 80mm lines and above up to a maximum of 150mm diameter. On lines 50mm and below, air bottles shall be 50mm diameter. Vent lines shall be 15mm dia., complete with globe type vent valve positioned 1000mm above floor level. All vent and drain piping shall be of the same material and construction as specified for the service involved.

3.4 CLEANING OF PIPING

3.4.1 Prior to assembly of pipe and piping components, all loose dirt, scale, oil and other foreign matter on internal or external surfaces shall be removed by means consistent with good piping practice, subject to the approval of the Services Consultant. Chips and burrs from machinery of thread cutting operations shall be blown out of pipe assembly. Cutting oil shall be wiped from internal and external surfaces. During fabrication and assembly, slag and weld spatter shall be removed from both internal and external pipe joints by peening, chipping and wire brushing to the degree consistent with good piping practices.

3.4.2 The Services Consultant shall be notified prior to starting any post erection cleaning operation in sufficient time to allow witnessing of the operation. The MEP Contractor shall consult with, and obtain approval from the Services Consultant with regard to specific procedures and scheduling. It shall be the MEP Contractor's responsibility to arrange for proper disposal of cleaning and flushing fluids. All potable water systems shall be chlorinated as described elsewhere.

3.4.3 Prior to blowing or flushing erected piping systems, the MEP Contractor shall disconnect all instrumentation and equipment, open wide all valves, and be certain all strainers screens are removed. Following approval of flushing or blowing operations, all items disconnected or blanked off shall be reconnected, and strainer screens shall be replaced. Systems should then be prepared for testing. Any special cleaning requirements in

addition to those covered in this article are indicated in the applicable sections for the service affected. Failure to obtain a contamination free system shall require repetition of cleaning. Fuel gas and medical gas pipework shall be cleaned and purged as specified by the appropriate supply authority or manufacturer.

3.5 DIELECTRIC CONNECTIONS

Pipe joints connecting dissimilar metals shall be made using insulating dielectric connections. Dielectric connections shall also be provided for joining similar metals in order to isolate cathodically protected pipelines from adjoining pipe sections. Such joints, including dielectric materials, shall be rated to withstand the temperature, pressure and other characteristics of the service for which it is to be used, including testing pressure.

3.6 PIPE JOINTS

3.6.1 Screwed Pipe Joints for steel pipework shall be made using purpose made malleable or wrought iron pipe fittings with taper pipe threads, compatible with the pipework material used. Male threads cut onto pipes for insertion into fittings shall be tapered and shall be cut with suitable pipe thread dies to match the threads on the fittings.

3.6.2 Flanged pipe joints shall be made using purpose made mild steel, cast iron or wrought iron screwed or welded flanges, compatible with the pipework material used. Steel flanges shall be raised face type except when bolted to flat faced cast iron flanges on equipment on which case they will be flat faced.

3.6.3 Joining compounds used to seal threaded pipe joints shall be non-toxic. Purpose made plastic joining ribbon tape (polytetrafluoroethylene PTFE) may be used, alternatively linseed oil based joining paste in association with hemp fibre may also be used. The MEP Contractor shall avoid the excessive use of joining material.

3.6.4 Gaskets for insertion between flanges shall be purpose made, full face diameter, of approved non-toxic composition material not less than 3mm thick before compression. Caulking of any joints, screwed, flanged, welded or otherwise will not be permitted.

3.6.5 Pipe joints on copper pipework 54mm and under shall be made using solder ring fittings incorporating tin/silver capillary solder to BS219:1977 Grade 96S, or compression type. Joints on pipework 67mm and above shall be fabricated couplings or flanged joints. Joints shall be made using water soluble flux, and self-cleaning fluxes shall not be used.

3.6.6 Pipe joints on copper pipework 67mm and above shall be fabricated couplings, fittings and flanged joints made from non-dezincifiable metals, all with socketed ends suitable for capillary end joints feeding with silver brazed alloy. All fabricated couplings, fittings and purpose made sections of pipework to be made from tube to same specification as tube on which they are installed. Flanges and flange bolting shall be rated for maximum working pressure. Flanges shall be of the slip-on pattern for silver brazing to the pipe. Bronze welding and brazing shall not be permitted. All solder and silver brazing alloys shall be zinc free and of potable quality.

3.6.7 Pipe joints on non-metallic pipework shall be solvent welded, heat welded or compression type, in accordance with the manufacturer's recommendations. Only approved methods of jointing such pipework will be acceptable.

3.7 HANGERS AND SUPPORTS

3.7.1 All piping and piping connected to equipment including valves and strainers, traps and other specialities and accessories shall be supported in a manner that will not result in or produce excessive stress, deflection, swaying, sagging or vibration in the piping or in the building structure either during erection, cleaning, testing or normal operation of the system. Piping shall not be so restrained, however, as to cause it to snake or buckle between supports or anchors to prevent proper movement due to expansion and contraction. Piping shall be supported at equipment such that equipment can be disconnected and removed without further supporting the piping. Piping shall not introduce any strains or distortion to the connected equipment.

3.7.2 Where building structural steel is to be fireproofed, all hangers, clamps, auxiliary steel, etc., which attach to it shall be installed prior to application of fireproofing. Hangers and supports shall be provided and installed complete, including lock nuts, clamps, rods, bolts, couplings, swivels, inserts and the required accessory items. Hangers for horizontal piping shall have adequate means of vertical adjustment for proper alignment of pipe and shall be provided with lock nuts. All hangers and supports in direct contact with copper tubing shall be of non-ferrous construction or plastic coated. One piece 'snap-in' plastic pipe clips for copper tubing will not be permitted. Pipe support brackets and clips shall be designed with sufficient clearance or flexibility to prevent binding and undesirable forces being applied to the building structure, the supports, the pipework system or the appliances to which pipework connects. Pipes shall be supported individually unless shown otherwise on the drawings.

3.7.3 Hangers rods for single and double rod hangers shall conform to the following:-

Pipe Size mm Pipe Size mm	Hanger Road Diameter mm
50 and smaller	6
80	10
100	12
150	16
200 to 450	20

3.7.4 It shall be the responsibility of the MEP Contractor to co-ordinate the location and method of support of the piping systems with that of all installations under other sections of this Specification. The loading of any hanger or support shall in no case exceed the manufacturer's recommended load.

3.7.5 Hangers for insulated pipework shall be sized for the O/D of the insulation or the insulation protection saddle. On insulated chilled water piping of all sizes, the MEP Contractor shall provide at each support point an insulation protection shield unit consisting of a semi-cylindrical segment of high density pre-compressed fibreglass, or similar approved heavy density insulation.

3.7.6 Unless otherwise indicated on the drawings, the maximum spacing of piping supports for steel and copper piping shall be as follows:-

Pipework Type	Nominal Pipe Size	Horizontal Support	Vertical Support
	(mm) DIA	Spacing (Metres)	Spacing (Metres)
Mild Steel	15	2.0	2.5
	20	2.4	2.8
	25	2.7	3.0
	32	2.7	3.0
	40	3.0	3.6
	50	3.4	3.8
	65	3.7	4.0
	80	3.7	4.3
	100	4.0	4.6
	150	4.2	4.6
	200	5.1	6.0
	250	5.8	7.0
	300	6.1	8.0
Pipework Type	**Nominal Pipe Size**	**Horizontal Support**	**Vertical Support**
	(mm) DIA	**Spacing (Metres)**	**Spacing (Metres)**
Copper	15	1.00	1.25
	22	1.25	1.50
	28	1.50	2.00
	35	1.50	2.00
	42	2.00	2.25
	54	2.25	2.75
	67	2.50	2.75
	76	2.50	2.75
	108	2.75	3.00
	154	3.00	3.50

3.7.7 Plastic, PVC or polyethylene pipework shall be supported at centres in accordance with the manufacturer's recommendations.

3.7.8 All vertical cast iron pipework shall be supported by means of galvanised steel fixing brackets with adjustable alignment, and all horizontal cast iron pipework shall be supported by means of galvanised steel hanging brackets, to suit M8 fixing bolt/rod (50mm-150mm dia.) or M12 fixing bolt/rod (200mm-300mm), all supported on short section of mild steel channel, secured by means of "Unistrut" fixings or equivalent.

3.8 EXPANSION, ANCHORING, GUIDING AND THRUSTING

3.8.1 Expansion joints for Heating and Chilled Water pipes shall be fully articulated twin bellows type formed from heavy wall chrome-moly steel, suitable for the working pressures of the systems. Each expansion joint shall be complete with ball ended tie bars to restrain the length of the unit and to allow offset movements in all directions at right angles to its axis. Each expansion joint shall be flanged at both ends.

3.8.2 Pipe line anchors and alignment guides shall be provided and installed as shown on the drawings or where appropriate. Pipe expansion loops and offsets shall be provided and installed as indicated on the drawings. Expansion loops shall be cold sprung at erection. Cold springing shall be equal to 50% of the anticipated thermal expansion of the pipeline.

3.8.3 Concrete thrust blocks shall be provided for all underground pressure piping systems, having push-on or mechanical joints, at each change of direction horizontally or vertically. Thrust blocks shall bear against undisturbed earth.

3.8.4 Pipework elsewhere shall generally be installed to take advantage of the inherent flexibility of bends and shall be supported in a manner to allow free expansion without undue stress on pipework branches and equipment.

3.9 BRANCH CONNECTIONS

3.9.1 Branch connections shall be made with standard tee fittings and 45% laterals of the type required for the services.

3.9.2 At the option of the MEP Contractor, branch connection from headers and mains may be cut-in to black steel piping using forged weld-on fittings.

3.9.3 Use of forged weld-on fittings shall be limited as follows:-

a) They must have at least the same rating as the main
b) The header or main must be 80mm or over
c) The branch line is at least two pipe sizes under header or main size.

3.10 TESTING AND BALANCING OF PIPEWORK

3.10.1 All tests shall be performed in the presence of the Services Consultant or such other parties, as may have adequate jurisdiction. All defective work shall be promptly repaired or replaced and tests repeated until approved by the Services Consultant. Any damage resulting from the tests shall be repaired and/or damage material replaced, all to the satisfaction of the Services Consultant at no cost to the Client. The Services Consultant and all others having legal jurisdiction shall be notified in sufficient time to allow witnessing when a test is to be performed.

3.10.2 Tests shall be performed, and approval of tests obtained, in writing prior to backfilling, insulating, painting or concealing in any manner, and in accordance with section 3.30 and this specification in general.

3.10.3 Records shall be prepared and retained for each system or section of system tested. Test reports shall be signed as approved by the Services Consultant and transmitted to the Services Consultant. If additional copies are required by those persons having legal jurisdiction, the MEP Contractor shall furnish them.

Test reports shall include, but not necessary be limited to the following:-

- Identification of piping system or section tested.

- Date of test and date of Services Consultants approval signature
- Testing medium, test equipment description (sketch if necessary), and method of description of test procedure.
- Test procedure, duration of test and recorded pressure drop.

3.10.4 Tests shall be observed after the pipe and contents have stabilised at the ambient temperature and the source of test pressure shut off. Pressure tests in general shall apply to piping only with all equipment, traps, relief valves and instruments blocked off or disconnected. In no case shall piping or any component be subjected to pressures exceeding their rating.

3.10.5 All system valves within the section being tested shall be open. Temporary restraints shall be provided on expansion joints and flexible connections during pressure testing.

3.10.6 Unless otherwise indicated, the hydrostatic testing medium shall be water and pneumatic testing medium shall be compressed air. Gauges used for pressure testing shall be checked and calibrated against a dead weight tester at least once per month and certified correct over the range of the gauge, to the Services Consultant. Gauges used for testing shall have minimum dial diameter of 150mm with scale divisions equal to no less than the maximum allowable pressure drop.

3.10.7 After cleaning and testing, all open pipework and valves shall be capped or plugged with purpose made polythene closures, unless otherwise specified. Fuel gas and medical gas pipework shall be tested as specified under the relevant sections.

3.10.8 All systems shall be balanced and regulated in accordance with the requirements of CIBSE Code W after hydraulic tests have been successfully complete. Proportional balancing shall be strictly followed, and on completion, all valve settings shall be marked on the commissioning drawings. Commissioning sheets shall be provided for each service with a schematic drawing showing the location of all valves, their design and actual flow rate and any marking or set point of the commissioning valve. Where low flow rates occur, the MEP Contractor shall use appropriate control valves to ensure that accurate balancing can be achieved. Test sheets shall form part of the commissioning data in the handover manual.

3.11 STERILISATION

3.11.1 After successful hydraulic testing, potable water lines shall be sterilised before connecting permanently to the source of potable water. Before commencing to sterilise a pipeline, the Local Water Undertaking shall be notified so that they may satisfy themselves that there is no possibility of polluting their supply mains.

3.11.2 The pipelines shall be sterilised by introducing water with a chlorine dose of at least 10 ppm (10 mg/L). After standing for 24 hours, the water shall be tested for residual chlorine to ensure that satisfactory sterilisation has been achieved. Potable water may be used to displace the chlorinated water, but the pipeline will not be put into service until bacteriological tests of water delivered at the end of the pipeline show that a satisfactory potable standard has been achieved. The MEP Contractor shall produce a certificate from a reputable body confirming satisfactory chlorination for each section of Potable water pipework tested.

3.12 PAINTING

3.12.1 Decorative painting to pipework, fittings, equipment and associated steelwork, including insulated pipework, fittings and visual equipment and the plant areas in the buildings, shall be carried out under the Architect's direction by the Main Contractor.

3.12.2 Decorative painting to uninsulated pipework, fittings, equipment and associated steelwork on roofs of the buildings shall be carried out under the Architect's direction. Weatherproof insulated pipework fittings and equipment on the roofs of buildings shall receive no further finish.

3.12.3 Prior to applying the decorative finish to exposed pipework and supports, the surface shall be corrosion protected.

3.12.4 Equipment in plant areas which has factory applied decorative paint finish will have no additional painting.

3.12.5 No painting will be carried out until hydraulic testing has been certified satisfactory.

3.13 INDETIFICATION

3.13.1 All insulated and uninsulated pipework in plant areas, service voids, service ducts, false ceilings and exposed in corridors and the roofs shall be provided with colour coded bands to indicate the service, together with direction arrows to indicate direction of flow and an F (flow) or R (return) where appropriate.

3.13.2 Identification colour coded bands shall be to International Pipework Colour Coding Standards and may take the form of self-adhesive plastic tapes. Identification will be applied after completion of painting specified elsewhere in this Specification to BS 1710 and BS 4800.

3.14 LABELLING

3.14.1 All items of plant and equipment shall be clearly identified by means of engraved ivorine labels securely fixed or attached to the wall in a position clearly visible.

3.14.2 All manual and automatic valves and strainers shall be identified with a valve number related to the valve schedule forming part of the Operating and Maintenance Manuals.

3.14.3 The MEP Contractor shall provide these labels and each label tag shall be sized to contain 15mm high lettering. The engraving shall be in white on black laminated material. The labels shall be secured in an easy position on the valve stem, handwheels, or in a hole drilled in the lockshield, with a key ring such that the valve operations is unaffected. Whenever this is not possible due to the design or type of valve the label shall be fixed with a brass chain around the body of the valve.

3.14.4 Valves, stopcocks, draincocks, aircocks and other similar items requiring periodic inspection, operation and servicing, but located in cupboards capable of being locked, shall have labels fixed by the MEP Contractor to the outside of the cupboard doors indicating he presence of valves etc. within the cupboard.

3.14.5 Where valves, stopcocks, draincocks etc. are located above suspended ceilings or in floor voids the MEP Contractor shall ensure that suitable identification discs are fixed to the removable ceiling tile immediately below the valve or the floor access panel immediately above the valve.

3.15 VALVES

3.15.1 Valves as specified herein and shown on the drawings, or as required, shall be provided and installed to ensure that all plant items, control and commissioning valves and branch circuits can be isolated and regulated. Where possible, all valves shall be of a single manufacturer. Valves shall conform to specifications for the specified service. All packings, gaskets, discs, seats, diaphragms, lubricants, etc., shall conform to the recommendations of the valve manufacturer for the intended service. If space permits, valves shall be installed with stems horizontal or extending vertically upwards unless specifically shown otherwise. All valves shall be installed in accessible locations for operation as well as removal, repair or replacement.

3.15.2 Shut-off valves shall be provided and installed in both flow and return lines at each item of equipment. Valves and cocks size 50mm nominal bore and below shall have screwed ends with taper heads. All valves 65mm nominal bore and above shall have flanged ends. All draw-off points or ranges of draw-off points shall be provided with lock shield isolating valves. Valves not enclosed in false ceilings, service shafts, ducts and plant rooms shall be provided with lock shield operation or will have the hand wheels removed and handed to the Client, to prevent unauthorised operation.

3.15.3 Valves for Hot and Cold water Systems

a) All isolating valves in pipework up to and including 50mm nominal bore shall be gunmetal or DZR ball type valves with lever/lock shield. These shall be as Crane Ltd Fig. D171 or Oventrop Ltd Fig. 107 70 or equal and approved.

b) All isolating valves in pipework of 65mm nominal bore and above shall be cast iron gate valves, with wedge disc. The valves shall have rising stems outside screw and yoke, bolted bonnet, replaceable gland packing, bronze trim and hand wheels. These shall be Crane Ltd Fig. F52 or Oventrop Ltd Fig 104 51 or equal and approved.

c) Any steam valves shall be of the bronze globe type with non-rising stems, and shall be as Crane Ltd Fig. D5 or equal and approved.

3.15.4 Radiator Valves

Not Required.

3.15.5 Valves for Gas Systems

Not Required.

3.15.6 Non-Return Valves for Hot and Cold Water Services and LTHW

a) All non-return valves in pipework up to and including 50mm nominal bore, shall be bronze swing check valves with metal to metal seats and screwed bonnet. These shall be Crane Ltd Fig. D140 or Oventrop Fig. 107 50 or equal and approved.

b) Non-return valves 65mm nominal bore and above shall be cast iron swing check valves with rubber faced gunmetal disk, bolted cover and all iron trim. These shall be Crane Ltd Fig. FM469 or equal and approved.

3.15.7 Double Regulation Valves for Hot and Cold Water Services and LTHW

a) Double regulation valves in pipework up to and including 50mm nominal bore shall be bronze globe valves with characterised disk and metal to metal seating, inside screw rising stem and screwed bonnet. Valves shall be provided with handwheels. The valves shall be provided with a device to prevent the valve being opened beyond its set regulated position. The valve shall also be capable of being used as a stop valve.

b) The double regulating valves shall be provided with test plug and cap assemblies on the inlet and outlet side of the valve. The test plug shall be suitable for safely attaching a pressure probe whilst the line is under pressure. Probes and test equipment compatible with the test plug shall be provided by the MEP Contractor for commissioning purposes. Upon final completion these shall be handed to the Client. Where low flow rates occur, the MEP Contractor shall install valves suitable for that purpose. Valves shall be supplied with manufacturer's flow charts indicating flow against pressure drop across the valve to enable commissioning to be carried out.

Suitable valves shall be:

- Up to 50mm - Crane Ltd Fig. D930 or Oventrop Ltd Fig. 106 02 or equal and approved.
- 65mm and above - Crane Ltd Fig.DM930 or Oventrop Ltd Fig. 106 26 or equal and approved.

3.15.8 Needle Valves for Air Release for Hot and Cold Water Service, LTHW and Chilled Water

Not Required.

3.15.9 Drain Cocks

a) Drain/emptying shall be installed at low points and on the dead side of all main isolating valves, and where indicated on the drawings. Drain cocks shall be bronze draw-off cocks with lever operation. In plant rooms they shall be straight type, Crane Ltd Fig. D171HU or Oventrop Ltd Fig. 1033 33 pattern, detachable hose union. Where exposed to view in rooms they shall be Crane Ltd Fig. D340 or Ballofix Ltd Fig. 25095B1. Allor equal and approved.

b) Drain cocks shall be sized to the following requirements :-

- 15mm for draining pipes up to 25mm nominal bore.
- 20mm for draining pipes 32mm to 80mm nominal bore.
- 25mm for draining pipes 100mm to 200mm nominal bore.
- 40mm for draining pipes 250mm nominal bore and above.

3.15.10 Stopcocks for Hot and Cold Water Services

a) Stopcocks shall be provided and installed on pipes up to and including 50mm nominal bore. Stopcocks shall be double union bronze type, with screwed bonnet and gland. Discs shall be composition faced. Gland packing shall be replaceable. Stopcocks shall be as Yorkshire 508GM or equal and approved.

3.15.11 Three-Way Cocks for Combined Vents

Not Required.

3.16 STRAINERS

3.16.1 Strainers shall be installed as specified herein and as shown on drawings. Whether detailed on the drawings or not, unless otherwise stated, the MEP Contractor shall ensure that at least one full bore line strainer is fitted to every heating and chilled water system. The MEP Contractor shall submit for approval by the Services Consultant a schedule of all strainers indicating the service, size and connections, screen material perforation, size of mesh, make, model number and any special features such as blow down cock. As nearly as possible all strainers shall be of a single manufacturer. All strainers shall be suitable for the pressures and temperatures of the systems in which they are installed, and shall have local isolating valves for removal of the screen without draining down the whole installation.

3.16.2 Strainers shall conform to the following specifications. All gaskets, screens, meshes, etc. shall conform to the recommendations of the strainer manufacturer for the intended service. The following specification shall apply to strainers for the relevant services.

a) Pipework services (excluding gas services) up to and including 50mm nominal bore, screwed 'Y' type bronze or pressed brass constructions with screwed covers for removal of strainer basket for cleaning. As Crane Ltd Fig. D297 or Oventrop Ltd Fig 112 00. or equal and approved.
b) Strainers above 50mm shall be cast iron with bolted cover for removal of strainer basket. As Crane Ltd Fig. FM276 or Oventrop Ltd Fig. 112 20 or equal and approved.

c) Unless otherwise indicated on the drawings or specified, pipe line strainers shall be 'Y' pattern and shall have stainless steel screens or meshes as follows :-

- Steam and air - 0.8mm diameter holes.
- Water - 1.6mm diameter holes.

d) All strainers shall be installed in accessible positions for cleaning purposes as well as for removal, repair or replacement.

e) Strainer baskets shall be positioned as follows : -

- Steam and air - basket horizontal to one side of pipeline
- All liquids - basket vertically below pipeline

f) Pipe nipples and globe valve shall be provided and installed where necessary for blowing down strainer screens.

3.17 THERMAL INSULATION

3.17.1 All hot and cold water services pipework shall be insulated where hidden from view in service ducts, plant rooms, floor voids, etc. Any pipework on view in public areas shall not be insulated, unless otherwise stated. Insulation shall be applied in a neat workmanlike manner with all joints taped and sealed to Class 'O'.

3.17.2 All heating, hot water service, cold water, chiller water, steam and condense pipework shall be insulated as detailed within this specification, or as otherwise called for, as well as all supply and recirculation ductwork. Vapour seals shall be provided where condensation is likely to occur, and the manufacturer's instructions for installation, with regard to jointing, sealing, pipe supports and finishes shall be strictly observed. The same material shall be used for all services on any project, and only the thicknesses, configuration, and finish of the material shall vary on the different services.

3.17.3 All thermal insulation shall comply with the requirements of BS5422 and 5970. All materials shall be suitable for the temperature and condition of the service and environment for which they are specified and shall be proof against rotting, mould, vermin and fungal growth.

3.17.4 All materials shall be non-combustible in accordance with BS476 Part 4, and shall have a surface spread of flame to Class 1 in accordance with Part 7 of BS 476 where they are not encased in sealed fire zone, and Class O where they are encased in sealed fire zones.

3.17.5 Thickness of insulation shall be as shown in the tables in this specification. All thermal insulation, unless indicated otherwise in the following Sections of this Specification, shall be Armaflex AF/Armaflex closed cell CFC free elastomeric material generally, and Class "O" Armaflex where this is required.

3.17.6 Thermal insulation shall be continuous with outer coverings continuous through support joints.

3.17.7 Valve bodies shall be insulated with purpose made valve boxes manufactured from Armaflex sheet in accordance with the manufacturer's instructions.

3.17.8 Insulation in service ducts, false ceilings and other areas concealed from view shall be self-finished, with care being taken on cold services to maintain a continuous vapour seal.

3.17.9 Ductwork shall be insulated with AF/Armaflex flexible sheet fixed in accordance with the manufacturer's instructions.

3.17.10 Insulation in plant rooms and boiler houses shall be finished with hammer clad aluminium sheeting, with thicknesses of aluminium to be not less than 0.7mm on pipework up to
150mm, and not less than 0.9mm on pipework up to 450mm diameter. Overlap on all joints shall not be less than 40mm, and heat bridges between hot pipework surfaces and cladding is unacceptable.

3.17.11 External pipework and ductwork insulation shall be painted with Armafinish HN paint to ensure weather protection. This shall be applied in accordance with the manufacturer's instructions 48 hours after the adhesive has set. A second coat shall be applied 24 hours after the first coat to achieve the desired protection.

3.17.12 The final colour of all paint shall be to the Architects approval.

3.17.13 All thermal insulation shall be applied by an installer who has received an approved training certificate from the manufacturer, and a copy of this approved certificate shall be supplied to the Services Consultant before installation commences. Great care shall be taken to achieve the best finish possible, and consistency in joints in all areas.

3.17.14 Armaflex insulated pipe supports shall be used on all chilled water pipework to prevent cold bridging.

3.17.15 All pipework shall be identified with self-adhesive colour bands to BS1710, with direction of flow arrows.

Thickness of Insulation	
Nominal Bore	Thickness
15mm	19mm
20mm	19mm
25mm-40mm	25mm
50mm-150mm	32mm
150mm-300mm	32mm
Flat surfaces	32mm sheet

3.18 NAME PLATES

3.18.1 All plant and apparatus shall be provided with name plates bearing the maker's name, reference number, size, type, test and working pressures, speed and any other relevant particulars engraved thereon.

3.19 MAINTENANCE TOOLS

3.19.1 The MEP Contractor shall not be required to provide any maintenance tools unless specifically requested elsewhere in this specification.

3.20 PLANT COMMISSIONING

3.20.1 All plant items shall be commissioned by the manufacturer or supplier where possible, to ensure that all warranties and guarantees are maintained. If this is not possible, a specialist commissioning engineer shall be employed to commission all plant, and shall issue a certificate confirming that the items have been commissioned in strict accordance with manufacturer's instructions.

3.20.2 Where possible, details of the manufacturers testing and commissioning instructions shall be included within the handover manual.

3.21 TEST EQUIPMENT

3.21.1 The MEP Contractor shall provide all the test equipment required for the tests as specified and shall demonstrate the accuracy of such test equipment before the test is carried out. The test equipment shall provide a controlled and stable source of air under pressure.

3.21.2 It shall incorporate a device for the measurement of the rate of delivery of air flow within an accuracy of ±5% at the permissible leakage rate. To carry out the tests, a test apparatus shall be provided comprising a fan or pressure blower, calibrated orifice meters and dampers for adjusting the fan volume and system pressure. The test fan provided shall deliver a volume of air per second not less than 50% of the volume of the duct section to be tested. Instruments for reading test pressure and pressure drop over the orifice meters shall also be provided.

3.22 VIBRATION

3.22.1 All equipment shall be installed in such a manner as to ensure that no vibration is transmitted to the building fabric.

3.22.2 Any plant items with motors shall have suitable anti-vibration mountings to the manufacturers Recommendations, fitted in such a way that they absorb all detrimental plant motion. Flexible connections shall be used on all ductwork connections to fans or air handling plant whether indicated on the drawings or not.

3.22.3 Connections to any floor mounted pumps or pressurisation units shall incorporate neoprene or rubber flexible joints on the connections to the pipework. These shall be supported in such a way as to prevent sagging, and shall be installed between the plant isolating valve and the plant item itself.

4 SPECIFIC CLAUSES - MECHANICAL SERVICES

4.1 GENERAL

4.1.1 Services to be provided by the MEP Contractor shall include, but not limited to, the following: -

- Extension of existing Mains Cold Water Services from Phase 1 building.
- Supply, Installation and Commissioning of domestic hot and cold water services including final connections to sanitary ware.
- Supply, Installation and Commissioning of Local Extract Ventilation.
- Supply, Installation and Commissioning of Above Ground Drainage System
- Supply, Installation and Commissioning of Electric Underfloor Heating System.
- Provision of handover documents and client training.

4.1.2 A representative list of regulations, standards and guidelines are given below, but are not exhaustive. The MEP Contractor shall ensure compliance with all applicable and current regulations, and shall obtain all necessary permission and approvals.

- The Health and Safety at Work Act
- The Building Regulations
- British Standards
- EC Directives and associated Codes of Practice
- County and Local Authority Byelaws
- Electricity at Work Regulations
- The COSHH Regulations
- The Noise at Work Regulations
- The Fire Precautions Act
- The Water Regulations 1999
- Gas Safe Register Guidelines
- CIBSE Codes and Recommendations
- The CDM Regulations.

4.1.3 Copies of any relevant certificates and approval documents shall be passed to the Client as they are obtained, but no later than at practical completion. Copies of these documents shall be included within the handover documents.

4.1.4 Incoming Water Services; The incoming water supply for the building will be provided from the existing supply. This is believed to terminate internally within boxing adjacent to the kitchen sink. This is believed to currently serve a roof level cold water storage cistern that it to be removed as part of the project and the new cold water system to be mains pressured.

4.2 COLD WATER BOOSTER INSTALLATION

Not Required.

4.3 COLD WATER BREAK TANK

Not required

4.4 COLD WATER DISTRIBUTION

4.4.1 The MEP Contractor shall allow for the supply and installation of the cold water distribution system as indicated on the drawings and described within this document.

4.5 PIPEWORK AND FITTINGS

Generally, all pipework shall run through the building as shown.

The MEP Contractor shall note that the Tender Drawings indicate the general intended route only. Final routes shall be agreed onsite and prior to any installation taking place.

External Mains Water

All underground water service pipework shall be installed in Blue polyethylene to BS EN 12201:2003.

The system shall comprise all pipework and necessary fittings including couplers, joints, tees and elbows.

Mains Water system components shall be WRAS approved, complying with the Water Supply Regulations 1999.

New underground mains water pipework shall be run at 750mm under ground level as a minimum. Where any clashes with other services occur, the pipes shall run underneath the service with which it clashes.

Water point of entry to the building shall be installed within a protective duct, to comply with The Water Regulations.

Above Ground

All hot and cold water pipework shall be run in light gauge copper tube to BS EN 1057: 1996 Black Label with copper capillary fittings to BS EN 1254: 1998.

All copper pipework shall be jointed with lead free solder to BS EN 29453: 1994 Grade 96S using cold water soluble flux. Self-cleaning fluxes shall not be used.

Where possible, all pipework shall be concealed within the ceiling voids and service ducts. Attention shall be given to accessibility, as required by the Water Regulations 1999.

Any exposed piping shall follow the line of walls, both vertically and horizontally, being clip distance therefrom.

The external washdown area pipe will be provided with an internal isolation valve, quarter turn handle, securely fixed to the wall, and a double check valve.

The external bib tap for the washdown area will be housed within a wall mounted insulated enclosure such as a Tapboxes Ref. STB or equal and approved.

4.6 LOCAL EXTRACT VENTILATION

4.6.1 The building is to be provided local wall mounted extract fans, one in the drying room, controlled by a humidistat controller, and one in the Workshop/Garage which is to be controlled via an electronic controller manufactured and suitable for the selected extract fan.

4.6.2 The extract fans are to be provided with a solid duct between the internal and external wall.

4.6.3 Externally, the duct is to be supplied with a suitable plastic or metal diffuser, fixed to the external wall.

4.6.4 The extract fan in the drying room will be an Xpelair GX9 controlled by an Xpelair XRH humidistat and capable of a minimum of ten air changes per hour or equal and approved.

4.6.5 The extract fan in the workshop/garage will be an Xpelair GX9 controlled by an Xpelair XCC1 electronic controller or equal and approved.

4.6.6 A louvre is to be fitted above the drying room external doors to provide a minimum of 0.6m² free area.

4.7 ABOVE GROUND DRAINAGE

4.7.1 The MEP Contractor shall allow for the fixing of all sanitary ware and associated fittings, which will be supplied ‘free issue’ by others.

4.7.2 All costs associated with the installation of the sanitary ware shall be included by the MEP Contractor.

4.7.3 The MEP Contractor shall supply and install above-slab drainage pipework for the WC’s, basins and sinks etc., including all vertical soil and vent pipework, as shown.

4.7.4 The MEP Contractor shall also allow for the installation of all extract vent / kitchen equipment condense and expansion drain pipework as necessary, using materials suitable for its purpose.

4.7.5 The MEP Contractor shall assume that overflow pipes from WC cisterns shall be internal.

4.7.6 The installation shall comply with section H of the Building regulations, Statutory Authority Regulations and all relevant British Standards.

4.7.7 All internal soil/vent pipe stacks, waste and anti-syphon systems shall be carried out in uPVC pipework and fittings as manufactured by Marley, or equal and approved, with push fit connections unless specified as other elsewhere.

4.7.8 Access for rodding shall be provided on all systems, and all systems shall be of a single manufacturer, and installed in accordance with the manufacturer’s requirements in terms of supports and jointing.

4.7.9 Pipework shall be supported throughout its length, using standard 2 fixing clips to ensure a gradual and consistent fall, and any pipework not meeting this criteria shall be replaced.

4.7.10 An air test shall be applied to each section of the sanitary installation on completion.

4.7.11 Water seals of appliances shall be fully charged and test plugs inserted into open ends. Air shall be pumped into the system under test until a pressure of 38mm of water is reached and held for 3 minutes. Soap tests shall be used to detect any leaks and tests shall be repeated until successful and approved.

4.7.12 The MEP Contractor shall allow for tests to be witnessed by the local Building Control Officer.

4.8 TESTING, COMMISSIONING AND SETTING TO WORK OF SYSTEMS

4.8.1 Upon completion of all Mechanical Services installation works, the complete systems shall be tested, dosed, flushed through, balanced and commissioned and left to work in a satisfactory condition, with all necessary tests etc recorded.

4.8.2 Copies of any relevant certificates and approval documents shall be passed to the Client as they are obtained, but no later than at practical completion. Copies of these documents shall be included within the handover documents.

4.9 FLUSHING, CHEMICAL CLEANING AND CORROSION INHIBITOR

4.9.1 On completion of the works the MEP Contractor shall thoroughly flush and chemically clean all elements of the heating system in its entirety and shall finally fill the system with Fernox corrosion inhibitor to the prescribed levels.

The MEP Contractor shall allow for sufficient valving arrangements throughout the heating network to enable him to carry out this element of work in stages if necessary.

The MEP Contractor shall allow for employing all specialist flushing, cleaning and dosing Contractors, in addition to all necessary laboratory testing and certification, licenses required.

The method / stages of cleaning and flushing of all pipework shall be as listed below:-

4.9.2 Testing/flushing and dosing of external pipework:

- Specialist contractor to be employed to carry out testing, cleaning, flushing and dosing of the pipework as follows:-

1 Take sample of mains water and test for bacteria.

2 Pressure test and check pipework is mechanically sound.

3 Connect flushing equipment to temporary flushing valves, check all valves are in the correct position.

4 Connect pumping equipment and hoses to mains water supply and carry out initial dynamic flush, with flushing velocities in accordance with BSRIA BG29/2011 to remove soluble and non-soluble contaminants.

5 Introduce CH28N or equal chemical cleaning agent (1% of section volume for 12 hours) and circulate to remove soluble contaminants before carrying out second dynamic flush (as first flush procedure but measurement of velocities not required).

6 Fill heating mains from local water main and vent.

7 Introduce inhibitor to system. Inhibitor to be the same type as any previous sections which may have been dosed.

8 All of the above procedures must be carried out as a continuous program with each stage leading to the next in a logical manner.

9 Witnessing to be carried out by site manager at each stage of this process, with full documentation being recorded within the O&M manual prior to handover.

10 After filling and introducing to the system, the overall inhibitor levels shall be checked at the boiler room, and topped up as and when necessary during the process.

11 The system should be dosed as close as possible to being introduced live onto the network. If a leg is not live, but filled and dosed, procedures should be put in place to circulate the water in that leg for a minimum of 4 hours per day until such time as the water is introduced to the main network.

12 All licences for temporary connection of mains water and discharge into drainage network to be obtained by contractor prior to carrying out of any work

4.10 CHLORINATION

4.10.1 After successful hydraulic testing, potable water lines shall be sterilised before connecting permanently to the source of potable water. Before commencing to sterilise a pipeline, the Local Water Authority shall be notified so that they may satisfy themselves that there is no possibility of polluting their supply mains.

4.10.2 The pipelines shall be sterilised by introducing water with a chlorine dose of at least 10 ppm (10 mg/L). After standing for 24 hours, the water shall be tested for residual chlorine to ensure that satisfactory sterilisation has been achieved. Potable water may be used to displace the chlorinated water, but the pipeline will not be put into service until bacteriological tests of water delivered at the end of the pipeline show that a satisfactory potable standard has been achieved. The MEP Contractor shall produce a certificate from a reputable body confirming satisfactory chlorination for each section of Potable water pipework tested.

4.11 TESTING AND COMMISIONING

4.11.1 The whole of all systems shall be tested and the successful results of those tests shall be recorded on Certificates signed by the MEP Contractor.

4.11.2 Heating, Hot and Cold Water supplies, shall be tested by hydraulic pressure and where applicable heat tested.

4.11.3 All systems shall be subjected to a hydraulic pressure equal to 1.5 bar or 1½ times the maximum working pressure, whichever is the greater, and this test shall be applied for a period of at least one hour. Factory assembled items, such as boilers and thermal interface units, shall be tested at works.

4.11.4 Combustion tests shall be carried out on all boilers and recorded on Certificates.

4.11.5 Should any system fail to withstand tests or operate properly due to faulty materials or workmanship the cost of any removals or reinstatement shall be borne solely by the MEP Contractor.

4.11.6 The electrical installation shall be tested in accordance with the appropriate procedures laid down in the "Regulations for the Electrical Equipment of Buildings" issued by the IEE and completion certification shall be issued at the end of the Contract.

4.11.7 All fuel, water and electricity for testing shall be paid for by the MEP Contractor.

4.11.8 The MEP Contractor shall carry out commissioning of all systems strictly in accordance with BSRIA BG/2 2010, CIBSE Commissioning Code C and W including the setting-to-work and regulation of each installation to ensure it operates in conformity with the requirements of the Specification.

4.11.9 Ventilation commissioning shall be carried out by the fan manufacturer, with all air valve and fan settings recorded in the O&M Manual.

4.11.10 Drainage air tests shall be applied to each section of the sanitary installation on completion.

4.11.11 Water seals of appliances shall be fully charged and test plugs inserted into open ends.

4.11.12 Air shall be pumped into the system under test until a pressure of 38mm of water is reached and held for 3 minutes. Soap tests shall be used to detect any leaks, and tests shall be repeated until successful and approved.

4.11.13 The MEP Contractor shall allow for drainage tests to be witnessed by the local Building Control Officer.

4.11.14 Copies of all test and commissioning certificates shall be incorporated into the relevant Operating and Maintenance Manual.

4.12 OPERATING AND MAINTENANCE MANUALS

4.12.1 The MEP Contractor will provide verbal instruction in the full use and operation of the systems shall be given to the Client representative.

4.12.2 The MEP Contractor shall provide three copies of an operation and maintenance manual at Practical Completion. Each copy shall contain as an absolute minimum typed full descriptions of the services and operating and maintenance instructions together with valve charts, serial numbers of equipment, schedule of manufacturers, test and commissioning certificates and copies of manufacturers operating and maintenance

instructions for all plant, equipment and automatic controls. The manuals shall also contain A1 size paper copies of ‘as installed’ drawings which shall be prepared by the MEP Contractor.

4.12.3 The MEP Contractor shall provide a copy of all Construction Record drawings in electronic form, these shall be suitable for importing into AutoCAD 2014 software and be in ‘.dwg’ format.

5 STANDARD CLAUSES – ELECTRICAL SERVICES

5.1 DISTRIBUTION BOARDS & SWITCHGEAR

5.1.1 A 8 x TP+N 125 Amp Distribution Board will be supplied and fitted for final circuit distribution. The Distribution Board will be fitted with a 125 Amp three phase and switched neutral mains incomer switched disconnector. The distribution board will be provided with a door lock and all final circuits will be protected by MCB's and RCBO's equal to and approved as per the Distribution Board schedule. All spare circuit ways will be covered by blanking modules.

5.1.2 The Distribution Board will be connected to the Phase 1 building via a buried cable within a 100mm duct via a three phase circuit from the Distribution Board within.

5.1.3 On completion of the installation, the Distribution Board is to be provided with an A4 sized printed circuit schedule fixed within the doors within plastic sleeves to comply with BS 7671:2008 Amendment 3:2015 514.9.1. The final circuit neutral and circuit protective conductors shall be connected to the correctly identified termination on the neutral and CPC bar. There shall be no sharp edges where cables enter the Distribution Board enclosures. All cable entries will be afforded protection against mechanical damage. All blank circuit ways will be covered using manufacturers blanking strip / modules. All Distribution Board covers are to be fitted with the Manufacturers lock, the keys being removed and provided to the Maritime and Coastguard Agency on completion of the project.

5.2 CONDUITS AND ACCESSORIES – CONTRACTORS CHOICE

5.2.1 Steel Conduit

a) Conduits shall be of heavy gauge welded steel tube and, together with all conduit fittings, shall comply with BS31, BS 4568 Part 1 and BS EN50086 or other appropriate British Standard.

b) Conduits and accessories shall be heavily galvanized.

c) No conduit smaller than 20mm diameter shall be used without the prior agreement of the Consulting Engineer. All bends and sets in conduits shall be made cold on a bending machine using formers of the correct radii for the diameter of the conduit used.

d) The use of ready-made machine bends, tees, elbows and inspection fittings of any sort will not be permitted.

e) Prior to and during erection, care shall be taken to protect the bore of all conduits from the ingress of dirt and moisture. The threads of all conduits laid in chases or projecting from the structure, pending plastering or screening, shall be protected by conduit couplers and threaded brass plugs.

f) Threaded ends shall be reamed and any screwing lubricant removed. All joints and unions shall be butted together and screwed up tightly. All surplus exposed threads and any abrasions on the conduit shall be painted with good quality corrosion inhibiting paint.

g) Drainage points shall be provided, as necessary, and conduits laid to falls in areas where condensed moisture might otherwise collect.

h) Where conduits enter boxes or fittings not provided with tapped entries the connections shall be made by means of conduit couple, smooth bore hexagon male brass bush and compression washer.

i) Where conduits enter on the top horizontal surface of an accessory mounted outdoors, a flange coupler shall be used.

j) All conduits shall be securely fixed to the building structure by means of spacer bar saddles and all conduit fittings separately fixed to the structure by means of countersunk head screws.

k) Standard circular conduit boxes with tapped spouts shall be used at intersections but for conduits over 32 mm diameter and for multiple runs, rectangular pattern boxes may be used. Where used externally, conduit boxes shall be galvanised and provided with heavy cast lids with watertight gaskets. All unused entries in boxes or equipment shall be provided with a brass stopping plug.

l) All conduit installations shall be fully erected before any cables are drawn in.

m) Installed with the minimum of running couplings. All exposed threads to be treated with a corrosion inhibiting paint.

5.2.2 PVC Conduit

a) Conduits shall be of heavy-gauge high impact rigid PVC tube, together with all conduit fittings manufactured to comply with the appropriate British Standard.

b) No conduit smaller than 20 mm diameter shall be used without the prior agreement of the Consulting Engineer. All bends and sets in conduits shall be made in accordance with the manufacturers approved method using a bending spring of the correct radii for the diameter of the conduit used. The use of ready-made machine bends may be permitted. However, the internal bend radius shall be a minimum of eight times the diameter of the conduit.

c) Every joint, junction or connection between parts of the PVC conduit installation shall be completed using PVC cement.

d) All conduits shall be securely fixed to the building structure by means of spacer bar saddles and all conduit fittings separately fixed to the structure by means of countersunk head screws.

5.2.3 General

a) Conduits cast in situ in a reinforced concrete structure shall not exceed 25mm diameter without the written approval of the Consulting Engineer and, where permission is obtained, shall be laid in the centre of the structure between the reinforcing steelwork. Conduits and all necessary boxes shall be accurately located to allow fittings and accessories to be fixed directly to the box. Where finishes are applied to the reinforced concrete structure the MEP Contractor shall provide extension rings as necessary.

b) All conduits shall be installed at least 150 mm clear of, and preferably below, the pipe runs of other services.

c) Where a surface conduit system is complete it shall be checked to ensure electrical and mechanical continuity, and the comments of the Consulting Engineer obtained before any wiring is commenced.

d) Wiring for systems with different voltage bands shall at all times be contained in separate conduit systems.

e) The MEP Contractor shall allow for the installation of all conduit boxes necessary to allow cables to be drawn in; access to the conduit system shall be provided at least every 6 metres for straight runs and sum of the angles between sections of conduit incorporating bends shall not exceed 180 degrees.

5.3 FLEXIBLE METAL CONDUIT

5.3.1 Flexible metal conduit shall be used only where it is essential to allow movement between the rigid conduit system and connected apparatus. The flexible conduit should not normally exceed 1 metre in length and shall terminate at each end in approved glands. A separate insulated earth continuity conductor shall be provided in all cases to bridge the flexible conduit and glands.

5.3.2 As an alternative to the above, flexible metallic covered cables using an earth core to the Consulting Engineer's approval may be used and installed, in accordance with the manufacturer's recommendations.

5.4 ARMOURED CABLES

5.4.1 All armoured cables shall be XLPE/LSOH/SWA/LSOH of 600/1000 volt grade with XLPE insulated and LSOH bedded cores, coloured for identification, armoured with a single layer of galvanized steel wire and LSOH over sheath. Cables shall be manufactured to BS 6724.

5.4.2 Armoured cables shall terminate in approved mechanical type glands with an armour clamping device to be of the same manufacturer as the cable, with earth tag washers being used, and to be nut and bolted to the metal work of the distribution item with a Brass Nut and Bolt.

5.4.3 Where Steel Wire Armoured Cables are to be terminated externally, 'CW' glands with compression fitting will be installed.

5.5 LIFE & SAFETY SYSTEM CABLES

5.5.1 All cables serving life safety and fire-fighting applications shall meet with the requirements of BS8519:2010 and shall have fire resistance to Category 1, 2 and 3 and suitable for power and control circuits, as defined in BS8519:2010. LSOH bedded cores, coloured for identification, armoured with a single layer of galvanized steel wire and LSOH over sheath.

5.6 WIRING IN CONDUIT AND TRUNKING

5.6.1 Wiring installed in conduits and trunking shall be single core copper conductors, insulated with thermosetting Low Smoke and Fume (LSOH) compound, 450/750 volt grade to BS 7211. The sheath shall be coloured in accordance with BS 7671: 2008 incorporating Amendment 3:2015

5.6.2 Cables installed in conduits shall be of the stranded type 7/0.53 for 1.5mm^2 and 7/0.67 for 2.5mm^2.

5.6.3 Cables shall be of a suitable size to carry the full load current of the circuit and to comply with BS7671: 2015 concerning voltage drop.

5.6.4 Neutral conductors shall in all cases be of the same cross-sectional area as the associated phase conductor. Cables shall be so bunched that all phase and the neutral conductors are enclosed in the same conduit or trunking.

5.6.5 Separate green/yellow circuit protective conductors shall be installed for each circuit and shall, unless otherwise specified, be of the same cross-sectional area as the associated phase conductor, to ensure compliance with the thermal requirements of BS 7671: 2008 incorporating Amendment 3:2015

5.6.6 The number and size of all cables drawn into any conduit or trunking shall comply with the relevant Regulations and Tables within BS 7671: 2008 incorporating Amendment 3:2015

5.6.7 On multi-phase circuits the individual cable cores shall be identified either by using appropriately coloured insulation throughout, or by means of coloured sleeves at all terminations.

5.6.8 Cables shall be installed on the "loop-in" system and no joints will be permitted. Sufficient slack cable shall be left in all Dado and Distribution Trunking to facilitate the installation at a later date of additional power or lighting outlets.

5.7 CABLES GENERAL

5.7.1 All coils and cables shall be delivered to site intact and bearing the manufacturers seal and certificates. All cables shall be of recent manufacture and shall, as a minimum, comply with the appropriate British Standard and be approved for use by BASEC.

5.8 FLEXIBLE CORDS

5.8.1 Flexible cords shall comply with the appropriate BS and shall be selected in accordance with the relevant Regulations within BS 7671: 2008 incorporating Amendment 3:2015 or as specified in Section 2. All flexible cords shall include an earth conductor (CPC).

5.9 VOLTAGE DROP

5.9.1 The requirements of the BS 7671: 2008 incorporating Amendment 3:2015 shall be closely observed.

5.10 ISOLATING SWITCHES

5.10.1 All hand dryers, extract fans, air conditioning unit external condensers and wall mounted internal units, Electric Water Heaters, Electrical Heaters and similar apparatus shall be provided with local means of isolation from the main supply either by a suitable isolating switch, where this is remote, by an isolating switch adjacent to the apparatus.

5.10.2 Isolating switches shall be arranged to disconnect all live supply conductors, and for appliances into which more than one phase of the supply is introduced, shall be arranged to break all the circuit conductors.

5.11 SPECIAL EQUIPMENT

5.11.1 All items of special equipment wiring systems etc. not specifically mentioned in this Section or within Section 4 shall be erected and connected in accordance with the manufacturer’s recommendations, together

with any details given in Section 4. The general conditions and requirements of this Section shall be adhered to where applicable.

5.12 MOUNTING HEIGHTS

5.12.1 The mounting heights of various items of equipment, accessories etc. shall suit the particular requirements of the building, but shall generally be as Part M of the Building Regulations unless indicated otherwise in Section 3, or specially indicated on accompanying drawings. The MEP Contractor shall verify the mounting heights with the Consulting Engineer's before installing the relevant part of the installation.

5.12.2 Light Switches - to be mounted at a maximum height of 1200mm from the finished floor level to the top of the switch. The exception to this are switched mounted on the Dado Trunking in the teaching areas.

5.12.3 Socket Outlets – wall mounted socket outlets to be mounted at a minimum 1200mm from the finished floor level to the bottom of the socket outlet. The exception to this being socket outlets above the work benches which are to be mounted 300mm from the work bench work surface or suitably positioned with the specified workbenches.

5.12.4 Mounting heights referred to above shall be measured from finished floor level (FFL) to the top or bottom horizontal surface, as indicated above, unless stated otherwise in Section 4.

5.13 EARTHING AND BONDING

5.13.1 For the purposes of the works, protection against electric shock is to be achieved using 'Automatic Disconnection of the Supply', formerly 'EEBADS'.

5.13.2 All service (main) and localised (supplementary) earth bonding shall be carried out by the MEP Contractor in accordance with BS 7671: 2008 incorporating Amendment 3:2015 and the Distribution Network Operator (DNO) requirements applicable to PME (TN-C-S) systems.

5.13.3 On completion of an installation, extension or major alteration of an installation, the MEP Contractor shall ensure that the above protection and requirements have been implemented.

5.13.4 A minimum of a 1.5mm² G/Y 6491B H07Z-R Low Smoke Cable manufactured to BS7211 copper stranded earth tail shall be installed at each BESA/switch/socket/outlet box etc. and the finally terminated within luminaries, switch grids, switches and socket outlets etc.

5.13.5 A 25mm² G/Y 6491B H07Z-R Low Smoke Cable manufactured to BS7211 Copper will be installed between the main earth terminal within the Distribution Board ELP1 and the mains water supply pipe and the main earth terminal and the building structure.

6 TECHNICAL CLAUSES – ELECTRICAL SERVICES

6.1 GENERAL DESCRIPTION OF WORKS

6.1.1 The electrical installation works described within this specification relates to the provision of all electrical and ancillary services (Fire Alarm and Data Cabling) to the building which is the Workshop/Garage and Drying Room behind what was the Shrub End Clinic, Iceni Way, Colchester Essex, CO2 9BY.

6.1.2 The works described herein comprise the supply, delivery to site and installation of all materials necessary for the complete and satisfactory operation of all electrical building services including the following:

- Cable Management
- Mains Distribution
- Lighting & Emergency Lighting
- Small & Fixed Power
- Fire Alarm System
- Inspection, testing, commissioning and certification of all installed systems
- Provision of record documentation
- Maintenance of all systems

6.2 Submain Supply

6.2.1 The MEP Contractor is to allow for three cable ducts, 100mm in diameter as per drawing 1321-CCE-00-GF-DR-E-70-P-1101 Revision C02. Each cable duct will be exclusive for 1. Main XLPE/SWA Submain Cable 2. Fire Alarm Cables 3. CAT 6 Data Cable for the Workshop/Garage Wireless Access Point.

6.2.2 For the purposes of the design, an external earth fault loop impedance of 0.25 ohm on all phases has been assumed at the incoming terminals of the distribution board in the Phase 1 (old Clinic) Building.

6.3 CABLE MANAGEMENT AND CONTAINMENT (MAINS AND ANCILLARY SERVICES)

6.3.1 Primarily, most cables are to be enclosed in 100mm galvanised metallic trunking and galvanised conduit.

6.3.2 Any cables enclosed behind MF plasterboard ceilings are to be secured using metal fire retardant clips and fixing installed so they are supported throughout the installation in such a way that they will not be liable to premature collapse in the event of a fire.

6.3.3 All fire alarm cables are to be fixed using metal fire retardant clips installed so they are supported in such a way that they will not be liable to premature collapse in the event of a fire.

6.3.4 The MEP Contractor is to, as far as is practicable, minimize the grouping of cables within the cable installation of the building.

6.3.5 The MEP Contractor shall ensure that any steel containment installation is effectively connected to the main earthing terminal of the installation and that electrical continuity is maintained throughout.

6.3.6 Where cables pass through a wall or ceiling, the MEP Contractor shall ensure that the integrity of that wall/ceiling is maintained against the passage of fire; supplying and installing all protective measures necessary.

6.4 FINAL CIRCUIT WIRING

6.4.1 General

a) The power and lighting wiring shall be carried out utilising BASEC approved single core thermosetting LSF insulated 6491B H07Z-R to BS 7211 and to meet the requirements of BS7671:2008 incorporating amendment 3:2015.

b) With the exception of supplies to safety services, it may be assumed that all references to FP200 cable within the circuit schedules may be substituted with any other BASEC approved cable complying with the requirements of BS 8436.

c) Diagonal wiring routes across ceiling voids to points will not be permitted, and all final circuit wiring routes shall be installed parallel to the principle building structural lines. Any cables likely to encounter damage shall be adequately protected so as to comply with BS7671:2008 incorporating amendment 3:2015.

d) It is assumed within design stage calculations that cables will not be concealed within thermal insulation and that cables will be in contact with thermal insulation on one side only. The MEP Contractor shall therefore plan the routes of all cables carefully to ensure that this design parameter is adhered to.

e) It is assumed that the main arterial cable routes through the building will be via the 100mm galvanised electrical trunking. All cables, including power, lighting, data, fire alarm, controls are to be supported using fire resistant fixings.

6.4.2 Conductor Sizes

a) The MEP Contractor shall, during the Tender period, take off his various quantities and check the length of circuit cables against the maximum length stated in the circuit schedules.

b) If the measured lengths exceed the maximum lengths scheduled then he shall increase the conductor size accordingly and submit confirmation calculations to the Consulting Engineer for approval.

c) The lengths of circuits are limited by voltage drop considerations and assume a volt drop in the sub mains of 2% and in the final circuit conductors of 1.5%. The minimum sizes allowable will be 1.5mm² for lighting circuits and 2.5mm² for power circuits.

d) Where extra low voltage lighting is to be installed then the MEP Contractor shall take due regard of the rating of each installed transformer to ensure that it is matched to the connected load, ensuring that neither under-voltage nor over- voltage occurs within the secondary connections.

e) The MEP Contractor shall also ensure that under-voltage does not occur due to voltage drop within the installed cables. He shall therefore size cables associated with low voltage lighting in accordance with the length of runs and associated higher connected amperage of the connected circuits.

f) Unless otherwise noted (the external socket outlet), the MEP Contractor shall assume that all wiring to any wall-mounted accessory or outlets shall be from above. Wherever this requirement makes it necessary to install wiring outside the normal ‘safe’ zones permitted by BS7671:2008 incorporating amendment 3:2015 the MEP Contractor shall inform the Building Services Consultant of the details and afford mechanical and 30mA earth leakage protection to the circuit.

6.5 LIGHTING & EMERGENCY LIGHITNG INSTALLATION

6.5.1 The MEP Contractor shall supply, install, test and commission the complete lighting installation in accordance with the electrical services layouts and schematic information provided.

6.5.2 The light fittings, manufactured by Whitecroft Lighting and of the type indicated in the technical submittal, quote and on the drawings, shall be supplied and installed by the MEP Contractor. Fitting types shall be verified with the engineer and Whitecroft Lighting before orders are placed by the contractor.

6.5.3 The MEP Contractor shall ensure that the all quantities of equipment indicated on manufacturer's quotations, where provided, correspond with the quantities indicated on the drawings. The quantities indicated on the drawings are deemed to be correct for the purposes of tendering.

6.5.4 The MEP Contractor shall supply, install, test, commission and set to work a combined emergency lighting system. Emergency lighting system shall be installed and shall function in accordance with BS5266, Part 1 2011 and all associated BS and EN documents. The system shall be arranged to operate upon mains failure and local sub circuit failure and shall operate for a minimum of 3 hours.

6.6 SMALL AND FIXED POWER INSTALLATION

6.6.1 The small power installation shall be provided in accordance with the drawing layouts. The method of wiring shall be in accordance as described above, unless otherwise stated on the drawings or elsewhere within this Specification.

Generally, the small power installation shall include the installation of twin gang 13 amp double pole metal clad switched socket outlet, double pole switched metal clad fused connection units, double pole metal clad 20 amp switches, supplying fixed equipment and 20 Amp rotary isolators isolators serving dedicated equipment, to be either arranged on radial or ring main circuits rated at 20/32 Amps, as indicated on the drawings.

6.6.2 For each fused connection unit, the MEP Contractor shall be responsible for ascertaining the required rating of the fuse for the equipment intended to be connected and installing appropriately rated fuses throughout the installation at the time of connection of the equipment. Fuses fitted must be manufactured to BS1362

6.6.3 Except where indicated on the drawings, The MEP Contractor shall provide wiring accessories manufactured by Honeywell from their MK Electric and Eaton or equal and approved.

6.7 DATA INSTALLATION

6.7.1 All data outlets are to be Category 6 twin outlets manufactured by Honeywell's MK Electric Metal Clad range or equal and approved.

6.7.2 The wiring shall be carried out using Cat 6 UTP LSZH cable manufactured to ISO/IEC 11801 2nd edition (2002), EN 50173 2nd edition (2001), ANSI/TIA/EIA 568-b.2 (2002) and acceptable to the Maritime and Coastguard Agency IT representatives.

6.7.3 The cable shall be enclosed with galvanised metal conduit.

6.7.4 The data outlet is to be terminated by the MEP Contractor and labelled. The Data cable will be installed back to the Netshelter in the Phase 1 building, individually identified, and left with sufficient length to be terminated in the cabinet racks by Maritime and Coastguard Agency IT representatives. The MEP Contractor will not be required to test the data cabling, but will be required to rectify any cabling faults found at the time of testing.

6.8 UNDERFLOOR HEATING

6.8.1 The underfloor heating design has been provided by Devi by Danfoss (quote No. DMH17/11/A) to provide 200 watts per m². The underfloor heating must be installed and operated to the manufacturers instructions. Any alternative manufacture used must be equal to and approved.

6.9 MAINTENANCE

6.10.1 The MEP Contractor shall include for the planned maintenance of all installed systems as part of the works for a period of 12 calendar months after the installation has been handed over.

7 TENDER FORMS

SUMMARY OF TENDER

SCHEDULE OF DAYWORK CHARGES

LIST OF SUB-CONTRACTORS TO BE EMPLOYED

SCHEDULE OF ALTERNATIVE MATERIALS OR MANUFACTURERS

7.1 SUMMARY OF TENDER

SHRUB END CLINIC PHASE 2, ICENI WAY, COLCHESTER, CO2 9BY

The Tenderer shall note that EACH item is to be assigned a cost and notation such as `included elsewhere` shall not be accepted.

The Tenderer is to return the completed Summary of Tender, together with the other Tender Forms duly completed, with the tender return documentation.

The Tenderer shall complete in the spaces below, the costs associates with the supply, delivery, installation, testing and commissioning of the following elements, including Main Contractors Discount.

	Mechanical & Public Health Services	
1.0	Preliminaries	**£**
1.1	Compliance with CDM 2015 Regulations	**£**
1.2	Contractors Design and/or Working Drawings	**£**
1.3	Domestic Hot & Cold Water Services	**£**
1.4	Local Extract Ventilation Systems (inc Control Wiring)	**£**
1.5	Above Ground Drainage	**£**
1.6	Below Ground Drainage Modifications	**£**
1.7	Builders Works In Connection With.	**£**
1.8	Testing and Commissioning, including Employer Training	**£**
1.9	Chlorination and Legionella Services	**£**
1.10	Construction Record Drawing and Operation & Maintenance Manuals	**£**
1.11	Any Other Items not Mentioned Above (Please Specify).	**£**
	Provisional Sums	
1.12	Contingencies	**£**
1.13	**Sub-Total - Mechanical & Public Health Services**	**£**

	Electrical Services	
2.0	Preliminaries	**£**
2.1	Compliance with CDM 2015 Regulations	**£**
2.2	Contractors Design and/or Working Drawings	**£**
2.3	Electric Underfloor Heating Installations	**£**
2.4	Lighting & Emergency Lighting Installation	**£**
2.5	Fire Alarm & Detection Installation	**£**
2.6	Small Power & Data Installation	**£**
2.7	External Services Installation (including Ducts)	**£**
2.8	Cable Management, Containment & Trays	**£**
2.9	Builders Works In Connection With.	**£**
2.10	Inspection, Testing and Certification	**£**
2.11	Construction Record Drawing and Operation & Maintenance Manuals	**£**
2.12	Any Other Items not Mentioned Above (Please Specify).	**£**
	Provisional Sums	
2.13	Contingencies	**£**
2.14	**Sub-Total - Electrical Services**	**£**
3.0	**Total (Item 1.13 + 2.14) Mechanical, Electrical and Public Health Services**	**£**

Signed:

Name:

Position in Company:

Company Name:

Company Address:

Date:

PLEASE NOTE: The Lump Sum price is to be fixed for 90 days.

7.2 SCHEDULE OF DAYWORK CHARGES

SHRUB END CLINIC PHASE 2, ICENI WAY, COLCHESTER, CO2 9BY

For the purpose of calculating the net prime costs of day work, the definitions prepared and agreed between the Heating and Ventilation and Electrical Industries and the Royal Institution of Chartered Surveyors shall apply, in respect to materials, labour and plant.

The net prime costs of Sub-Sub-Contractors shall be defined as the net costs of payments made by the Sub-Contractor to any other company working for him as a Sub-Contractor under the terms of the Main Contractor.

The following percentage additions shall be applied to the net prime costs to cover for overheads, profit and Main Contractors` discount (where applicable).

ITEM	MECHANICAL TRADES	ELECTRICAL TRADES
Materials	%	%
Labour (a) Standard Time	%	%
(b) Premium	%	%
Plant	%	%
Sub-Sub-Contractors	%	%

Signed:

Name:

Position in Company:

Company Name:

Company Address:

Date:

7.3 LIST OF SUB-CONTRACTORS TO BE EMPLOYED

SHRUB END CLINIC PHASE 2, ICENI WAY, COLCHESTER, CO2 9BY

The MEP Sub-Contractor shall indicate at the time of tender the name of all sub-contractors (including specialist contractors) who will undertake works on the project.

WORKS PACKAGE TO BE SUB-LET	NAME AND ADDRESS OF SUB-CONTRACTOR

Signed:

Name:

Position in Company:

Company Name:

Company Address:

Date:

7.4 SCHEDULE OF ALTERNATIVE MATERIALS OR MANUFACTURERS

SHRUB END CLINIC PHASE 2, ICENI WAY, COLCHESTER, CO2 9BY

The MEP Sub-Contractor, at the time of tender, shall cost the possible saving below and may offer potential cost saving to the Employer for consideration.

ALTERNATIVE MATERIALS OR MANUFACTURERS	POTENTIAL COST SAVINGS

Signed:

Name:

Position in Company:

Company Name:

Company Address:

Date: