SPECIFICATION FOR THE ENGINEERING SERVICES ASSOCIATED WITH THE REFURBISHMENT WORKS

AT

GLOSSOP FIRE STATION

AT

DERBYSHIRE FIRE & RESCUE SERVICE

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CONTENTS

STANDARD TECHNICAL SPECIFICATION

FOR MECHANICAL AND ELECTRICAL SERVICES INSTALLATION

SECTION ONE

GENERAL REQUIREMENTS

STANDARD TECHNICAL SPECIFICATION

SECTION ONE GENERAL REQUIREMENTS

CONTENTS

STANDARD TECHNICAL SPECIFICATION
SECTION ONE
GENERAL REQUIREMENTS

1.1 GENERAL DETAILS

1.1.1 Conditions of Contract

The Contractor shall be the Principal Contractor. The Principal Contractor shall enter into an agreement with the Employer. Conditions of Contract are detailed under separate cover and are to be read in conjunction with this Specification document. The Contractor shall be responsible for obtaining all relevant documentation relevant to the contract conditions.

1.1.2 Compliance with Specification

This section of the Specification describes standard requirements for workmanship, materials and management procedures to be used in the execution of the Works described in this Specification and on the Drawings.

The Works shall comply with all relevant requirements of standard sections of this Specification except where contrary requirements are indicated in the particular Specification or on the Drawings. In such cases the particular Specification and the Drawings shall take precedence.

The Employer's Representative shall be empowered to charge for payment of costs incurred by him as a result of any part of the Works failing to comply with specific requirements. Such charges shall include but not be limited to costs incurred for:

- preparation of snagging lists, defects lists or other supervisory documents made necessary by the existence of an unreasonable number of items still requiring attention after any section of the Works has been offered to the Employer's Representative as being complete and ready for inspection;

- additional inspections, witnessing, approvals or other attendances;

- any associated redesign work;

- preparation and printing of drawings and details;

- issuing of instructions relative to alternative requirements made necessary by non-compliance with specified requirements;

- supervision and administration.

1.1.3 Definitions

The following definitions and associated requirements shall apply to terms used in this Specification.

Approval of a drawing or any other element of the Works shall be deemed to indicate that the Employer's Representative has no immediate objections or comments. Such 'approval' shall not be construed as acceptance of any responsibility for the accuracy or quality of the Works or for any fault, error, omission, defect or deficiency that may subsequently be noted. All approvals shall be subject to written confirmation signed or countersigned as appropriate by the Employer's Representative.

The Drawings shall be the drawings issued in conjunction with this Specification for tendering purposes or subsequently issued under the Contract.

Working Drawings shall be any necessary drawings, sketches, diagrams, schematics, programmes or other illustrations provided in the execution of the Works:

- to determine the locations, dimensions, wiring requirements, builder's works and other details of elements of the Works, as necessary for the execution of the Works; and/or

- for approval of such details by the Employer's Representative or any other relevant authority.

The Employer's Representative shall be the Architect, the Engineer, the Project Manager or other party designated under the conditions of contract to inspect, approve, witness or accept the Works on behalf of the Employer and to issue instructions under the Conditions of Contract.

Issued for Construction or similar phrases used in the course of issuing drawings or information by the Employer's Representative shall be deemed to mean that such drawings or information shall be used as the basis for the production of Working Drawings.

Materials shall be any materials, plant, equipment, drawings, expendable items, packaging, rubbish or any other elements used in or arising from the implementation of the Works, as appropriate to the context.

The Specification shall be this Specification, together with the Drawings and any other relevant requirements of the Contract or instructions issued under the conditions of contract.

Witnessing of a test, commissioning or any other activity shall be construed as confirmation of the results of such activity; it shall not be construed as either approval or acceptance. The same qualifications shall apply as for 'Approval'.

The Works shall include all materials, labour, plant, testing, commissioning and other commodities or activities necessary for the completion of the work described in or implied by the Specification and governed by the conditions of Contract.

1.1.4 Extent of the Works

The Works shall be deemed to include every item described in the Specification and every item shown on the drawing together with all activities, materials, labour plant, adjustments, attendance, fixings, supports, brackets and other items necessary for the provision and commissioning of complete installations in accordance with the intent of the Specification and the Drawings and in accordance with good practice.

The Works shall include all necessary provision to take account of details not shown on the Drawings owing to their diagrammatic nature. This requirement shall include all materials and activities necessary for the co-ordination of the Works with details on architectural, structural and other drawings available at the time of tendering or subsequently issued under the Conditions of Contract.

Such items as ‘provided’, ‘supplied’, ‘fitted’, ‘fixed’, ‘installed’, etc. when used in this Specification or on the Drawings shall be deemed to include the supply, fixing, placing in position, adjusting, testing, regulation, commissioning and putting into working order of the relevant equipment including any necessary ancillary equipment or activity, except where the intended meaning is specifically limited by such phrases as ‘supply only’ or ‘supply and hand to the Employer’s Representative’.

1.1.5 Co-ordination and Access

The Works shall be installed in co-ordination with other services’ installations and the building fabric. Details of such co-ordination shall be agreed before fixing of any item in each particular area of work.

Every component shall be installed in such a manner as to be readily and safely accessible for any normal observation, adjustment, maintenance or other activity required by its use. The Works shall be deemed to include all reasonable provision for compliance with this requirement, including co-ordination with other services and structural features.

The decision of the Employer’s Representative shall be final in respect of what is readily and safely accessible.

Any apparent instance of a component being shown on the Drawings in an inaccessible position shall be drawn to the attention of the Employer’s Representative before the item and associated components are installed.

All components shall be delivered to site in a form suitable for the access available for positioning, assembly, erection, installation and their eventual removal and replacement.

Co-ordination of the Works shall be deemed to include any necessary moving or circumventing of any plant or other obstructions placed on site during the course of building or other trades' work.

1.1.6 Mandatory Requirements

The term "shall" indicates that a statement is a mandatory requirement of this Specification.

The decision of the Employer's Representative shall be final in respect of whether any other statement in the Specification can reasonably be interpreted as being a mandatory requirement.

1.1.7 Confidential Documents

This Specification, the Drawings and all other associated documents shall be regarded as confidential.

All confidential documents shall be returned to the Employer's Representative after being used for tendering purposes.

1.1.8 Letters of Intent

In certain circumstances, the Employer may find it necessary to issue a letter of intent to a supplier before the Contract is placed, in order to reserve materials for delivery on a date to suit the anticipated programme of work. Immediately after the Contract is placed, an order shall be issued for the supply of any reserved materials.

The order placed for reserved materials shall confirm all requirements as detailed in the Specification and the Drawings. All requirements of the Specification and the Drawings shall take precedence over any different or less detailed requirements contained in the letter of intent.

1.1.9 Beneficial Use of the works Prior to Practical Completion

In certain circumstances, e.g. involving modifications to existing installations, the Employer's Representative shall have the option to instruct that any part of the Works be operated for the beneficial use of the Employer before the issue of a Certificate of Practical Completion.

Except where specific provision for such beneficial use is included in the particular Specification, the Employer shall reimburse reasonable costs associated with the operation of the system and any measures necessary to enable the full defects liability period to be effective from the date of Practical Completion. Such reimbursements shall be evaluated in accordance with the Conditions of Contract.

1.1.10 Familiarity with Site

The Works shall be deemed to include all necessary provision for factors particular to the site that could be ascertained by visiting the site prior to the submission of the tender for the Works. Such factors shall include but not be limited to:

- access;
- existing buildings;
- existing services;
- safety precautions and compliance with Health and Safety at Work Regulations;
- any other factors that could affect the progress of the Works or the cost of the Works.

1.2 REGULATIONS AND STANDARDS

1.2.1 Conformity with Regulations

The current requirements and recommendations of all relevant codes of practice, statutory regulations, bye laws, commissioning codes and installation instructions shall be complied with during the execution of the Works, including the following:

- The Health and Safety at Work Regulations;
- Construction (Design and Management) Regulations 2007;
- The COSSH Regulations;
- The Factories Act;
- The Clean Air Act;
- The Environmental Protection Act;
- The Building Regulations;
- The Mines and Quarries Act;
- The Public Health Act;
- The Offices, Shops and Railway Premises Act;
- British Standards Institution Publications or, in the absence of a relevant British Standard, the appropriate ISO or CEN/ CENELEC standard;
- Requirements and recommendations of the local Fire Officer;
- Requirements of any insurance companies concerned;
- The LPC Rules for automatic sprinkler installations;
- Requirements of local supply companies for gas, water, electricity, telephones and mains drainage;
- IEE Regulations for Electrical Installations;
- The Electricity at Work Regulations;
- CIBSE Commissioning Codes, Guides, Technical Memoranda and Practice Notes.

The Works shall include all necessary applications and notifications to planning and licensing authorities.

1.2.2 Construction (Design and Management) Regulations 2007

General

The successful Contractor will be appointed by the Employer as the Principal Contractor to undertake the duties and responsibilities as laid down in the Construction (Design and Management) Regulations 2007 (CDM-C).

The Employer has also nominated a CDM Co-ordinator who will liaise with the Principal Contractor during the construction phase of the project.

The Contractor shall allow adequate costs and resources within his tender for exercising his statutory duties under the regulations and for adequate liaison with the CDM Co-ordinator and Client as necessary.

Key Duties

The Principal Contractor shall include for the following duties notwithstanding his responsibilities and duty of care under Health and Safety Law and Common Tort.

The Principal Contractor's key duties are to:

- Develop and implement the health and safety plan.
- Arrange for a competent and adequately resourced Contractor to carry out the sub-contract work.
- Ensure the co-ordination and co-operation of the Contractor.
- Obtain from the Contractor the main findings of their risk assessments and details of how they intend to carry out high risk operations.
- Ensure that the Contractor has information about risks on site.
- Ensure that workers on site have been given adequate training.
- Ensure that the Contractor and workers comply with any site rules which may have been set out in the health and safety plan.
- Monitor health and safety performance.
- Ensure that all workers are properly informed and consulted.
- Make sure only authorised people are allowed onto site.
- Display the notification of the project to the Health and Safety Executive.

- Pass information to the CDM Co-ordinator for the Health and Safety file.

The Regulations ACOP and Guidance Information

The Contractor's attention is drawn to the following Regulations, Approved Code of Practice and general guidance notes available from HSE Books. Telephone Number 01787 881165.

* Statutory Instrument Health and Safety.
  The Construction (Design and Management) Regulations 2007

* Managing Construction for Health and Safety.
  Construction (Design and Management) Regulations 2007.

* Guidance for Designers.
  Designing Health and Safety in Construction ISBN 07176 08077.

* Guidance for Builders and Contractors.
  Health and Safety for Small Construction Sites HS(G) 130 ISBN 07176 08069.

* HSE Notification of Project Form F10 .

1.2.3 Safety and Fire Precautions

Safe methods of working and access shall be employed throughout the execution of the Works.

All necessary precautions shall be observed in respect of special areas of work where hazards may exist in connection with dangerous substances. The Employer's representative shall be notified immediately of any discovery of asbestos or other hazardous substances on the site.

Due cognisance shall be given to the risks of explosion, toxic gases and infection in existing drains, tunnels, service voids and other enclosed spaces.

The Works shall include all necessary provision for protective clothing, masks, goggles, breathing apparatus, safety lines and other equipment.

All necessary precautions shall be adopted to safeguard against fire and explosion and especially where the execution of the Works involves flames, sparks, other sources of ignition or the use of flammable or explosive materials.

All necessary provision shall be made for maintaining the integrity of fire compartment walls, floors and other structural elements in the course of and after completion of the Works.

1.2.4 Prohibited Substances

Substances known to be deleterious to health or to the environment shall not be used in the execution of the Works. All suppliers of materials and services for incorporation into the Works shall be made aware of this prohibition.

The Employer's Representative shall be notified of any prohibited substances contained in specified materials. The Works shall be deemed to include for the provision of suitable alternatives for any prohibited materials included in specified materials.

The substances indicated in Appendix 1.2 shall be included in the list of prohibited materials.

1.3 DOCUMENTATION

1.3.1 Drawings

The Drawings

The Drawings are intended to depict the scope and intent of the Works to such an extent as to allow tenders to be submitted and subsequently for use as a basis for the preparation of Working Drawings. The Drawings shall be deemed to be not suitable for use as Working Drawings.

Any conflict between requirements indicated on the Drawings and requirements of the Specification shall be brought to the attention of the Employer's Representative. The Employer's Representative's decision shall be final as to which requirement should take precedence.

Working Drawings

Working Drawings shall be submitted to the Employer's Representative within a reasonable time to allow comment to be made to meet the required date in the agreed programme of work. In the event of additional details, drawings or other information being required to enable the Working Drawings to be completed, these shall be requested from the Employer's Representative at a time which is neither unreasonably distant from nor unreasonably close to the date required.

The Working Drawings shall include details of all builder's work, together with any additional information required for the preparation of final architectural details, eg of services shafts, floor ducts, brickwork surrounds for louvres, building-in of fire dampers, sleeves or cable transits, etc.

Triplicate copies shall be provided to the Employer's Representative of all Working Drawings. This requirement applies to issues for approval and, where appropriate, final issues.

Drawings to Scale

All drawings to scale shall conform with standard metric scales, ie 1:1, 1:5, 1:10, 1:20, 1:50, 1:100, 1:200, 1:500, etc. The Employer's Representative shall be empowered to refuse to approve any drawings using a non-standard scale, eg 1:25, 1:33, etc.

Manufacturers' Drawings

The Working Drawings shall include certified manufacturers' drawings. These shall include details of all plant, machinery, control panels, switch panels, purpose built equipment and other such items as may be requested by the Employers Representative.

Manufacturer's drawings shall include the following, as appropriate:-

- dimensions and weights;
- holding down bolt locations and other builder's work details;
- details of suitable methods of lifting and positioning equipment;
- assembly and commissioning instructions;
- wiring details, including terminal numbers;
- cabling requirements;
- starting and running currents and fuse ratings;
- running capacity of water, gas, steam or any other associated piped services;
- positions of connections of pipework, cables, flues and other components;
- integral maintenance access;
- external access required for maintenance;
- any particular requirements for the operating environment.

'As-fitted' Drawings

'As-fitted' drawings shall be provided as described under Record Documents.

Plant Room and Control Room Drawings

The Works shall include the provision of plant room and/or control room drawings (hereinafter referred to as plant room drawings).

Plant room drawings for wall mounting shall be permanently printed black on white plastic sheet or other approved material and framed and fixed on walls of the appropriate rooms. Frames shall be of

hardwood and glazed. Where drawings are required to be mounted on control/indicating panels and/or consoles, they shall be engraved on traffolite or similar approved plastic laminate.

Plant room drawings shall include the following as appropriate and agreed with the Employer's Representative:-

- detailed plant layout;
- plant operation charts and relevant instructions;
- plant room valve chart;
- control schematics;
- system schematics;
- appropriate zone locations;
- any other details as may reasonably be required by the Employer's Representative for the safe and efficient operation of the relevant system(s).

1.3.2 Record Documents

Record documents shall comprise:-

- drawings and schedules giving details of all installations 'as installed';
- all test certificates;
- all commissioning records/certificates;
- all guarantees and warranties;
- all insurance inspection reports and certificates;
- project completion records.

Record documents shall be available at least in draft form at the time of user tuition during the commissioning period. They shall be issued in their final, approved form before the Works are offered to the Employer's Representative as being practically complete.

Record documents shall be approved by the Employer's Representative before being finally issued to the Employer.

Record documents shall conform with all relevant requirements specified for Working Drawings.

The final issue of approved record documents shall be delivered to the Employer on site or other such locations as may be required by the Employer's Representative. A receipt including a detailed list of all record documents delivered shall be obtained and copied to the recipient and the Employer's Representative.

Each set of record documents shall comprise:-

- one set of prints of each record drawing;

- ring binders of appropriate size containing the drawings and all other documents as detailed herein.

The Contractor shall also issue to the client an electronic record of all drawings for use on AutoCAD with the file extension .dwg.

Record drawings shall provide at least as much detail as the Drawings in respect of the locations of all plant, equipment, valves, isolators, switches, dampers, control panels, distribution boards, access panels, etc, and the routes of pipes, trays, conduits, ducts, etc and any other components of the Works.

Record drawings shall include schematic and diagrammatic details giving at least as much detail as the Drawings, together with all additional details included in the Working Drawings in respect of wiring diagrams, control panels, control systems, distribution boards, other specialist systems/equipment and instrumentation. They shall include any other details necessary for the operation, maintenance, dismantling, re-assembly and possible future modification of all components of the installations included in the Works.

Record drawings shall include all details necessary for the identification, location, size, rating, capacity or other detail necessary for the maintenance, operation, replacement or any other relevant activity of all plant, equipment, apparatus or other materials.

Record drawings may include appropriate details in schedule form.

Record drawings shall include all relevant details of builder's work essential to the Works. This shall include services shafts, cable containers, air ducts or water-ways, structural supports and any other relevant items.

Record drawings shall include comprehensive details of all power wiring, control wiring, pneumatic or other controls system piping. Such details shall include sizes and types of conductors and piping and identify the terminal points of each.

The scales used on Record drawings shall conform with those used on the Drawings except where a more detailed scale is required by the following list:-

Details	Scale
External Services	1:200
General Layouts	1:100
Plant/Equipment Room Layouts	1:50

Manufacturers' Details of
Equipment Requiring Servicing 1:20

The size and scale of all record drawings shall be adequate to meet the approval of the Employer's Representative.

In the event of any record documents being unavailable at the time necessary for acceptance of the Works as being practically complete, the Employer's Representative shall be empowered to employ any measures necessary for their production and to deduct the cost of such measures from payments applicable for completion of the Works.

1.3.3 Operating and Maintenance Manuals

Comprehensive manuals shall be provided to assist the user in the safe and efficient operation and maintenance of all systems and equipment incorporated in the Works. The manuals shall include:-

- a general description of the scope and manner of working of each system and each item of plant and equipment;

- a detailed description of the scope and manner of working for each automatic control/monitoring system, including wiring diagrams and schematics showing the inter-connections between all plant and equipment;

- clear and comprehensive instructions for the method of starting up, running and shutting down of all systems, plant and equipment;

- details of all normal operating conditions and control set points;

- detailed instructions on actions to be taken in the event of an emergency including, for example, how to isolate power and fuel supplies, water supply, etc;

- instructions in respect of any necessary precautions against damage to the installed works, eg from frost, corrosion, etc;

- instructions in respect of any plant subject to periods of disuse for seasonal or other reasons;

- instructions and schedules listing all items requiring periodic servicing and/or inspection, together with details of the necessary activities and recommended frequency thereof;

- a detailed list of recommended spare and replacement parts, lubricants and any other expandable items, including catalogue references, part numbers, etc as necessary for the identification of each item.

Manufacturers' leaflets, booklets or other documentation that does not conform with A4 size shall be indexed and cross-referenced in the manuals. Such documentation shall be presented in suitable box files or folders.

Operating and maintenance manuals shall be available at least in draft form at the time of user tuition during the commissioning period. The final, approved issue shall be made before the Works are offered to the Employer's Representative as being practically complete.

Operating and maintenance manuals shall be approved by the Employer's Representative before being finally issued to the Employer.

The final issue of approved operating and maintenance manuals shall be delivered to the Employer on site or other such location as may be required by the Employer's Representative. A receipt including a detailed list of all documents delivered shall be obtained and copied to the recipient and the Employer's Representative.

Two complete sets of operating and maintenance manuals shall be provided. The manuals shall be presented in the form of loose leaves contained in appropriate ring binders, lever arch files, etc. The binders shall contain cardboard divisions between each section. A ready means of reference and a detailed index shall be included.

The entire Operation and Maintenance Manual including the As Fitted drawings, all manufacturers' manuals / documentation and user guides etc. shall be supplied in an electronic format and shall be write protected and clearly labelled. All electronic documentation shall be provided in both its native format (ie: .docx, .dwg etc) and a duplicate in the latest release of Adobe's portable document format (.pdf). All files shall be organised into a folder structure reflecting the layout of the physical Operations and Maintenance Manual and compatible for use with the clients preferred operating system (Windows / Mac OS etc).

One copy of the electronic documentation shall be affixed securely to the first Operations and Maintenance Manual folder (if there are multiple folders) and one copy handed to the Client at handover. Electronic documentation shall be accepted on any form of portable storage device that utilises a common interface with a personal computer or Macintosh dependent upon the clients preferred device.

In the event of operating and maintenance instructions being unavailable at the time necessary for acceptance of the Works as being practically complete, the Employer's Representative shall be empowered to employ any measures necessary for their production and to deduct the cost of such measures from payments applicable for completion of the Works.

1.4 CONTRACT MANAGEMENT

1.4.1 Site Visits and Meetings

The Works shall include all necessary visits to the site for purposes of liaison, co-ordination, inspection and discussion, including attendance at regular site meetings and at other times as may reasonably be

required by the Employer's Representative to suit particular circumstances.

1.4.2 Defects Liability

The defects liability period for the Works shall be twelve months commencing from the date of Practical Completion, unless stated otherwise in the conditions of contract.

All defective materials, defective workmanship or items of outstanding work listed at the time of Practical Completion shall be dealt with within fourteen days, or other reasonable period as may be agreed by the Employer's Representative or designated in the conditions of contact.

Any defaults or defective items becoming apparent during the defects liability period shall be dealt with immediately when necessary or otherwise within fourteen days or other reasonable period as may be agreed by the Employer's Representative or designated in the conditions of contract.

All defective materials or workmanship listed at the end of the defects liability period shall be dealt with within fourteen days or other reasonable period as may be agreed by the Employer's Representative or designated in the conditions of contract.

In the event of any unreasonable period of time elapsing before defective or outstanding items are dealt with, the Employer's Representative shall be empowered to arrange for such items to be carried out by other parties and to deduct all associated costs from payments due under the conditions of contract.

1.4.3 Testing

The Works shall be tested during the course of installation and on completion as required by relevant codes of practice, as specified in standard and particular parts of the Specification and otherwise as may reasonably be required by the Employer's Representative.

Certificates shall be provided to confirm the results of every test conducted, signed by the manufacturer or installer as appropriate. Where tests are required to be witnessed, the certificates shall be countersigned by the Employer's Representative.

Under no circumstances will the project be handed over without the issue of all test certificates.

Test certificates shall include the following details as appropriate:

- project name and details of system or installation under test;
- date and duration of test;
- reference of any standard, code of practice or Specification delineating applicable parameters;

- normal working conditions, e.g. pressure, voltage, resistance, etc. of element under test;

- actual conditions witnessed during the test.

The Works shall include the provision of all instruments and other equipment and materials necessary for testing. Evidence shall be provided at the request of the Employer's Representative to verify the accuracy and suitability of all instruments and methods of use in tests.

At least seven days' notice shall be given of any tests that will require the presence of the Employer's Representative.

The Works shall be tested in sections to suit the programme of work and the need for ensuring that all tests are completed before the relevant section is concealed by backfilling, insulation, duct covers, suspended ceiling or any other items that could restrict access. Any means of concealment put in place before testing is carried out shall be removed at the discretion of the Employer's Representative.

1.4.4 Commissioning, User Tuition and Handing Over

General Requirements

All necessary arrangements and facilities shall be made available for the Employer's Representative to witness and approve commissioning.

Detailed records shall be provided of all commissioning procedures. Copies of commissioning records shall be provided initially for approval and subsequently included in the Operating and Maintenance manuals together with other completion records.

Inclusion in Programme of Work

Realistic provision for pre-commissioning, commissioning and use instruction shall be included in the programme of work, as described elsewhere in the Specification.

Pre-Commissioning

All necessary installation work, testing and approvals/witnessing thereof shall be completed before any commissioning procedures are commenced.

Due notice shall be given to the Employer's Representative of the dates for pre-commissioning activities and for relevant approvals/witnessing thereof.

Pre-commissioning activities shall include:

- the construction, installation and testing of associated installations;

- all necessary static tests, adjustments and inspections of all

elements of the relevant installation;

- cleaning of all systems and equipment internally and externally, including strainers and filters;

- the issuing of relevant certificates in accordance with a format agreed with the Employer's Representative.

Commissioning

Commissioning shall comprise the process of transforming an installed system or item of plant from a state of static completion into full working order, including all necessary measuring, balancing, regulation and adjustments.

All recommendations of appropriate IEE Regulations and CIBSE commissioning codes shall be complied with.

All plant, systems and equipment shall be fully commissioned before being offered to the Employer's Representative as being practically complete.

The Works shall include all necessary provision for the attendance of the manufacturer's representative for the commissioning of each item of plant and special systems or equipment.

The Works shall include the provision of all tools, instruments and other equipment necessary for commissioning. Evidence shall be provided as required by the Employer's Representative to verify the accuracy and suitability of all instruments and methods used in commissioning.

Commissioning shall be carried out by personnel specialising in such activities.

Commissioning Records

In the course of agreeing the programme of work, a detailed method statement for each commissioning activity shall be submitted to the Employer's Representative for approval.

All commissioning records shall be approved by the Employer's Representative before being included in the completions record documents.

Commissioning records shall include details of initial and final readings of all measurements taken, together with all relevant information to confirm that the installations have been set to work within the operating tolerances specified or otherwise laid down in the commissioning codes.

User Instructions

When the Employer's Representative has confirmed that the Works or relative sections thereof have been commissioned, and before the

Works are offered as being practically complete, full instructions shall be given to the Employer's operatives on the correct, safe and efficient operation and maintenance of all associated systems, plant and equipment.

Adequate time shall be allocated to enable the Employer's operatives to understand the complexities of the systems and to learn the necessary procedures for their operating and maintenance.

User instruction shall include an appraisal of all activities recommended in the operating and maintenance manuals.

User instruction shall include an appraisal of the "as fitted" drawings.

Evidence of user instruction shall be provided to the Employer's Representative in the form of summaries of topics covered and dates of instruction. The summaries of instruction shall include a record of the period(s) instructed and the confirmatory signature of one of those under instruction.

Fuel for Commissioning

The Works shall include provision for all necessary fuel and power for commissioning, unless the particular Specification states otherwise.

1.4.5 Builder's Work

All Builder's work shall be included within this contract in accordance with the conditions of contract and the contractor shall make provision for builder's work to be carried out by the nominated building work contractors as scheduled within section eight of this specification.

Builder's work shall generally include :

- concrete and brickwork foundations or bases for plant machinery and pipework thrust blocks;

- cutting holes, pockets and chases and making good in walls, floors ceilings or doors;

- building in or rag bolts and other fixings;

- cutting and removing floorboards, skirtings and other joinery and making good;

- the excavation and backfilling of trenches and the installation of location markers and tapes;

- the formation of services ducts and shafts and the provision of covers thereto;

- the provision of access panels in walls, floors, ceilings, services, ducts/shafts, boxings or elsewhere as necessary.

The Works shall include the provision of all information necessary for the execution of the associated builder's work. This shall include fully dimensioned Working Drawings for plant bases, holes or pockets formed in concrete structures, access panels and major holes in brickwork or other masonry structures. It will be acceptable for minor holes and chases in brickwork or other masonry to be marked on site, subject to the agreement of the building contractor and the Employer's Representative.

Proposals for holes through concrete shall be approved by the Employer's Representative before the concrete is cast or on existing structures before the work is commenced.

The accuracy of the locations, levelling and dimensions of all builder's work shall be verified before subsequent installation of the Works. Verification shall not involve the Employer's Representative.

Details of all builder's work requirements shall be submitted to the Employer's Representative and approved by him before the work commences. Any instructions for builder's work shall be confirmed to the builder by the Employer's Representative.

Builder's work shall not include the drilling of holes for screw fixing, expanding bolts, etc. Such activities shall be deemed to be included in the Works in all circumstances.

1.4.6 Dimensions and Setting Out

Accurate dimensions shall be taken on site as necessary to ensure that Works are correctly co-ordinated and integrated with all elements of the site, buildings, other services and any other relevant features.

The Works shall be set out in accordance with details on the Working Drawings.

1.4.7 Drying Out the Building

No part of the Works shall be used for drying out the building, except under the following conditions.

Detailed written proposals including supervision arrangements shall be submitted for approval at least seven days prior to the proposed commencement of the operation.

Such proposals shall designate which sections of the Works shall be operated and the measures to be implemented to ensure that the Works will be handed over in good condition.

Any deleterious effects arising from the operation of the system shall be made good before the system is offered for inspection prior to Practical Completion.

No additional costs shall be attributable to the Employer for any work associated with drying out the building.

1.4.8 Programme of Work

A programme of work shall be provided and agreed in good time to enable the progress of the Works to be properly incorporated into a co-ordinated programme for the whole project.

The programme of work shall be prepared with due cognizance of all relevant factors, including:

- delivery of materials;
- the need for co-ordination with other services' installations and other trades;
- required dates for witnessing and inspection of the Works;
- the time required for witnessing and inspection of the Works;
- the time required for the preparation and approval of the Working Drawings;
- the time required for commissioning;
- the time required for the preparation of and approval of "as fitted" drawings and operating and maintenance manuals;
- the time required for instructing the Employer's operatives in the operation and maintenance of the Works.

The programme of work shall be accompanied by sufficient details to enable the Employer's Representative and other interested parties to confirm that the programme is unrealistic in terms of resources required for co-ordination, inspection, witnessing, certification, etc.
The Employer's Representative shall be notified immediately in the event of any circumstances arising that could jeopardise the progress of the Works. Such circumstances would include extended delivery of materials, industrial disputes, etc.

The programme of work shall allow sufficient time for the diligent execution of all procedures related to testing, commissioning, user tuition, approvals and handing over of the Works. Appendix 1.1 shows the time scales that would be considered reasonable on a typical large project having a construction period of twelve months. This is given for guidance only; however, it shall be demonstrated to the Employer's Representative that realistic provision has been made in the programme of work for the diligent execution of all relevant activities shown in the model programme, together with any similar activities pertinent to the Works.

1.4.9 Precautions Against Damage or Theft

The Works shall be deemed to include all costs associated with all necessary precautions against damage or theft of materials and property used in connection with the Works or belonging to persons employed in connection with the Works.

1.4.10 Plant and Tools

The Works shall include all necessary scaffolding, ladders, hoisting equipment and other apparatus for the supply, delivery, positioning and erection of materials, except where alternative provision is specified in the contracts documents.

The Works shall include the provision of all necessary plant, tools, transformers, control devices and associated cabling.

All necessary measures shall be employed to ensure that plant, tools, cabling and other apparatus are used in a safe manner and in accordance with appropriate regulations.

No item of plant, machinery or other apparatus shall be retained on site unnecessarily after completion of the activities for which it was required.

1.4.11 Services for the Works

The Works shall include provision for the use of water, electricity and any other services necessary in the execution of the Works, except where the particular Specification or the Conditions of Contract state otherwise.

1.4.12 Travel and Expenses

The Works shall include all associated costs involved in transporting personnel to the site or other place, together with the payment of all relevant expenses or allowances.

1.4.13 Samples

Samples of materials and goods to be incorporated into the Works shall be provided as required for approval by the Employer's Representative.

Samples shall be provided to suit the programme of work.

1.4.14 Trade Customs and Practice

Local Agreements

All necessary provision shall be included in the Works for compliance with any local agreements for additional payments or other compensatory measures that may be attributable to any persons employed to execute any part of the Works.

Demarcation

All necessary provision shall be included in the Works for compliance with any agreement in effect requiring that any part of the Works be carried out by persons qualified or otherwise certified to ply a particular trade.

1.4.15 Overtime

The Works shall be deemed to include all overtime working necessary for any of the following reasons:

- the time allocated in the programme of the work;
- any requirements of enforcement authorities for large items of plant or other materials to be delivered or erected at a time to suit traffic or other conditions;
- the need for working outside normal hours in occupied premises;
- the need for maintaining existing services during normal working hours;
- any other foreseeable circumstances.

Prior notification shall be given to the Employer's Representative for any instances of overtime working.

In the event of overtime being necessary as the result of unforeseeable circumstances, the Employer's Representative shall be requested in writing to issue an instruction to proceed. Any payments for premium time shall be related to records conforming with the relevant requirements specified for daywork sheets.

1.4.16 **Publicity and Advertisements**

No photographs, articles for publication or any advertising material containing references to any part of the Works shall be published without the express permission of the Employer's Representative in writing.

Trade signs shall not be erected except when authorised by the Employer's Representative. Such authorisation will not include for Local Authority planning approval.

1.5 GENERAL TECHNICAL REQUIREMENTS

1.5.1 Identification Plates

Identification Plates

Each item of plant and equipment shall be provided with an engraved identification plate bearing its reference number, name or other reference as designated in the Specification or on the Drawings. Identification plates shall have letters and/or numbers of adequate size as appropriate for each case.

Plate Fixings

Nameplates and identification plates shall be fixed on or adjacent to the equipment using screws, studs or rivets. Adhesives shall not be used.

1.5.2 Electrical Equipment

Provision of Details

Sufficient details shall be provided for approval and to enable all electrical components of the Works to be integrated with all other relevant electrical equipment. Such details shall include wiring diagrams, schedules and schematics specifically applicable to the Works; 'typical' details shall not be accepted.

Details shall be provided of operating voltage, fuse/overload ratings, running and starting currents, locked rotor currents, earthing requirements and any other features relevant to the safe and efficient operation of the equipment.

All terminal references and equipment references on wiring diagrams and schematics shall conform with similar references shown on the Drawings.

Motors

Except where alternative requirements are specified elsewhere, electric motors shall conform with British Standards requirements for super silent squirrel cage induction type; they shall be totally enclosed ventilated or screen protected and have sealed for life bearings.

Starters

Direct-on-line starting shall not be employed on any load above 5.5 kW. Assisted starting shall be employed above 5.5 kW.

Starters shall be metal clad or insulated surface pattern except where located inside a control panel having an integral isolator.

Three phase starters shall be of the three or four pole contactor type with phase failure protection, thermal and/or magnetic overload trips on each phase and no volt release.

Starters shall be suitable for push button operation except where specified elsewhere.

Where remote control is required, poles shall be incorporated to ensure complete isolation of the coil circuit.

Electricity Supply

All electrical equipment shall be suitable for use with a 415 volt, 60Hz, three phase and neutral alternating current electricity supply, except where different requirements are specified elsewhere. This requirement does not preclude the use of single phase motors rated at 1.0 kW or less.

Interference Suppression

All plant, machinery and equipment used in the construction of the Works or incorporated in the Works shall comply with relevant regulations for interference suppression.

1.5.3 Interruption of Existing Services

The agreement of the Employer's Representative shall be obtained prior to the commencement of any work requiring the interruption of any existing service.

All necessary liaison shall be carried out with the owners and/or users of existing services and confirmed in writing before any work commences in connection with existing services.

Due compensation shall be paid to the Employer and/or owners/users for any claim arising from damage or disruption caused by failure to observe all necessary precautions in any section of the Works involving existing services.

1.6 SITE MANAGEMENT

1.6.1 Protection of the Works

All necessary precautions shall be taken during the execution of the Works to prevent physical damage, dirt, corrosion, dampness, pollution or other detrimental occurrences to plant, equipment, wiring, pipework or other component parts. Such precautions shall include:

- temporary covers as appropriate;

- the mandatory use of proprietary caps, plugs, blank flanges, glands or terminations or approved purpose made blanking pieces on open ends of pipework, ducts, etc;

- the retention of factory applied wrappings on radiators, convectors, luminaires, control equipment, items of plant, etc until other trades' work involving potentially deleterious effects has been completed;

- storage of delicate components in a safe place until potentially damaging activities have ceased in or adjacent to the final location of such components;

- the provision and use of adequate storage containers, racks, etc in the periods between delivery and erection;

- protection against frost;

- any other measures reasonably considered necessary by the Employer's Representative.

All necessary measures shall be implemented to prevent any element of the Works from being misused, eg as temporary support, means of access or scaffolding, or for any purpose other than that for which is was designed.

The Employer's Representative shall refuse to accept any equipment:-

- that has evidence of damage, deterioration or other deleterious effects;

- that is suspected of having suffered deleterious effects resulting from the absence of suitable protective measures.

If the Employer's Representative has reasonable grounds to believe that adequate protective measures have not been employed, all necessary means shall be implemented to demonstrate that no deleterious effects have occurred. Such means shall include:-

- rodding, pigging or dismantling of pipework;

- additional testing of cables or pipework;

- removal of ceilings, duct covers or any other element of the building;

- uncovering of services in trenches;

- making good to any part of the building, services or external works made necessary as a result of demonstrating that no deleterious effects have occurred;

- any other measures as may be required to suit the particular circumstances.

1.6.2 Delivery of Materials

The Works shall include all relevant provision for packaging, carriage and delivery of all necessary materials to the site.

Materials shall be delivered to site as required to suit the programme of work.

All surplus or redundant materials and packaging shall be removed from the site immediately.

1.6.3 Unloading and Storage of Materials

The Works shall include all costs associated with the unloading, storage, hoisting, distribution and placing in position of the materials used, except when alternative provision is specified in the contract documents.

Track laying vehicles shall not be allowed onto any part of the structure without the express written permission of the Employer's Representative.

Written permission shall be obtained from the Employer's Representative before any bulk storage of materials is allowed on any part of the structure.

1.6.4 Site Accommodation

The Works shall include provision for site offices, storage sheds, workshops and other accommodation necessary for the execution of the Works, except where the particular Specification of Conditions of Contract state otherwise.

Site accommodation shall be deemed to include any necessary provision for electrical supplies.

Site accommodation shall include toilet and messing facilities appropriate to the number of persons employed in the execution of the Works, except where the Conditions of Contract include for alternative provision of such facilities.

1.6.5 Cleanliness of Site

All surplus and redundant materials, scaffolding, packaging and other items shall be removed from the site during the course of or on completion of the Works as appropriate.

Care shall be taken throughout the course of the Works to ensure that materials in use, surplus materials and rubbish shall not present any hazard or obstruction to the movement of personnel or plant.

1.7 QUALITY MANAGEMENT

1.7.1 Materials and Workmanship

Compliance with the Specification

Materials and the standard of workmanship employed in the execution of the Works shall comply with good practice and shall comply with all relevant requirements of the Specification, except where the written approval of the Employer's Representative has been given in advance for compliance with an alternative requirement.

Different materials from those specified shall be subject to prior approval and shall be accepted only where there are benefits either - to the Employer, in terms of quality or cost; or to the progress of the Works. No additional costs shall be attributable to the Contract for any reason in connection with changes made to the Specification in order to assist in meeting the programme of work.

Rejection of Materials or Workmanship

All necessary facilities shall be made available to enable the Employer's Representative to inspect any materials and workmanship as required. This shall include inspections of materials at the manufacturer's works, in store, during the installation or after installation as appropriate.

The Employer's Representative shall be empowered to reject at any time any materials or workmanship that do not comply with all requirements of the Specification.

Any rejected materials or other part of the Works shall be removed and replaced in compliance with requirements of the Employer's Representative.

No claims for loss, expense, delay nor any other reason shall be based on failure to complete any section of the Works as a result of materials or workmanship having been rejected for non-compliance with specified requirements.

Approved Deviations from Specification

The Works shall include all items as specified except where the Employer's Representative has given written agreement for the acceptance of alternative requirements.

Where the Specification includes such terms as 'or equal and approved', 'or equivalent' or 'or similar approved type', such alternative shall only be deemed appropriate after the approval of the Employer's Representative has been given. Such approval shall be given in writing either:-

- where the conditions of tender so allow, as acceptance of an offer included in the tender for an adjustment of the tender figures; or

- after the tender has been accepted, as an instruction issued in accordance with the Conditions of Contract.

1.7.2 Uniformity

All components having the same function shall be of the same type and interchangeable where relevant. Whenever possible similar materials or ranges of materials shall be of one manufacture.

All components shall conform to relevant requirements of current British Standards and corresponding ISO or CEN standards with respect to sizing and compatibility.

Except where otherwise stated, all screw threads on nuts, bolts, studs and rods shall conform with metric standards.

Names, numeric and alphanumeric identifications of plant and equipment on labels, Working Drawings, 'as-fitted' drawings, schedules, operating instructions and any other location shall be consistent and in accordance with a logical format.

1.7.3 Workmanship and Supervision

All elements of the Works shall be carried out in a neat and workmanlike manner.

The Works shall be deemed to include all necessary provision for the employment of competent personnel in management, supervisory, skilled and unskilled capacities.

A manager, foreman or other technically qualified and competent person shall be nominated and be retained on site throughout the course of the Works. This manager shall be fully conversant with all aspects of the Works and shall be responsible for liaising with and accepting instructions from the Employer's Representative.

Supervision of the Works by the manager/foreman shall include all necessary inspections and 'snagging' to ensure that all elements of the Works are completed and to an acceptable standard before being offered to the Employer's Representative for inspection.

1.7.4 Vouchers

Invoices, accounts or other documents as appropriate shall be provided as required by the Employer's Representative as proof that any materials incorporated in the Works are in full conformity with specified requirements.

1.7.5 Cleaning

The whole of the Works shall be thoroughly cleaned as required by the Employer's Representative before being offered as being practically complete.

Cleaning of the Works shall include:-

- removal of all superfluous plaster, paint, excess jointing material, grout and other debris;

- making good to decorations or other finishes after removal of superfluous materials;

- removal of dust/grime from luminaires, diffusers, polished/ chrome or other bright metal finishes, gauge glasses, glasses, instrument faces, etc.

Cleaning shall include the interiors of all plant, panels and other relevant equipment.

Cleaning shall include the interiors of all services ducts, trunking, shafts or other concealed locations.

1.8 COST MANAGEMENT

1.8.1 Schedule of Quantities and Rates

Within fourteen days of the issuing of the instruction to proceed with the Works, or at such other time as may be required by the invitation to tender or conditions of contract, a fully priced schedule of quantities and rates shall be submitted to the Employer's Representative.

The schedule of quantities and rates shall show the quantities of each item of plant and equipment, and each type and size of fitting and other component included in the tender, together with the installed rate for each including the cost of the material, labour and expenses, profit and discounts.

The schedule of quantities and rates shall be divided into sections in conformity with the Summary of Tender. The total for each section and the grand total shall conform with the prices shown in the Summary of Tender.

The schedule of quantities and rates shall be used in determining the cost of any variation to the Works involving additions or omissions of quantities.

At the discretion of the Employer's Representative the schedule of quantities and rates may be used in determining interim valuations.

1.8.2 Variations and Additional Information

Instructions

The Employer's Representative may at his discretion issue instructions relating to variations in requirements of the Specification or giving additional information relative to specified requirements. All such instructions shall be issued using a standard form of instruction, eg Architect's Instruction, and in accordance with the Conditions of Contract.

Circumstances may arise whereby decisions made on site or urgent design decisions need to be implemented before sufficient time has elapsed to enable a formal instruction to be issued. In such cases the Employer's Representative will issue an interim written instruction, eg a Site Instruction or Engineer's Instruction, at the time of making the decision. Requirements of such instructions shall be implemented on the understanding that a formal instruction will be issued in confirmation.

The Employer's Representative will issue an Engineer's Instruction in confirmation of every Site Instruction.

Adjustment of Costs

Where the requirements of a formal instruction constitute a variation to the scope of the Works, any adjustment of costs shall be determined in accordance with the Conditions of Contract.

Adjustments to the cost of the Works shall be evaluated in accordance with one of the following methods as appropriate, and as directed by the Employer's Representative.

- Where the variation involves an addition or reduction in the quantities of materials installed, the costs shall be calculated using the Schedule of Quantities and Rates.

- Where the variation involves the provision of significant quantities of plant and materials of a type not included in the Schedule of Quantities and Rates, a separate quotation shall be submitted.

- Where the variation involves modifications to existing installations or to materials already installed, the costs shall be either subject to a quotation or measured as daywork and based on the time expended and materials used, as directed by the Employer's Representative.

Quotations

When the Employer's Representative directs that a quotation is applicable, sufficient detail shall be included in the quotation to demonstrate that the costs are reasonable and in conformity with the level of pricing applicable to the Tender.

Daywork

Daywork shall only be applicable when the Employer's Representative so directs in writing.

Daily records shall be maintained on site of all time, materials and plant used in the execution of dayworks. Weekly records shall be submitted to the Employer's Representative for signature not less than seven working days after the end of the week in question. Copies of signed daywork sheets shall be issued to the Employer's Representative:-

- at the time of signature; and

- together with any application for payment in respect of that work.

Daywork sheets shall serve only as a record of the work involved in a particular activity. The signing of a daywork sheet shall not be construed as an instruction nor any indication as to whether the work constitutes a variation to the scope of the Works.

Payment for Variations

Any application for payment for additional works shall include a list giving the following information for each variation:-

- the Engineer's Instruction number;

- a brief description of work;

- the submitted cost, or failing this an interim budget cost, or where appropriate the agreed cost;

- the percentage of the work completed to date.

In the absence of a fully substantiated application, any payments for additional work completed shall be entirely at the discretion of the Employer's Representative.

STANDARD TECHNICAL SPECIFICATION
FOR MECHANICAL INSTALLATION SERVICES
SECTION ONE - APPENDIX 1.1
PROHIBITED SUBSTANCES

Substances known to be deleterious, including but not limited to the following, shall not be used in the execution of or construction of the Works.

- Aggregates used in concrete not complying with BS 882 or BS 8110.
- Asbestos
- Calcium chloride in reinforced concrete.
- Calcium silicate bricks.
- Crocidolite.
- Formaldehyde foam.
- Fibrous materials composed of mineral fibres, either man-made or natural, having a diameter less than 3.0 micron or a length less than 200 micron, or materials which contain fibres of any size not stabilised or sealed to prevent migration.
- High alkali cement not conforming to British Standards used with aggregates containing silica.
- High alumina cement in structural elements.
- Phenolic foams.
- Polyisocyasnurate.
- Polyurethane foam.
- Urea formaldehyde.
- Wood wool slabs in permanent formwork to concrete or in structural elements.

STANDARD TECHNICAL SPECIFICATION

FOR MECHANICAL SERVICES INSTALLATION

SECTION TWO

PIPEWORK SERVICES

STANDARD TECHNICAL SPECIFICATION

SECTION TWO

PIPEWORK SERVICES

2.1 INSTALLATION OF PIPED SERVICES

Installation of all pipework shall follow the detail set out in the accompanying tender drawings, due allowance being made by the tenderer for the diagrammatic nature of same, and be in accordance with the best accepted practice.

Details set out in the following clauses of this Section are generally appropriate to all services except where specifically stated elsewhere in the Specification and drawings.

All exposed pipe runs shall be arranged to present a neat appearance and, where practical, be parallel both with one another and with the building structure, taking due regard however to the grading, venting and draining requirements. All vertical pipes shall be plumb.

All exposed pipe runs shall be arranged so that the longest length of tube practicable is used between bends, tees and flanges or unions. Short lengths of tube joined together by sockets shall not be permitted.

All pipework, valves, fittings and equipment forming the piping installations shall be erected so that it can be dismantled and is accessible for repair and replacement. In this context, 'accessible' means that the provision for dismantling the flange, union, etc. can be reached and worked upon either in the open or else by removal of a purpose-made duct cover, manhole or similar cover; the fitting is not accessible if, as fixed, it cannot be manipulated.

Where pipework is not readily accessible, it shall be welded. Unions or flanges shall be provided at valves and equipment so that they can be dismantled. No pipe shall be installed without a flange or union at a point where it passes through a wall, floor or ceiling and is not readily removable.

No joints shall be formed within the thickness of walls, floors or ceilings.

Unions or flanges shall be provided generally at a maximum spacing of one per 18 metres in positions agreed by the Engineer.

To facilitate routine maintenance, the positions of all valves, drains and supports should be determined with this aspect in mind. Grouping of valves, drain, union, flanges, etc. shall be preferred to scattered siting.

Clearance between pipework and finished walls, floors, ceiling and other fixtures should be adequate for cleaning purposes and future dismantling, and shall not be less than the distance given below:

Pipework to floors	-	minimum distance 100mm
Pipework to ceilings	-	minimum distance 100mm
Pipework to walls	-	minimum distance to conform with standard bracket centres
Pipework to pipework	-	minimum distance 32mm.

The Sub-Contractor shall include for bends in pipes around piers and all other projections and recesses and for all offsets due to varying thicknesses of plaster, walls, floors, ceilings, and other structural works. It shall be the responsibility of the Sub-Contractor to ascertain the skirting heights, sill heights and floor finishes. No pipework offsets shall be allowed on pipework visible in rooms, except as agreed with the Architect and/or Engineer.

Where pipes are held in vices, as when screwing or cutting, care shall be taken to ensure that the pipe surface is not damaged. Any pipework so damaged shall not be fitted. Any pipework surface damaged by the scoring of stillsons, whilst being installed, shall not be accepted.

The Sub-Contractor shall ensure that all pipes, fittings, valves, etc. are free from corrosion and internal obstruction. Pipes and fittings showing signs of corrosion shall not be fitted.

The Sub-Contractor shall protect the open ends of all pipework. Suitable caps, plugs or plastic covers only shall be used to cover open ends; wood, rag or paper plugs shall not be used.

The Sub-Contractor shall not used a valve fitted to the open ends of a disconnected pipe to prevent the entry of dirt.

Failure to comply with the above instructions shall mean that the Engineer shall have the right to order the pipework to be dismantled as far as considered necessary and the pipework to be thoroughly cleaned internally.

The Sub-Contractor shall carry out this work free of cost to the Employer and shall bear all costs incurred by removing, cleaning and replacing the sections of pipework.

2.2 PIPEWORK MATERIALS

All pipework installed by the Sub-Contractor shall conform with the following table of pipework materials. Variation from this table will not be accepted, unless required in a following section of the Specification.

Table of Pipework Materials

Service	Pipework Material
Heating flow and return	Black mild steel
Steam	Black mild steel
Condensate	Black mild steel
Chilled water flow and return	Black mild steel
Gas	Black mild steel
Oil	Black mild steel
Foam	Galvanised mild steel
Dry risers	Galvanised mild steel
Wet risers	Galvanised mild steel
Mains cold water	Copper
Boosted cold water	Copper
Tank cold water	Copper
Fire Hose Reel water	Copper
Cold Water below ground	Medium Density Polythylene Blue
Domestic hot water flow and return	Copper
Cold feeds	Copper
Open vents	Copper
Drains from equipment	Copper
Safety valve discharges	Copper
Sump pump discharges	Copper
Compressed Air (Non-Medical only)	Galvanised mild steel
Vacuum (Non-Medical only)	Galvanised mild steel

2.3 MILD STEEL PIPEWORK

Where the table of pipework materials requires the use of mild steel pipework, this shall be straight, cleanly finished, round in cross section, free from cracks, surface flaws, laminations and other defects and shall be free from rust and scale.

Standard steel pipes having nominal bores of up to 150mm shall be in accordance with BS 1387:1967 and shall be provided in random lengths of between 4.5m and 7.5m. Gauge of pipe walls shall be in accordance with the heavy grades of the Standard.

Steel pipework over 150mm bore shall be of mild steel manufacture in accordance with BS 3601:1974 HFS/CDS steel 22. The wall thickness shall be suitable for the pressures of the system in which it is to be installed. Steel pipework for welding shall be supplied with plain ends, bevelled for butt welding.

Where pipes are required for screwed joints, they shall be provided with screwed taper threads to BS 21, Part 1.

Steel pipes, which are to be used 'black', shall be varnished externally throughout their length after manufacture.

Galvanised steel tubes shall be to BS 1387, heavy grade.

Where steel pipes are to be installed underground, they shall be double wrapped in Densotape.

2.4 COPPER PIPEWORK

Where the table of pipework materials requires the use of copper pipework, this shall be solid drawn from phosphorous de-oxidised non-arsenical copper to BS 1035 free from any deleterious film.

Copper pipework used above ground shall be Half Hard - light gauge in accordance with BS 2871, Part 1, Table X.

Copper pipework used below ground shall be Half Hard Annealed - heavy gauge in accordance with BS 2871, Part 1, Table Y to be plastic coated.

All piping and tubing used in the installation described in this Specification shall be straight, cleanly finished, round in cross section, free from cracks, surface flaws, laminations and other defects.

2.5 DUCTILE IRON PIPEWORK

Where the table of pipework materials requires the use of ductile iron pipework, this shall be straight, cleanly finished, round in cross section, free from cracks, surface flaws, laminations and other defects.

Standard ductile iron pipes, having nominal bores from 80mm to 600mm shall be in accordance with BS 4772, Class K9, and shall be provided in standard 5.5m lengths of pipe where practical with ends finished for spigot and socket joints.

All ductile iron pipes shall be supplied with a concrete lining, consisting of sulphate resisting cement and specially graded washed silica sand, all sealed in accordance with BS 3416.

2.6 JOINTING OF MILD STEEL PIPEWORK

Black mild steel pipework up to and including 50mm dia. shall be screwed.

Black mild steel pipework of 65mm dia. and above shall be welded unless welding would constitute an unacceptable fire hazard.

All galvanised steel pipework shall be screwed.

Black mild steel pipework in the following areas shall be welded regardless of size:

(a) Pipework in boiler room, plants rooms and pump rooms.

(b) All pipework on MPHW, HPHW or Steam systems.

(c) Pipework in ducts, trenches and other positions not readily accessible.

(d) Pipework in rooms housing electrical switchgear, tele-communications equipment, computers, control gear, etc.

All screwed black steel pipework shall have provision made for dismantling, using Navy Pattern unions.

All welded black steel pipework shall have provision made for dismantling using slip on bossed welding flanges.

Galvanised mild steel pipework up to and including 50mm dia. shall have provision made for dismantling using galvanised malleable iron Navy Pattern unions.

Galvanised mild steel pipework of 65mm dia. and above shall have provision made for dismantling using galvanised screw-on flanges, faced and drilled B.S.T.E.

2.7 JOINTING OF COPPER PIPEWORK

Copper pipework up to and including 67mm dia. shall be jointed using capillary fittings.

Where necessary due to high temperatures, these capillary fittings shall be heavy duty type with integral hard solder ring of silver brazing type.

Copper pipework of 76.1mm and 108mm dia. shall be jointed using wedge ring soldered fittings.

All the above fittings as manufactured by Yorkshire Imperial Fittings Ltd.

Copper pipework of 159mm dia. and above shall be jointed using silver brazing fittings as manufactured by DREH Ltd., 215 Barnfield Road, Swindon, SN2 2DN.

All jointing of copper tubes shall be strictly in accordance with the fitting manufacturer's recommendations.

All solder droppings and surplus flux shall be removed on completion of the joint.

During all jointing operations the fitter/plumber shall be accompanied by a competent assistance and suitable asbestos mats shall be used to protect the building fabric and decorations.

Every precaution shall be taken to prevent damage by scorching or fire, but the Sub-Contractor shall provide the fitters/plumbers with two portable fire extinguishers for use in an emergency.

All copper pipework up to and including 54mm dia. shall have provision made for dismantling using gun-metal unions.

All copper pipework of 67mm dia. and above shall have provision made for dismantling using gun-metal silver brazing flanges.

2.8 SCREWED JOINTS

Screwed joints shall be tapered thread to BS 21.

Steel pipes having screwed joints shall be carefully reamed out before the plain end is screwed.

When making a joint, the screw thread shall be coated with a white jointing compound to BS 5252 and a good quality hemp, all surplus jointing compound being finally clean off to leave a surface suitable for painting. P.T.F.E. tape may only be used with the prior agreement of the Engineer.

The joints shall be arranged so that on completion two or three threads are left showing.

Should a screwed joint prove defective under subsequent test, caulking will not be allowed.

2.9 WELDED JOINTS

Steel pipes, having welded joints on the run, shall be prepared for jointing in a manner suitable for the technique employed.

Welding shall be carried out in accordance with BS 2971 for metal arc welded joints, using covered electrodes and BS 1821:1957 and BS 2640:1955 for oxyacetylene welded joints.

Pipes shall be prepared for welding with ends sawn or cut off by hand, flame cut by machine or flame cut by hand with subsequent truing up by filing or by grinding to a bevel of 37.5' as may be required. Welding rods shall in all cases be of good quality copper coated low carbon steel and the manufacturer shall provide test certifications representative of the rods used in accordance with BS 1453:1972, Group A.

All welded joints, produced by the oxyacetylene flame process, shall be of best quality, the butts being slightly convex with regular ripples and no undercutting, washing away or surface cavities being present. Notches at the root indicating incomplete penetration and excessive weld protruding into the pipe bore in excess of 1.5mm shall not occur and the external reinforcement shall run out smoothly to the pipe surface on either side.

Welding shall in all cases be carried out by skilled craftsmen, who are in possession of a current certificate of competency issued by an approved authority (which shall be produced at the request of the Engineer) and have had a suitable period of experience for the class of work in which they are engaged in accordance with BS 4871 and BS 4870.

Highly skilled non-certificated welders may only be used by written permission of the Engineer and test welds, in accordance with BS 4870, Part 1, 1972 with satisfactory laboratory test certificates, shall be submitted before this permission is granted. The Engineer shall determine a suitable independent testing authority and any costs arising from these tests shall be borne by the Sub-Contractor.

During all welding or cutting operations, the welder shall be accompanied by a competent assistant and suitable asbestos mats shall be used to protect the building fabric and decorations. Every precaution shall be taken to prevent damage by scorching or fire, but the Sub-Contractor shall provide the welders with two portable fire extinguishers for use in an emergency.

After cutting or welding, all flashings shall be removed from all pipework before erection.

All welded joints shall be painted with two coats of red oxide on completion of the joint.

2.10 FLANGED JOINTS

All flanges shall be in accordance with BS 10, or equivalent metric specification suitable for the pressure of the service concerned.

Flanges on black mild steel pipes shall be of the welded slip-on bossed type, secured by welding both the neck and bore, care being taken not to distort the machined face.

Flanges on copper pipework shall be of the gun-metal silver solder to brazing type.

The joint between flanges on black and galvanised steel pipes shall be made up with full face Klingerite joint ring graphite faced on both sides, completed using mild steel bolts having a minimum tensile strength of 431N/sq.mm (28 tons per sq.in.) with nuts and washers.

The joint between flanges on copper pipework shall be made with a full face Cupro-Nickel Taylor ring and white jointing paste on both sides, completed using mild steel bolts having a minimum tensile strength of 431N/sq.mm (28 tons per sq.in.) with nuts and washers.

All bolts, nuts and washers shall be manufactured from mild steel to BS 19 'Table of Pipe Flanges (for land use) Part 2' to the table appropriate for the pressure specified.

Flanges shall incorporate bolt holes, drilled not punched. Flange faces shall be machined fully across. When the joints are made, the bolt shall project 3mm minimum beyond the nut.

2.11 FITTINGS FOR MILD STEEL PIPEWORK

Fittings for all galvanised mild steel pipework and black steel pipework up to and including 50mm dia. shall be malleable cast iron pipe fittings to BS 143, manufactured by the Whiteheart process to Grade 1 of BS 309 banded or beaded for reinforcement with the exception of steam pipework on which wrought steel pipe fittings, manufactured from mild steel by a seamless or welded process to BS 1740 shall be used.

Fittings on galvanised pipework shall be galvanised to BS 729, Part 1.

The screwed ends of the fittings shall be provided with parallel female and tapered male threads to BS 21, Part 1, the axis of threads being coincident with the true axis of the fittings. Where required, taper threaded fittings shall be provided and shall be in accordance with BS 143.

Fittings on black mild steel pipework of 65mm dia. and above shall be welded fittings to BS 1965 and be manufactured by a forged seamless process from mild steel.

In addition to the range of fittings set out in the standards, branch bends manufactured to the same details may be used.
End of fittings, which shall have the same bore and the same wall thickness as that of tube manufactured to the 'heavy' grade of BS 1387, shall be bevelled for butt welding.

Generally all fittings shall, where practicable, be of the easy sweep type. Branches shall be made using swept tees of branch bends except where an air lock is liable to form, ie tees on rising mains, etc, where square tees shall be used.

Elbows shall be used only where the use of bends is impracticable and where the Engineer's permission has been obtained.

Where standard fittings are not available for the duty required, reductions on the run and to the branch shall, in all cases, be made with reducing sockets, not bushes.

Reducing fittings on horizontal pipework shall be of the eccentric pattern fixed so as to give a smooth run to the crown of the pipe. Concentric pattern reducers shall be used on vertical pipework.

If bends and springs are manipulated on site, then cold bending by a hydraulically operated machine will be permitted for standard steel pipes having a bore of 50mm or less, but larger pipes shall be bent hot. All bends shall be normalised by heat treatment after manipulation. All sets, double sets and springs shall be formed from long lengths of tube with as large a radius as possible and shall be free from distortion.

The diameter shall be maintained; crinkled and scored work will not be accepted.

Where junctions to steel mains are formed by factory or site welding, such work shall be carried out to the above standards for steel tubulars. All necessary reinforcements by way of plates, collars or shoes shall be provided. All branch bends, where possible, shall be formed by the use of special welding fittings of the same quality as the pipe and shall conform to BS 1965:1963 and amendments.

Where branch bends are used the profile of the hole shall be carefully set out to match the fittings, and where the holes are flame-cut all loose scale and oxide shall be removed from the main before the branch is welded into position.

The distance between the centres of two adjacent branch welds shall not be less than twice the diameter of the large branch.

All changes in direction shall be proportioned so that the ratio between the centre line radius of the bend and the inside diameter is not less than 1.5:1.

Lobster back and cut and shut bends will not be permitted.

Unions shall, in all instances, be manufactured with double gun-metal seats as the Navy pattern.

2.12 FITTINGS FOR COPPER PIPEWORK

Capillary fittings shall be to BS 864, Part 2, type 'A'. All fittings shall be manufactured from materials being non-dezincifiable, ie copper or gun-metal.

Silver brazing fittings shall be manufactured from copper tube to BS 2871, Part 1, Table X, suitably socketed for assembly with silver brazing alloys to BS 1845.

All fittings shall be suitable for the working conditions of the system and purpose-made fittings shall be used throughout. All branch connections shall be by purpose-made tees, either square or sweep, to suit the application.

Where practical fittings shall be of the long sweep pattern. Where standard fittings are not available for the duty and sizes required, reductions shall be made with purpose-made fittings.

Where light gauge copper tubes are pulled on site to form bends and offsets, the materials used shall be as for adjacent straight lengths. Tubes having nominal bores up to 28mm may be bent cold but larger sizes shall be annealed before manipulation.

In all cases tubes shall be loaded prior to bending with springs, low melting point alloys or an inert sand, care being taken that contamination of the tube material is avoided. Where bending machines are used these shall have smooth, clean guides and formers, any scored or damaged tools being rejected.

No pulled bends with any deformity whatsoever resulting in the forming of the bend will be permitted.

Unions shall be manufactured from gun-metal and shall be in accordance with BS 864.

2.13 FITTINGS FOR DUCTILE IRON PIPEWORK

All fittings used on ductile iron pipework shall be concrete lined ductile iron of the 'push-in' Tyton type, as manufactured by Stanton and Staveley.

Concrete thrust blocks of a suitable size shall be provided at joints and changes in directions, where necessary.

2.14 PIPEWORK SUPPORTS

All pipework shall be adequately supported on hangers or on brackets with rollers, in order to permit free movement due to expansion and contraction.

Pipework supports shall be arranged as near as possible to joints and changes in direction.

The Sub-Contractor shall include for the supply of all necessary supports and brackets, complete with all bolts, screws and insert or plug fastenings.

Particular importance must be made to the design and method of supports and brackets for pipework and equipment. Care should be exercised regarding strength of material, construction, method of fixing, practicability and appearance when designing brackets. Drawings of all brackets and supports shall be forwarded to the Engineer for approval before manufacture is commenced. Details of all Patent fixing to the building fabric shall also be submitted to the Engineer for prior approval.

Softwood plugs will not be permitted.

The Sub-Contractor shall be responsible for the positioning and marking out of all brackets and supports.

Building-in of brackets shall be done by the Building Contractor but the Sub-Contractor shall be responsible for ensuring that this is carried out correctly.

Vertical pipework shall be adequately supported at the base of the riser and at all intermediate levels. Branch circuit pipes shall not be used as a means of support for the riser main.

Brackets and supports shall be set out so that they do not obstruct the access to valves, flanges or fittings requiring maintenance.

Pipes shall be spaced in relation to one another and to the building structure so as not to interfere with any other service and to allow for the required thickness of thermal insulation as specified later.

Pipes shall not be supported from each other but, where there is no alternative, the Engineer's written approval must be obtained. The brackets so installed shall not prevent the removal of any individual pipe where necessary and provision shall be made for any unequal expansion.

Pipes shall not be supported from any item of equipment.

All high level pipework is to be carried on neat galvanised swivel hangers with GM split rings or steel glands, suitably spaced to prevent sagging and to allow expansion and contraction.

Brackets, hangers and supports are to be as follows:-

a) <u>Brackets</u>

(i) Brackets to walls: Flat iron with fishtail end, minimum size 40mm x 6mm.

(ii) Brackets to walls: Angle iron with fishtail, minimum size 32mm x 32mm x 6mm.

(iii) Brackets to R.C.Beams: Rag bolt with eye built in, minimum size 15mm dia.

(iv) Brackets to R.S.J: Girder clips.

(v) Brackets suspended from flat roofs: Rod with eye (min. size 9mm dia.) on underside with back plate and locknut on top side.

(vi) Brackets in trenches: Channel iron, minimum size 100mm x 50mm x 6mm.

b) Hangers

(i) Rods (minimum size 9mm dia.) with purpose-made hook and/or eye.

(ii) Tubes (minimum bore 6mm) with chandelier hooks or ring sockets.

c) Supports

(i) Smithy purpose-made mild steel band (minimum size 25mm x 3mm strap) with nut and bolt or malleable iron split ring with socket for all mild steel pipework.

(ii) Smithy purpose-made heavy gauge brass strip band with nut and bold or gun-metal split ring with socket for all copper pipework.

(iii) Smithy purpose-made mild steel stirrup (minimum size 32mm x 3mm) with roller and chair, sized to manufacturer's recommendations for steel and copper pipework where required to allow for expansion. Bronze rollers shall be used for copper pipework.

Any combination of the above will be allowed, providing that uniformity of type is adopted throughout the various sections of the building.

All hangers and supports, except at necessary fixed points, must be allowed to swing freely to take up expansion and contraction.

All low level pipework to be supported by munzing ring and tube secured into walls by brass anchor fixings.

All brackets, hangers and supports, except supports for copper pipework, are to be hot dip galvanised after manufacture to BS 729.

The spacing distance between brackets and supports to be as follows:-

All sizes of copper piping 2.0m apart, 15mm to 50mm steel piping 2.3-3.0m, 65mm and over steel piping 3.7-4.6m.

In addition to the centre given, supports shall be provided adjacent all valves, flanged joints and other special components to prevent undue strain on the adjoining pipework and so that the equipment or sections of pipework may be removed, leaving the adjoining pipework adequately supported at the ends.

Main walls and partition walls, etc where pipes pass through sleeves shall not be considered as pipe supports.

2.15 EXPANSION LOOPS AND BELLOWS

All pipework shall be installed to accommodate without distortion the linear expansion when heated. Pipe supports shall be of the type which will allow full movements of the pipes, except at fixed points which shall be provided as necessary between expansion bends, sets or bellows. The fixed points shall be secured by anchors of an approved design.

The Sub-Contractor shall provide and fix all the requisite expansion loops formed in the pipe runs by means of long radius welded elbows to the required dimensions. The loops shall be installed in the mains with mild steel flanges and each leg of the loop shall be pulled cold to approximately 50% of the estimated expansion of the leg.

Single and double expansion bellows shall be installed as necessary to absorb the axial movement of the pipelines and these shall have screwed or flanged ends as circumstances dictate.

The bellows shall be installed with due allowance having been made for cold draw, which will vary according to the type and length of bellows proposed and the temperature of installation. Where 'Installation Bars' or fittings are incorporated with the bellows during delivery and erection, these must be removed before heat is applied.

Care shall be taken when installing flanged end bellows to line up the bolt holes on joint and making flanges, and to ensure that the joint is not twisted in any way or any torsional stresses applied.

Free guide sleeves shall be fitted on each side of the expansion joint, unless such joint be installed adjacent an anchor point when guides shall be fitted on the free side only.

Guides shall consist of a tube of diameter not more than 3mm greater than the outside diameter of the main and in length four and a half times the diameter of the main with a minimum length of 300mm, unless an alternative design is shown on the tender drawings.

Guides shall be installed not more than one and a half pipe diameter from the expansion joint to the first tubular guide, and not 15-20 pipe diameters between this guide and the next pipe support.

When installing manufactured expansion loops or bellow joints, the manufacturer's installation recommendations shall be observed in every respect.

When pressure testing pipework distribution mains, the Sub-Contractor shall ensure that the test pressure will not damage the bellows. Where the test pressure exceeds the maximum operating pressure the Sub-Contractor shall include for temporary spacer pieces to be installed for the duration of the tests.

Where no bellows or loops are specified provision for expansion and contraction of pipework shall be made by changes in direction, and it shall be the responsibility of the Sub-Contractor to make sufficient allowance for this.

Branch connections are to be taken from the top or bottom of both flow and return mains, depending on the prevailing air venting arrangements. Branches will have incorporated in them two bends before passing into ducts, trenches, vertical chases, etc. The bends shall be so arranged as to take up the expansion and contraction of the mains without putting any extraneous strain onto the particular branches.

2.16 ANCHOR POINTS

Where indicated on the drawings or as required, mild steel anchors shall be installed to resist the maximum stresses of the pipework.

The anchor shall be fixed only to solid building fabric. The anchors shall consist of heavy section iron 'U' strap, minimum size 50mm x 6mm, welded to the pipework and attached to minimum 150mm x 75mm x 6mm channel iron supports by H.T. nuts and bolts, unless shown otherwise on the tender.

For heavier loading applications, mild steel locking channels shall be welded to the pipe on each side of the supporting channel.

All cleats, brackets and steelwork required for building-in shall be supplied by the Sub-Contractor, unless stated otherwise elsewhere in the Specification.

Details of all anchors shall be submitted to the Engineer for approval before manufacture.

2.17 GRADING OF PIPEWORK

All pipework shall be installed with continuous gradients to allow for drainage and/or air venting, according to the service concerned. Gradients shall be generally as follows for the various services.

LPHW/MPHW/HPHW Mains	1 in 500	Steam	1 in 250
LPHW/MPHW/HPHW Branches	1 in 250	Condense	1 in 125/250
DHWS and all CWS	1 in 750	Comp. Air	1 in 125
		Gas	1 in 250

2.18 AIR VENTING OF SYSTEM

Full provision shall be made by the Sub-Contractor for air venting of the systems at all high points in pipework formed by the Sub-Contractor, whether or not shown on the drawings.

Automatic air vents shall be used only where indicated on the tender drawings and shall have gun-metal bodies with not less than 15mm connection copper or stainless steel floats, guides and non-corrodible needle valves. In all cases the air vent shall be preceded by a lockshield pattern stop valve and the discharge from the air vent shall be 10mm copper pipe, which shall discharge to outside in a position which shall be agreed in advance with the Architect and/or Engineer.

The automatic air vents shall in all ways be suitable for the pressure and temperature of the system on which they are to be installed.

Pipework shall be so arranged as to allow air to be vented out of the system through radiators, fan connectors, etc. However, at high points where this is not possible an air bottle shall be installed.

Air bottles of pipework up to and including 80mm bore shall be manufactured from 50mm bore pipe, 100mm bore and over from 100mm bore pipe. All shall be 250mm long with welded end caps and be complete with 8mm bore copper pipe brought down from the top of the air bottle to within reach of ground or floor level, and fitted with 8mm lockshield needle valve complete with key.

Where required by the Architect/Engineer, air bottle vents shall be brought to false ceiling level and shall terminate with an 8mm (0.25" BSP) manual air vent projecting neatly through the ceiling.

On MPHW/HPHW systems the discharge pipe and needle valve shall in all ways be suitable for the pressure and temperature of the system on which they are to be installed, and shall be arranged so as to discharge to a safe place.

All exposed air bottles, automatic vents and drip pipes where required shall be properly insulated and protected against frost.

2.19 DRAINING OF SYSTEM

Drain points shall be provided by the Sub-Contractor at all accessible low points of water services installations, and also on the branch side of all main isolating valves and cocks whether shown or not on the drawings.

Drain points shall be fitted with a lockshield drain cock of gun-metal construction manufactured to the requirements of BS 2879:1957, type 'A', complete with hose union and removable key. Drain points in gas pipework shall comprise of a pocket of equal bore to the main with a drain valve. The base of the pocket shall be drilled and tapped to accept a 15mm lever operated plug cock of suitable design.

Drain points on MPHW/HPHW systems shall be fitted with a bronze needle valve with plugged outlet.

2.20 PIPE SLEEVES

In all cases where pipes pass through walls, ceilings and fittings, the Sub-Contractor shall provide sleeves which shall be built-in by the Building Contractor, but the Sub-Contractor shall be responsible for ensuring that this is performed correctly. Sleeves shall in no case be used as pipe supports, a free annular space always being provided. Puddle flanges shall be provided on pipework passing through walls and trenches intended to be covered by earth, etc, or where passing through bund walls. Sleeves shall be of pipe cuttings properly reamed, cleaned and trimmed at 90' to bore.

Sleeves in load-bearing walls or footings shall be cast iron pipe. Sleeves in non-load-bearing walls, floors, ceilings and partitions shall be in copper or mild steel to suit the particular pipe material.

External flashing sleeves shall be provided by the Sub-Contractor except where indicated otherwise. They shall incorporate an integral flange to which a flashing shield can be clamped or welded. The Building Contractor shall build the shield into the membrane and fill the space between the sleeve and pipe with waterproof material or mastic compound.

Inside diameter of sleeves shall be not less than 12mm larger than the outside diameter of the pipe, except where pipes pass through load-bearing walls or footings where sleeves shall be 100mm larger than the outside diameter of the pipe.

For pipes with change direction over-sized sleeves, the size larger than normal shall be fitted to allow for expansion.

The space between the pipe enclosed and its sleeve shall be caulked with a suitable approved material.

Sleeves shall not protrude from the finished face of walls. In toilets, kitchens and other situations where the floor may be swilled, the sleeve shall project 30mm above the finished floor level.

2.21 FLOORPLATES

Where exposed to view, pipes and tubing passing through walls, floors, ceilings, partitions and false ceilings of occupied rooms shall be fitted with a heavy chromium-plated die cast zinc alloy masking plate. Such plates shall be split on the diameter, be a snug fit to the pipe concerned and provided with counter-sunk holes for set screws.

2.22 SAFETY VALVES

All safety valves shall be as NABIC Fig. 42 and shall be set to discharge at 1.15 times the design pressure or 5 psig above the working pressure, whichever is the greater.

2.23 VALVES AND STOPCOCKS

Valves and stopcocks shall conform with the table at the end of this section of the Specification, unless detailed differently in the particular section of the Specification.

2.24 PRESSURE, ALTITUDE AND TEMPERATURE GAUGES

Where depicted on the schematics and as generally described hereunder, the Sub-Contractor shall supply and install a thermometer, altitude or pressure gauge.

Thermometers shall be fitted on each boiler or cylinder (if not included for in the manufacturer's specification) on flow and return headers, and on each return main prior to connection into the return header, on the secondary side of all calorifiers and on the down stream side of all mixing valves.

Thermometers shall be as manufactured by B.S.S. Ltd and be their type 438S or 439S, dependant upon whether the application calls for a straight or angular pattern. They shall all be calibrated in both Centigrade and Fahrenheit and be supplied with a loose red pointer to be set at the design working temperature. The scale range shall be suitable for a maximum temperature approximately twice the design temperature. They shall be supplied with a pocket suitable for insertion into the fluid concerned. All gauges fitted within the Boiler House, Calorifier Room, Plenum Room and Tank Room shall have a 150mm dia. dial gauge fitted; elsewhere shall have a 100 dia. dial.

Altitude gauges shall be fitted on each heat exchanger, ie boiler, calorifier, etc.

Altitude gauges shall be as manufactured by B.S.S. Ltd and be their type 415S/D. They shall be supplied with a loose red pointer to be set at the design working head and be calibrated in both metres and feet. The scale range shall be suitable for a maximum of approximately twice the design head. All gauges shall be supplied with a suitable angle or pigtail siphon and a B.S.S. Ltd Fig. 394S Gun-metal Gauge Cock. All gauges fitted within the Boiler House, Calorifier Room, Plenum Room and Tank Room shall have a 150mm dia. dial gauge fitted; elsewhere shall have a 100mm dia. dial.

Pressure Gauges shall be fitted on either side of pump sets (where duty stand-by or multiple pump configurations are installed gauges shall be on the common discharge, not a pair per pump).

Pressure gauges shall be as manufactured by B.S.S. Ltd and be their type 407S/SM. They shall be supplied with a loose red pointer to be set at the design working head and be calibrated in both gauge and psig. The scale range shall be suitable for a maximum of approximately twice the design head. All gauges shall be supplied with a suitable angle or pigtail siphon and a B.S.S. Ltd Fig. 394S Gun-metal Gauge Cock. All gauges fitted within the Boiler House, Calorifier Room, Plenum Room and Tank Room shall have a 150mm dia. dial gauge fitted; elsewhere shall have a 100mm dia. dial.

All pressure gauges shall be backplate mounted on a varnished hardwood panel with chamfered edges. The panel shall have labelling to indicate the pump function and inlet and outlet condition. Pipework to the pressure gauges shall be in copper and be neatly run to the pump.

2.25 TESTING

The Engineer shall witness all testing and commissioning and shall have access at all reasonable times to such parts of the Sub-Contractor's, his sub-contractors' and suppliers' works as may be necessary for the purpose of inspecting, examining and testing the materials, workmanship and performance.

2.26 NOTICE PRIOR TO TESTING

The Sub-Contractor shall give the Engineer seven days' written notice of his intention to carry out a test, and shall have carried out all necessary adjustments prior to commencing the test.

2.27 TESTING IN SECTIONS

The Sub-Contractor shall allow for testing and commissioning the installation in sections as may be required, in order to conform with the programme. All pipework and ductwork in these sections shall be sealed and tested as specified below, so that the insulation can be applied and the section completed to assist the programme.

2.28 TESTING OF PIPEWORK, WELDS, ETC

The whole installation shall be hydraulically tested to twice the working pressure of the systems or 4.137 bar, whichever is the greater.

Gas pipework shall be tested at a minimum of 50 mbar, utilising an inert gas.

The Contractor shall calculate the test period utilising the system volume and the formula stated within the CORGI/ACOPS regulations relating to the minimum detected leak values and the permitted leak value. All tests on the gas system shall be carried out and certified by an ACOPS/CORGI registered gas fitter fully in accordance with the Gas Safety (Installation and Use) Regulation 1984.

This pressure shall be maintained for a period of two hours in each case, and due allowance shall be made for attendance by the foreman upon the Engineer during the progress of such tests. The Sub-Contractor shall also be responsible for arranging for the Water Authority to witness this test should they require to do so. Any equipment fitted not suitable for this pressure shall be adequately protected or isolated from the system during the test.

All leaks are to be immediately repaired and the installations re-tested until the above requirements are obtained.

The Sub-Contractor must allow for such emptying and re-filling and maintenance of heat necessary until all leaks have been satisfactorily stopped.

Upon completion of the final hydraulic tests on the system the Sub-Contractor shall apply heat and open all valves and charge the calorifiers.

All valves and stopcocks throughout the system shall be adjusted and regulated until all circuits are working under normal conditions and to the satisfaction of the Engineer. Joints found to be faulty under heat are to be completely re-made.

All tests are to be carried out before application of the paint or insulation, and valve adjustments made with the circulating pumps in operation.

The Sub-Contractor shall ensure that before informing the Engineer of the proposed tests all remedial work has been carried out, and that there are no leaks. Failure to comply with this clause could result on a charge being made by the Engineer to the Sub-Contractor for the abortive visit.

Each welder shall be assigned a reference which shall be stamped on each weld, and when the general hydraulic tests of the completed systems are carried out each weld shall be lightly hammered during the time that pressure is maintained.

If any leaks occur at welds the portion of the weld near the leak shall be cut out and re-welded. Such leaks shall not be repaired by caulking or attempted fusion of the surrounding metal. Should a considerable portion of welded joints made by a particular operator be found to be defective due to faulty workmanship, all such welds shall be cut out and re-welded by another operator whose work has proved satisfactory.

During the progress of the works inspections will be made by the Engineer to ensure the quality of welding, and also ensure that all burrs and swarf have been removed from cuts and that the cuts have been made square.

The Engineer reserves the right to instruct the Sub-Contractor to cut open any ten sections of the pipework to inspect cuts or to have welded joints laboratory tested.

If the test and inspection should prove that the welds are to the required standard or that all burrs and swarf have been removed, the Client will pay costs incurred by the Sub-Contractor in removing, testing and replacing the sections of pipework. If however the inspection and test shows that the welds or cuts are below the class of workmanship for this class of work, or if they are found to be faulty in any respect, the Sub-Contractor shall made good any such faults free of cost to the Client and shall pay all fees incurred by the tests.

If, in the opinion of the Engineer, this result suggests that the standard of workmanship on the whole of the rest of the work is below that required, the Engineer shall be entitled to instruct the Sub-Contractor to remove the remainder of the sections in whole or in part and have these sections renewed to conform with this Specification. The Sub-Contractor in this case shall have no claim for the costs involved in removing and renewing these sections of the works, whether such works are found to be faulty or not.

The Engineer's decision shall be final.

2.29 TEST CERTIFICATES

The Sub-Contractor shall at the time of the test present three copies of a test certificate for signature by the Engineer and one to be retained by the Sub-Contractor.

Insurance company certificates of hydraulic tests held at the manufacturers' works shall be submitted for boilers, calorifiers and cylinders.

Manufacturers' certificates of tests of the specified duties held at the manufacturers' works shall be submitted for pumps, fans and motors, etc. No item of equipment shall be delivered to site before the Engineer has given his approval of the test certificate.

Where no test pressures are given the test shall be carried out in accordance with the appropriate British Standard (current edition) and subject to the Engineer's approval.

2.30 COMPLETION OF TEST

On completion of a satisfactory test of the system the Sub-Contractor shall allow for draining the installation and for re-filling the system when the building is due to handed over to the person to be permanently in charge of the plant.

VALVES FOR USE IN MECHANICAL SERVICES INSTALLATIONS

Alternative types to those specified below shall be allowed strictly in accordance with requirements of Clause 7 of Section One of the Specification.

SERVICE	FUNCTION	SIZE	TYPE	REF.
LTHW and CHW	Isolating	≤50mm	Hattersley	33X/33LS
LTHW and CHW	Isolating	≤65mm	Hattersley	549PN16
LTHW and CHW	Commissioning	≤50mm	Hattersley	CV2432/2473L
LTHW and CHW	Commissioning	≤65mm	Hattersley	CV2733PN16
LTHW and CHW	Regulating	≤50mm	Hattersley	1432
LTHW and CHW	Regulating	≤65mm	Hattersley	733DRPN16
LTHW and CHW	Non-return	≤50mm	Hattersley	47
LTHW and CHW	Non-return	≤65mm	Hattersley	651PN16
LTHW and CHW	Heat emitter) Fan Coil etc)	≤50mm	Hattersley	2380/2380 LS 2406/2406LS
LTHW and CHW	Strainer	≤50mm	Hattersley	807
LTHW and CHW	Strainer	≤65mm	Hattersley	810PN16
LTHW and CHW	Drain cock	≤50mm	Hattersley	81HU
LTHW and CHW	Drain tap	≤20mm	Hattersley	371
MTHW/HTHW	Isolating	≤50mm	Hattersley	1200PN40
MTHW/HTHW	Isolating	≤65mm	Hattersley	4733PN16
MTHW/HTHW	Commissioning	≤50mm	Hattersley	CV5200
MTHW/HTHW	Commissioning	≤65mm	Hattersley	CV6733
MTHW/HTHW	Regulating	≤50mm	Hattersley	1200DRPN40
MTHW/HTHW	Regulating	≤65mm	Hattersley	4733DRPN16
MTHW/HTHW	Non-return	≤50mm	Hattersley	014NRPN16
MTHW/HTHW	Non-return	≤65mm	Hattersley	4651PN16
MTHW/HTHW	Strainer	≤50mm	Hattersley	807
MTHW/HTHW	Strainer	≤65mm	Hattersley	810PN16
MTHW/HTHW	Vent/Drain	≤50mm	Hattersley	014PN16

SERVICE	FUNCTION	SIZE	TYPE	REF.
Steam	Isolating	≤32mm	Hopkinson	8103
Steam	Isolating	≤40-80mm	Hopkinson	8123 Flanged BSTF
Steam	Isolating	≤100mm	Hopkinson	2171 Flanged BSTF
Condensate	Isolating	≤50mm	Hattersley	33X
Condensate	Isolating	≤65mm	Hattersley	35PN16
Condensate	Check	≤50mm	Hattersley	47
Condensate	Check	≤65mm	Hattersley	651PN16
Gas	Isolating	≤50mm	Hattersley	200M
Gas	Isolating	≤65mm	Hattersley	201M/201MG
Oil	Isolating	≤50mm	Hattersley	200M
Oil	Isolating	≤65mm	Hattersley	201M/201MG
MCWS	Stopcock	≤54mm	Yorkshire	514GM with Loose jumper
MCWS	Stop valve	≤65mm	Hattersley	35PN16
BCWS, TCWS and HWS	Main Branch Isolating	≤54mm	Hattersley	33X/33XLS
MCWS, BCWS, TCWS and HWS	Service valve for cistern, WHB appliance etc.	≤22mm	Ballofix	Screw driver operated
MCWS, BCWS, TCWS and HWS	Isolation, (flanged to equipment)	≤100mm	Hattersley	35E/35ELS
Compressed Air	Isolating	≤15mm	Saunders	Type A

SECTION TWO

PIPEWORK SERVICES

CONTENTS

STANDARD TECHNICAL SPECIFICATION

FOR MECHANICAL AND ELECTRICAL SERVICES INSTALLATION

SECTION THREE

THERMAL INSULATION AND PAINTING SERVICES

SECTION THREE

MECHANICAL SERVICES INSTALLATION

THERMAL INSULATION AND PAINTING SERVICES

CONTENTS

SECTION THREE

MECHANICAL SERVICES INSTALLATION

THERMAL INSULATION AND PAINTING SERVICES

3.1 SPECIALIST THERMAL INSULATION SUB-CONTRACTOR

a. The mechanical contractor shall include for all thermal insulation work to be carried out by an approved specialist thermal insulation sub-contractor who is a member of:-

The Thermal Insulation Contractors Association
Charter House
450 High Road
Ilford
Essex IG1 1UF

b. All the following clauses are intended to establish the standards for thermal insulation in various applications in terms of thermal performance, visual appearance and mechanical strength of surface covering. Not withstanding these clauses, the thermal insulation system shall comply fully with the requirements of all relevant local authorities.

3.2 FIBRE SIZE

a. Exclude all insulation products made of fibres, whether man made or naturally occurring, where the mean diameter of the fibres is less than 3 microns.

3.3 COSHH REGULATIONS

a. Provide evidence of compliance with the CONTROL OF SUBSTANCES HAZARDOUS TO HEALTH Regulations 1988 on demand including evidence of assessment and competence of assessor (s).

3.4 BRITISH STANDARDS AND REGULATIONS

a. All insulation materials and works shall satisfy and comply with the requirements of the following Regulations and British Standards.

3.4.1 Regulations

a. The Building Regulations 1991,
Approved Document L, 1995 - Conservation of fuel and power
Approved document B, 2000 - Fire Safety

b. Health and Safety Executive Guidance Notes:-

1. EH 40, Occupational Exposure Limits (1989)
2. EH 46, Exposure to mineral wools (1986)

c. COSHH Regulations.

3.4.2 British Standards - Terminology

a. BS3533 - Glossary of Thermal Insulation Terms.

3.4.3 British Standards – Materials Specifications

a. BS 3958 Specification for thermal insulating materials.

Part 3 Metal mesh faced man-made fibre mattresses.

Part 4 Bonded preformed man-made mineral fibre pipe sections.

Part 5 Bonded man-made mineral fibre slabs

b. BS 3927 Specification for rigid phenolic foam (PF) for thermal insulation in the form of slabs and profiled sections.

3.4.4 British Standards – Performance Standards

a. BS 5422 (rev.2001) Method for specifying thermal insulating materials on pipes, tanks, vessels, ductwork and equipment (in the temperature range - 40 degrees C to +700 degrees C)

3.4.5 British Standards – Material Testing

a BS 874 Methods for determining thermal insulating properties with definitions of thermal insulating terms.

b. BS 2972 Methods of test for inorganic thermal insulating materials.

c. BS 476 Fire tests on building materials and structures.

- Part 4 Non-combustibility test for material.
- Part 6 Method of test for fire propagation for products.
- Part 7 Method of classification of the surface spread of flame of products.
- Part 8 Test methods and criteria for the fire resistance of elements of building construction.
- Part 11 Methods of assessing the heat emission from building materials.
- Part 24 Method of determination of the fire resistance of ventilation ducts.

d. BS 5111 Laboratory methods of test for determination of smoke generation characteristics of cellular plastics and cellular rubber materials.

3.4.6 British Standards – Application Methods

a. BS 5970 (rev 2001) Code of practice for thermal insulation of pipework and equipment (in the temperature range - 100 degrees C to +870 degrees C).

3.4.7 Definition of Class 'O'

a. Class 'O' rating is a term defined in the Building Regulations, approved document B, appendix A, which makes use of British Standard performance ratings to limit the surface spread of flame of a material or product (BS 476 : Part 7) and the rate at which heat is released from it (BS 476 Part 6).

b. Class 'O' rating is not a classification identified in a British Standard test and is considered to be a higher class than Class '1'.

c. A Class 'O' rating insulation material or the surface of a composite insulation product is either:-

1. Composed throughout of material which when tested in accordance with BS 476 : Part 4 is rated non-combustible.

2. Composed throughout of materials when tested in accordance with BS 476 : Part 11 gives a temperature rise on the specimen of less than 35 degrees C, temperature rise of the furnace less than 25 degrees C and flaming time of less than 10 seconds.

3. A Class '1' material in accordance with BS 476 : Part 7 which has a fire propagation index (I) of not more than 12, and sub-index (i) of not more than 6 when tested in accordance with BS 476 : Part 6.

4. Limited combustibility refers to insulation materials of not less than 300kg/m^3 which satisfy (c) (1) or (c) (2) in the Class 'O' definition.

3.5 APPROVED INSULATION MATERIAL FOR PIPES AND DUCTWORK

a. The thermal insulation material shall be as detailed in the following table unless specifically over-ridden by particular clauses relating to an individual application or area in the building.

b. Thermal insulation materials used shall be selected from Appendix-A list of approved thermal insulating materials. Alternative products shall not be used without written permission from the Engineer. The contractor shall provide the Engineer with full documentation and test certificates confirming that the proposed alternative materials are equal in every respect to those specified in Appendix-A.

3.6 GENERAL REQUIREMENTS

a. Thermal insulation shall be applied to all the following services and equipment.

1. All LTHW pipework.

2. All chilled water pipework

3. All condenser cooling water pipework.

4. All cold water pipework, except pipework exposed to view in toilet areas.

5. All domestic hot water service pipework except pipework exposed to view in toilet areas.

6. All external pipework.

7. Fire services and other services pipework where liable to freeze. (e.g. located outdoors or in unheated indoor areas or outside the envelope of the building insulation)

8. Condensate drains from fan coil units, air handling units, cooling units or any other item or equipment fed with chilled water.

9. Chilled water pumps.

10. LTHW heating calorifiers, domestic hot water service storage calorifiers and cylinders.

11. Chilled water buffer vessels.

12. Cold water storage tanks where indicated.

13. Rainwater pipes within the building (condensation protection).

14. Fresh air intake ductwork.

15. Air conditioned and tempered air supply ductwork.

16. Discharge ductwork from VAV/constant volume terminal boxes and fan coil units (includes discharge plenum, flexible ducts and diffuser plenum).

17. Re-circulation and return air ductwork in plantrooms.

18. All external ductwork:-

    a. exposed to weather
    b. protected from weather.

19. Extract and return air ductwork, where indicated on the drawings, as requiring fire protection or acoustic cladding.

b. All thermal insulation materials, finishes, emulsions and adhesive etc, shall conform to the requirements of the:-

    1. Local Authority

    2. National Building Regulations

    3. Local Fire Brigade, Fire Prevention Department.

c. All insulation shall be carried out in a neat and effective manner and the engineer reserves the right not to accept any work of inferior quality or that is badly finished.

d. All joints, surface finishes, edges and overlaps will not be allowed if they are of an irregular or dangerous nature.

e. The mechanical contractor shall ensure that the setting out of pipework and ductwork services makes due allowance for the installation of thermal insulation materials and finishes.

f. No thermal insulation shall remain bonded to walls, floors, ceilings etc, or any other part of the building structure.

g. Each pipe and duct shall be thermally insulated separately. A minimum of 25mm clearance shall be allowed between external surfaces of insulation and other adjacent surfaces.

h. All areas in which thermal insulation work is being carried out shall be maintained and left as clean as possible with all surplus material being cleaned away upon completion.

i. The thickness of thermal insulation material applied to pipework, ductwork, equipment etc, shall not be less than those specified in the following clauses. Actual thickness of the insulating material shall not vary by more than ±10% of the declared thickness.

j. The engineer reserves the right to cut away any section of the thermal insulation to ensure that it is in accordance with the specification. Any material found not to comply with this specification will be replaced at no additional cost to the contract.

All surfaces to be insulated shall be cleaned of all foreign matter, grease and rust and painted as required before application of the thermal insulation.
All traces of surplus soldering flux and building materials dust or debris shall be removed from the surface of copper pipework.

l. No thermal insulation shall be commenced on any section of a system or item of equipment until that section or item has been pressure tested and proved satisfactory by the engineer and test certificate issued.

m. All thermal insulation shall be carried out with no form of “heat bridge” being present which would affect the finish of the insulation. All insulation damaged or subject to failure due to “heat bridge” shall be replaced at no cost to the employer.

n. All thermal insulation materials shall be non-corrosive to ferrous and non-ferrous metals, resistant to vermin, moulds and fungi, free from objectionable odour at the operating temperature and shall not suffer permanent deterioration as the results of contact with moisture.

Within the building, whether concealed or exposed, all insulating materials and finishes and all combination of such materials and finishes offered shall be Class-O in accordance with the Building Regulations and achieve a smoke generation rating less than 5% in accordance with BS 5111.

p. Where a material or combination of materials does not comply, the mechanical contractor shall provide proof of the Local Authority’s acceptance of such a material.

q. Thermal insulation external to the building may, subject to the Local Authority’s approval, be Class 1 flame spread in accordance with BS 476, Part 7.

r. The thermal insulation shall be applied to the pipework, ductwork or vessel, etc. so as to be in close contact with the surface to which it is applied.

s. At all unions, flanges, strainers and valves etc; the pipe insulation shall stop adjacent to but clear of the fitting, the fitting/strainer/valve/flange being insulated with oversized or purpose made insulation, as detailed later.

t. Where an item is to remain uninsulated the adjacent insulation shall terminate with a segmented aluminium band arranged to fit both pipe and insulation diameters and ensure that no insulation material is exposed to minimise fibre migration.

u. Where pipes pass through wall or floor sleeves the finished insulation shall be carried through the pipe sleeve. The annular space between the insulation finish and the sleeve shall be packed with non-flammable and fire retardant material to form a fire stop.

v. Insulation on systems where the surface temperature may be below the dew point of the surrounding air, ie, chilled water, all cold water services and air conditioning ductwork, the insulation is to be covered with an impervious vapour barrier. All terminations and protrusions through the insulation shall be sealed to maintain the integrity of the vapour barrier.

w. All external liquid applied finishes shall be applied at atmosphere temperatures of 7.5 degrees C and above and not during inclement weather conditions during which drying times will be prolonged and the finish impaired.

3.7 ALUMINIUM CLADDING

a. Where aluminium cladding is specified, all aluminium metal work shall be pre-formed, neatly and correctly installed and manufactured to ensure a smooth clean uniform installation, free from sharp and dangerous edges.

b. Where specified all aluminium cladding shall be stucco embossed sheeting, the thickness being stated in the various applications, with matching aluminium stucco embossed straps with suitable securing clips.

c. Where aluminium cladding is to be applied over insulation which has been vapour sealed the fixing of the aluminium cladding shall be carried out by one of the two alternative methods as follows:-

1. To ensure that pop rivets and screws etc, do not perforate the vapour barrier mastic strip of class 'O' Armaflex tape shall be applied between the aluminium cladding and the vapour barrier at points where such fixings occur to absorb the rivet/screw penetration.

2. On all straight sections rivets and/or screws shall be omitted and the aluminium cladding shall be secured by aluminium straps with suitable securing clips at centres not exceeding 450mm with a minimum of two straps per cladding length. Bends, tees take-offs and other fittings which require to be fixed with rivets and/or screws shall have mastic strip or class 'O' Armaflex tape applied between the aluminium cladding and the vapour barrier at points where such fixing s occur to absorb the rivet/screw penetration of the vapour barrier.

3.8 PIPEWORK AND DUCTWORK INSERTS AT SUPPORTS

a. All pipework and ductwork brackets/supports shall be installed around the outside of the thermal insulation and vapour seal.

b. The insulation at all support points shall be pre-formed load bearing inserts manufactured from high density phenolic foam or hardwood from sustainable sources and to the same thickness as the adjacent insulation on each side of the bracket/support.

c. Each insert shall incorporate a bright aluminium foil outer covering to provide a vapour barrier to match that of the adjacent insulation.

d. The length/width of each insert shall protrude not less than 40mm on either side of the bracket/support.

e. The insulation either side of the bracket/support shall butt up tightly to the insert and the vapour barrier made continuous by taping the joints between the foil faces on the insulation and inserts with a minimum 50mm wide Idenden T303 class 'O' foil tape.

f. For HTHW, steam and condensate pipework where roller and chairs form the supports a 2mm thick galvanised sheet steel protective sleeve shall be provided around the hardwood insert between the roller and guide bracket.

g. All inserts and where required, protective sleeves shall be provided and installed with the pipe bracket by the mechanical contractor.

h. All inserts shall be provided and installed with the duct support by the Ductwork Specialist Sub-Contractor.

i. As it is essential to maintain the vapour seal all duct supports shall conform to method 2 of DW/142.

j. Phenolic foam inserts shall not be used on services operating above 100ºC.

3.9 PROTECTION OF THERMAL INSULATION

a. Any insulated pipework and ductwork that is likely to be accidentally damaged during maintenance, or in gaining access to any area or void, or at low level in plantrooms, ducts etc shall be additionally protected to prevent this damage.

b. This protection shall be constructed using an angle framework and a non-corrosive casing of sufficient thickness, height and width to withstand the damage.

c. Any damage within the contract period which may occur as a result of non-compliance with the above requirements shall be made good and protection provided by the mechanical contractor at no additional cost to the employer.

3.10 THERMAL CONDUCTIVITY

a. The thermal insulation material shall comply with the following values of thermal conductivity at the mean temperatures indicated.

Insulating Material	Mean temperature of insulation (^{0}C)				
	0	+10	+50	+75	+100
	Thermal conductivity (W/m·K)				
Phenolic foam (PF)	0.018	0.018	0.023	0.025	X
Mineral wool (MW)	0.032	0.034	0.037	0.040	0.044
Nitrile rubber (NR)	0.035	0.037	0.040	X	X

3.11 VAPOUR BARRIER

a. A vapour barrier on the outside (warm side) of the insulation shall take the form of a coating or sheet material, adequately sealed, that is resistant to the passage of water vapour. It shall be applied at the same time or immediately after fitting the insulation and before the fluid in the pipe or vessel is cooled.

b. The vapour barrier shall not reduce the fire performance of the complete assembly of insulating and finishing materials below the limits specified.

c. The vapour barrier shall comply with BS 5422 (table 1) and BS 5970 (table 8) and Building Regulations class 'O' definition.

3.12 THERMAL INSULATION THICKNESS

a. The thermal insulation shall be determined in accordance with the value of thermal conductivity stated in clause 3.10.

b. LTHW heating and condenser cooling water systems (Temperature up to a maximum of 85ºC)

Thickness based on BS 5422:REV2001 – Table 11 (+75^{0}C)		
Nominal Pipe Size (mm)	Mineral Wool Thickness (mm)	Phenolic Foam Thickness (mm)
15	30	15
20	40	15
25	40	20
32	40	20
40	40	20
50	40	20
65	40	25
80	50	25
100	50	25
125	50	25
150	50	25
200	50	30
250	50	30
300 and above	50	30
Vessels and Flat Surfaces	50	35

c. MTHW heating systems (Temperature above 85ºC up to a maximum 120ºC)

Thickness based on BS 5422:REV2001 – Table 11 (+100^{0}C)	
Nominal Pipe Size (mm)	Mineral Wool Thickness (mm)
15	40
20	40
25	40
32	50
40	50
50	50
65	50
80	60
100	60
125	60
150	60
200	60
250	60
300 and above	60
Vessels and Flat Surfaces	65

d. HTHW heating systems (Temperature above 120ºC)

Thickness based on BS 5422:REV2001 – Table 11 (+150^{0}C)	
Nominal Pipe Size (mm)	Mineral Wool Thickness (mm)
15	50
20	60
25	60
32	65
40	65
50	65
65	75
80	75
100	75
125	75
150	75
200	80
250	80
300 and above	80
Vessels and Flat Surfaces	90

e. Hot water services (Temperature up to 60ºC)

Thickness based on BS 5422:REV2001 – Table 12 (+60^{0}C)		
Nominal Pipe Size (mm)	Mineral Wool Thickness (mm)	Phenolic Foam Thickness (mm)
15	25	15
20	30	15
25	30	20
32	30	20
40	35	20
50	35	20
65	35	25
80	40	25
100	40	25
125	50	30
150	50	30
200	50	30
250	50	30
300 and above	50	30
Vessels and Flat Surfaces	50	35

f. Cold water services - protection from freezing, including cold water feeds and vents. Based on;

Initial temperature of water, +2ºC
Evaluation period, 12 hours
Permitted ice formation, 50%

Thickness based on BS 5422:REV2001 – Table 15				
Nominal Pipe Size (mm)	Indoors (-6^{0}C)*		Outdoors (-10^{0}C)*	
	Mineral Wool (mm)	Phenolic Foam (mm)	Mineral Wool (mm)	Phenolic Foam (mm)
15	50	20	175	45
20	25	15	60	20
25	20	15	30	15
32	20	15	20	15
40	20	15	20	15
50	20	15	20	15
65	20	15	20	15
80	20	15	20	15
100	20	15	20	15
125	20	15	20	15
150	20	15	20	15
200	20	15	20	15
250	20	15	20	15
300 and above	20	15	20	15
Vessels and Flat Surfaces	20	15	20	15

* Indoors installations roof spaces, ventilated ground floor voids, unheated basements and garage spaces and outside the envelope of the building insulation of heated buildings.

\# Outdoor installations include pipework inside external services vertical and horizontal shafts and ducts.

g. Cold water services, chilled water services and rainwater pipes to prevent condensation. Based on;

Ambient still air temperature, 25ºC
Ambient air relative humidity, 80%
Low emissivity bright aluminium foil finish.

Thickness based on BS 5422:REV2001 – Table 8						
Nominal Pipe Size (mm)	10^0C*		5^0C*		0^0C*	
	Mineral Wool (mm)	Phenolic Foam (mm)	Mineral Wool (mm)	Phenolic Foam (mm)	Mineral Wool (mm)	Phenolic Foam (mm)
15	20	15	25	15	30	20
20	25	15	30	15	40	20
25	25	15	30	20	40	25
32	25	15	30	20	50	25
40	30	15	30	20	50	25
50	30	15	40	20	50	30
65	30	20	40	25	50	30
80	30	20	40	25	50	30
100	30	20	40	25	50	30
125	40	20	40	25	50	30
150	40	20	50	30	60	35
200	40	20	50	30	60	40
250	40	25	50	30	65	40
300 and above	40	25	60	35	65	40
Vessels and Flat Surfaces	50	30	65	40	80	50

* Temperature of pipe contents; 10ºC - Cold water services
5ºC - Chilled water services
0ºC - Rainwater pipes

h. Cold water storage tanks, including feed and expansion tanks Insulate in accordance with Table g. - Vessels and Flat Surfaces

i. Ductwork carrying warm air

Thickness based on BS 5422:REV2001 – Table 10a		
Temperature difference between air in duct and ambient still air	Mineral Wool Thickness (mm)	Phenolic Foam Thickness (mm)
10 K	40	20
25 K	50	25
50 K	65	35

j. Ductwork carrying chilled air (condensation control) Based on;

Ambient still air temperature, 25ºC
Ambient air relative humidity, 80%
Low emissivity bright aluminium foil finish.

Thickness based on BS 5422:REV2001 – Table 10		
Minimum temperature of air inside the duct	Mineral Wool Thickness (mm)	Phenolic Foam Thickness (mm)
15ºC	30	20
10ºC	50	25
5ºC	75	40
0ºC	100	50

3.13 PIPEWORK INSULATION - CONCEALED FROM VIEW IN CEILING VOIDS, SERVICES RISERS, SHAFTS, DUCTS, ETC

a. All pipework to be insulated with pre-formed pipe sections with a factory applied Class 'O' bright reinforced aluminium foil laminate facing. The sections are to be hinged for snap-on assembly.

b. Longitudinal and butt joints shall be securely taped with a minimum 50mm wide Idenden T303 Class 'O', plain soft aluminium foil tape. The whole to be further retained in position by light gauge aluminium bands at not less than 450mm centres. i.e. two bands per metre section equally spaced between the circumferential butt joints.

c. On chilled water and cold water services particular attention shall be paid to the foil taping to ensure maintenance of the vapour barrier particularly at termination points where any exposed insulation edges shall be over taped and returned to the piping surface.

d. Where insulation on the chilled water and cold water services abuts pipe support inserts, the insulation shall be foil taped to all inserts to maintain the integrity and continuity of the vapour barrier.

e. All valves, strainers, flanges, unions etc, are to insulated by one of the following methods:-

1. Mineral Wool lamella mat having a density of not less than 40-50kg/m^3 with a factory applied class 'O' bright reinforced aluminium foil laminate facing and secured to the adjoining insulation by means of 75/100mm wide Idenden T303 class 'O' plain soft aluminium foil tape to maintain the integrity and continuity of the vapour barrier.

2. Oversize pre-formed phenolic foam pipe sections with a factory applied class 'O' bright reinforced aluminium foil laminate facing and secured to the adjoining insulation by means of 75/100mm wide Ideneden T303 class 'O' plain soft aluminium foil tape to maintain the integrity and continuity of the vapour barrier.

3.14 PIPEWORK INSULATION - EXPOSED TO VIEW IN BOILER ROOMS, PLANTROOMS, TANK ROOMS AND ELSEWHERE ON SHOW

a. All pipework to be insulated with pre-formed sections as detailed in clause number 3.13 (a), (b), (c) and (d) and protected with a final finish of 22 gauge stucco embossed aluminium cladding as detailed in clause number 3.7.

b. All valves, strainers, flanges, unions etc, are to be insulated with purpose made removable 20 gauge stucco embossed aluminium boxes fully lines with insulation of the same type and thickness as adjoining pipework.

c. For cold water services and chilled water services, all valves, strainers, flanges etc., shall, in addition, first be insulated with 50mm thick oversized pre-formed sections or flexible mat insulation having a density of 35kg/m^3 with a factory applied class 'O' bright reinforced aluminium foil laminate facing and secured to the adjoining insulation by means of 75/100mm wide Idenden T303 class 'O' plain soft aluminium foil tape to maintain the integrity and continuity of the vapour barrier.

d. Pump casings and any other similar items of equipment on cold water or chilled water systems shall be insulated in a similar manner to valves on such systems in accordance with clause number 3.14 (c). This will include purpose made removable 20 gauge stucco embossed aluminium boxes fully lined with insulation of the same type and thickness as adjoining pipework.

e. The fully lined removable stucco embossed aluminium boxes for valves, strainers, flanges, unions, pump casings etc, shall be works folded edges where practicable, site cut edges being provided with continuous grommet surrounds. The boxes shall be secured with quick release toggle fasteners to facilitate easy removal without disturbing the adjacent insulation and particular notice of this requirement shall be taken by the mechanical contractor when setting out pipe routes.

3.15 PIPEWORK INSULATION - EXTERNAL TO THE BUILDING

a. All pipework to be insulated with pre-formed pipe sections as detailed in clause number 3.13 (a), (b), (c) and (d) and protected by a weather proof finish coating.

b. The finish coating shall comprise a layer of No. 10 open weave glass cloth impregnated with white or grey, colour to approved, Idenden ET-150/Decadex PVA polymeric weatherproof emulsion. A minimum of two coats of the emulsion is to be applied to achieve a weatherproof standard as recommended by the manufacturer.

c. All valves, strainers, flanges, unions etc, are to be insulated as detailed in clause number 3.13 (e) with weatherproof finish coating as detailed in clause number 3.15 (b).

d. On all external pipework etc, the vapour barrier must be maintained and the insulation and finish shown to be weatherproof.

3.16 PIPEWORK INSULATION - FINAL CONNECTIONS TO FAN COIL UNITS ETC

a. The final connection of LTHW and chilled water pipework to all fan coil units shall be carried out using 25mm thick CFC free class ‘O’ Armaflex cable grey closed cell elastomeric insulation.

b. The class ‘O’ Armaflex insulation shall be either pre-slit or tubular, the insulation being either snapped on or slid as appropriate, with all joints and seams being vapour sealed with Armaflex Non-Flam adhesive.

c. The specified thickness of class ‘O’ Armaflex insulation shall be maintained at all T-joints bends, valves, unions and other fittings.

d. At pipe supports to avoid thermal bridges, class ‘O’ Armaflex pre-insulated pipe support inserts with outer metal jacket with a thermal resistance at least equal to the insulation installed on adjacent pipework to the support shall be used.

e. The class ‘O’ Armaflex insulation shall commence at the fan coil unit LTHW and chilled water isolating valves and include the isolating valves, strainers, control valves, unions, flexible connections etc.

3.17 DUCTWORK INSULATION - CONCEALED FROM VIEW IN CEILING VOIDS, SERVICES RISERS, SHAFTS, DUCTS ETC

a. Rectangular, flat, oval and circular ductwork is to be insulated with mineral wool flexible mat or phenolic foam duct insulation having a density of not less than 40kg/m^3 with a factory applied class 'O' bright reinforced aluminium foil laminate facing, installed in accordance with the manufacturers recommendations.

b. The insulation shall be fully adhered to the ducting. Longitudinal and butt joints shall be securely taped with a minimum 100mm wide Idenden T303, class 'O' plain soft aluminium foil tape. The whole to be further retained and supported in position by means of either;
   - 19-22 gauge x 50mm mesh galvanised wire netting.
   - Idenden Insulation Hangers with self-locking retaining washers.
   - Aluminium banding.

   Care to be taken when applying the wire mesh support or banding to avoid puncturing the aluminium foil vapour barrier.

   The retaining washers of the Idenden hangers to be covered by strips of 100mm wide Idenden T303, class 'O' plain soft aluminium foil tape.

c. On ductwork carrying chilled air, i.e., the air temperature inside the duct is less than the ambient air surrounding the duct. Particular attention shall be paid to the application of the foil taping to ensure maintenance of the vapour barrier particularly at termination points where any exposed edges shall be over taped and returned to the ducting surface.

d. Where insulation on ductwork carrying chilled air abuts duct support inserts, the insulation shall be foil taped to all inserts to maintain the integrity and continuity of the vapour barrier.

e. Attenuators shall be insulated exactly as the ductwork connecting on either side of the attenuator.

f. All access doors and panels on ductwork where not specified as pre-insulated are to be insulated as the adjacent ductwork and the specialist thermal insulation sub-contractor shall submit details of the proposed method for approval by the engineer.

3.18 DUCTWORK INSULATION - EXPOSED TO VIEW IN BOILER ROOMS, PLANTROOMS, TANK ROOMS AND ELSEWHERE ON SHOW

a. Rectangular ductwork is to be insulated with mineral wool slabs having a nominal density of 60kg/m^3 or phenolic foam slabs having a nominal density of 40kg/m^3 with a factory applied class 'O' bright reinforced aluminium foil laminate facing.

b. The slabs are to be securely fixed by means of a suitable non-flammable adhesive and Idenden self adhesive stick pin insulation hangers applied in accordance with the manufacturers recommendations. The "dab" method of applying adhesive will not be permitted.

c. Flat oval and circular ductwork is to be insulated with mineral wool lamella mat having a nominal density of 40-50kg/m^3 with a factory applied class 'O' bright reinforced aluminium foil laminate facing.

d. Longitudinal and butt joints and where stick pin insulation hangers protrude through the insulation and foil facing shall be securely taped with a minimum 100mm wide Idenden T 303, class 'O' plain soft aluminium foil tape.

e. On ductwork carrying chilled air i.e., the air temperature inside the duct is less than the ambient surrounding the duct. Particular attention shall be paid to the application of the foil taping to ensure maintenance of the vapour barrier particularly at termination points where any exposed edges shall be over taped and returned to the ducting surface.

f. Where insulation on ductwork carrying chilled air abuts duct support inserts, the insulation shall be foil taped to all inserts to maintain the integrity and continuity of the vapour barrier.

g. The rectangular, flat oval and circular ductwork insulation shall be protected and enclosed with a final finish of 20 gauge stucco embossed aluminium cladding. For rectangular ductwork the cladding shall be supported on a suitable aluminium framework of corner angles and channels taped to the foil finish of the insulation and the cladding secured to the framework by means of self seal pop rivets. For flat oval and circular ductwork the cladding shall be secured by matching stucco embossed straps and /or self seal pop rivets to minimise puncturing of the vapour barrier.

h. Attenuators shall be insulated exactly as the ductwork connecting to each side of the attenuator, including the 20 gauge stress embossed cladding.

i. All access doors and panels on ductwork where not specified as pre-insulated are to be installed as the adjacent ductwork and the specialist thermal insulation sub-contractor shall submit details of the proposed insulation method for approval by the engineer.

3.19 DUCTWORK INSULATION - EXTERNAL TO THE BUILDING

a. Rectangular ductwork is to be insulated with mineral wool slabs having a nominal density of 60kg/m^3 or phenolic foam slabs having a nominal density of 40kg/m^3, with a factory applied class 'O' bright reinforced aluminium foil laminate facing.

b. The slabs are to be securely fixed by means of a suitable non-flammable adhesive and Idenden self adhesive stick pin insulation hangers applied in accordance with the manufacturers recommendations. The "dab" method of applying adhesive will not be permitted.

c. Flat oval and circular ductwork is to be insulated with mineral wool lamella mat having a nominal density of 40-50kg/m^3 with a factory applied class 'O' bright reinforced aluminium foil laminate facing.

d. Longitudinal and butt joints and where stick pin insulation hangers protrude through the insulation and foil facing shall be securely taped with a minimum 100mm wide Idenden T303 class 'O' plain soft aluminium foil tape.

e. On ductwork carrying chilled air, i.e., the air temperature inside the duct is less than the ambient surrounding the duct. Particular attention shall be paid to the application of the foil taping to ensure maintenance of the vapour barrier particularly at termination points where any exposed edges shall be over taped and returned to the ducting surface.

f. Where insulation on ductwork carrying chilled air abuts duct support inserts, the insulation shall be foil taped to all inserts to maintain the integrity and continuity of the vapour barrier.

g. For rectangular ductwork the corners of the insulation shall be supported and protected by means of light gauge aluminium angles, the whole being wrapped in a layer of No. 10 open weave glass cloth impregnated with white or grey, colour to be approved, Idenden ET 150/Decadex PVA polymeric weatherproof emulsion. A minimum of two coats of the emulsion is to be applied to achieve a weatherproof standard as recommended by the manufacturer.

h. For flat and circular ductwork the insulation shall be protected by being wrapped in a layer of No. 10 open weave glass cloth impregnated with white or grey, colour to be approved, Idenden ET 150/Decadex PVA polymeric weatherproof emulsion. A minimum of two coats is to be applied to achieve a weatherproof standard as recommended by the manufacturers.

i. Attenuators shall be insulated exactly as the ductwork connecting to each side of the attenuator including weatherproof finish.

j. All access doors and panels on ductwork where not specified as pre-insulated are to be insulated as the adjacent ductwork and the specialist thermal insulation sub-contractor shall submit details of the proposed insulation method for approval by the engineer.

3.20 INSULATION AROUND DUCTWORK SPECIALISED FITTINGS

a. Where test holes, damper arms, thermostats etc are installed in the ductwork, the insulation is to be terminated with aluminium angle mechanical protection to enable the insulation to be dressed around and clear of the fitting.

b. Mechanical edging shall be provided at junctions to walls, floors, ceilings, etc to provide a means for dressing and terminating the insulation.

3.21 DUCTWORK FLEXIBLE CONNECTIONS AND FLEXIBLE DUCTWORK

a. Ductwork flexible connections to air handling units, fans, building expansion joints etc, and flexible ductwork, where continuation of the vapour seal is to be maintained shall be insulated with mineral wool flexible mat duct insulation having a density of not less than 45kg/m^3 with factory applied class ‘O’ bright reinforced aluminium foil laminate facing.

b. Longitudinal and butt joints shall be securely taped with a minimum 100mm wide Idenden T303, class ‘O’ plain soft aluminium foil tape. The whole to be further retained and supported in position by means of 19-22 gauge x 50mm mesh galvanised wire netting. Care to be taken when applying the wire mesh support to avoid puncturing the aluminium foil vapour barrier.

3.22 BOILERS

a. Boilers shall be provided with an insulated jacket as supplied by the boiler manufacturer or shall be provided with pre insulated boiler casings as standard and as depicted within the equipment schedules forming Appendix “B” of this specification

However where this is not possible boilers shall be insulated with asbestos free magesia plastic composition to a thickness of 38mm and a hard setting composition to a thickness of 13mm, the application being as follows:-

Before any plastic work is commenced the installation shall be heater to a temperature of not less than 55^0C, and so maintained until all of the insulation has been applied and dried out. Although a minimum temperature is specified, the installation shall be run as near to its maximum working temperature as practicable during this period.

Each coat shall be thoroughly dried out before the application of the following coat.

First a wash of china clay or other suitable material shall be applied and allowed to dry thoroughly.

The first coat of plastic material shall then be applied not exceeding 13mm thickness.

An additional layer of 25mm thick plastic material shall be applied and allowed to dry thoroughly.

A final covering of 13mm hard setting composition shall then be applied in three coats and reinforced with open mesh scrim cloth or hessian, trowelled to a smooth and even finish and bevelled clear of any flanges, valves, fittings, etc.

Any variation in thickness and concentricity shall be limited to 6mm at any point and any work which does not confirm to this, or is carried out in an untidy fashion, will not be acceptable.

3.23 BOILER FLUES

a. All flues from oil and solid fuel fired boilers, boilers fired by forced draught gas burners and flue ducting serving multi-boiler installations shall be insulated with a 50mm thick foil faced rigid section glass fibre Lamella slab, secured with tie wires formed of three turns of 1mm dia. Wire spaced at 450mm centres.

The insulation shall then be covered by 0.8mm thick stucco embossed aluminium sheeting, securely riveted. Where flanges and spigots occur the insulation shall be terminated at each side of the flange, with a neat return edge and the aluminium finish butting up to the flange. The flange to be then covered with a removable casing, as detailed under Boiler House and Plant Rooms.

The whole of the insulation shall be arranged to accommodate the movement of expansion and contraction.

Removable clean out doors shall be provided in all horizontal section of flues at no greater than 5mm centres. All clean out doors shall be of double skin construction, having 50mm integral insulation and be attached by adjustable quick release fasteners.

Door sealing be by means of securely attached non-combustible rope.

3.24 HEAT EXCHANGERS - HEATING CALORIFIERS, HOT WATER STORAGE CALORIFIERS AND CYLINDERS. (WHERE NOT SUPPLIED AS PRE-INSULATED ITEMS)

a. To be insulated with mineral wool lamella mat having a nominal density of 40-50kg/m^3 or phenolic foam slotted laminate having a nominal density of 40kg/m^3, with a factory applied class 'O' bright reinforced aluminium foil laminate facing.

b. Longitudinal and butt joints shall be securely taped with a minimum 100mm wide Idenden T303, class 'O' plain soft aluminium foil tape and retained in position with aluminium bands.

c. The insulation shall be protected and enclosed with a final finish of 20 gauge stucco embossed aluminium cladding secured by means of self seal pop rivets. Domed ends to be fitted with multi-coned segments with swaged joints and centre cover disc.

d. Insulation around manholes, access plates etc, shall be trimmed with suitable sized aluminium angles to permit removal of bolts and covers. Easily removable purpose made stucco embossed aluminium insulated covers shall be provided retained in position by means of quick release toggle fasteners.

3.25 CHILLED WATER BUFFER VESSELS

a. To be insulated with mineral wool lamella mat having a density of 40-50kg/m^3 or phenolic foam slotted laminate having a nominal density of 40kg/m^3, with a factory applied class 'O' bright mesh faced aluminium foil laminate facing.

b. Longitudinal and butt joints shall be securely taped with a minimum 100mm wide Idenden T303, class 'O' plain soft aluminium foil tape and retained in position with aluminium bands.

c. Particular attention shall be paid to the foil taping to ensure maintenance of the vapour barrier particularly at termination points where any exposed insulation edges shall be over taped and returned to the vessel surface.

d. The insulation shall be protected and enclosed with a final finish of 20 gauge stucco embossed aluminium cladding secured by means of self seal pop rivets. Domed ends to be fitted with multi-coned segments with swaged joints and centre cover disc.

e. Insulation around manholes, access plates etc, shall be trimmed with suitable sized aluminium angles to permit removal of bolts and screws. Easily removable purposed made stucco embossed aluminium insulated covers shall be provided, retained in position by means of quick release toggle fasteners.

3.26 FLAT SIDED WATER STORAGE TANKS - INTERNAL

a. All flat sided water storage tanks where located within the building, and not specified as pre-insulated, shall be insulated with mineral wool slabs having a nominal density of 60kg/m or phenolic foam slabs having a nominal density of 40kg/m^3, with a factory applied class 'O' bright reinforced aluminium foil laminate facing. The insulation shall be applied to all sides and top and where applicable to the bottom of the tank.

b. The slabs are to be securely fixed by means of a suitable non-flammable adhesive and self adhesive stick pin insulation hangers applied in accordance with the manufacturers recommendations. The "dab" method of applying adhesive will not be permitted.

c. All joints in the surface covering and where stick pin insulation hangers protrude through the insulation and foil facing shall be securely taped with a minimum 100mm wide Idenden T303, class 'O' plain soft aluminium foil tape, particular attention being paid to the application of the foil taping to ensure maintenance of the vapour barrier.

d. The whole of the mineral wool insulation is to be retained and supported in position by means of 19-22 gauge x 50mm mesh galvanised wire netting. Care to be taken when applying the wire mesh support to avoid puncturing the aluminium foil vapour barrier. (Not necessary for phenolic foam insulation)

e. Tanks located in boiler rooms, tank rooms and plant rooms shall omit the wire netting and shall be protected and enclosed with a final finish of 20 gauge stucco embossed aluminium cladding. The cladding shall be supported on a suitable aluminium framework of corner angles and channels taped to the finish of the insulation and the cladding secured to the framework by means of self seal pop rivets.

f. Insulation around manholes, access panels etc, shall be trimmed with suitable sized aluminium angles to permit removal of bolts and cover/hinged cover. Easily removable purpose made insulated covers shall be provided retained in position by means of quick release toggle fasteners.

3.27 FLAT SIDED WATER STORAGE TANKS - EXTERNAL

a. All flat sided tanks where located external to the building, and not specified as pre-insulated, shall be insulated as described for internal cold water storage tanks in clause numbers 3.24 (a), (b), (c) and (f).

b. Tanks located externally shall omit the wire netting or stucco embossed cladding specified for internal tanks and be finished with a layer of No. 10 open weave glass cloth impregnated with white or grey, colour to be approved, Idenden ET-150 Decadex PVA polymeric weatherproof emulsion. A minimum of two coats of the emulsion is to be applied to achieve a weatherproof standard as recommended by the manufacturers.

c. On all external tanks the vapour barrier must be maintained and the insulation and finish shown to be weatherproof.

3.28 EXTERNALLY FLANGED SECTIONAL WATER STORAGE TANKS - INTERNAL

a. To be insulated with an initial layer of 40mm thick plain mineral wool slabs having a nominal density of 60kg/m^3 or phenolic foam slabs having a nominal density of 40kg/m^3, securely fixed by a suitable non-flammable adhesive and self adhesive stock pin insulation hangers applied in accordance with the manufacturers recommendations.

b. Followed by second layer of 40mm thick mineral wool slabs having a nominal density of 60kg/m^3 or phenolic foam slabs having a nominal density of 40kg/m^3,with a factory applied class 'O' bright reinforced aluminium foil laminate facing, secured to the initial layer of slabs by a suitable non-flammable adhesive and previously applied stick pin insulation hangers.

c. The "dab" method of applying adhesive will not be permitted.

d. All joints in the surface covering and where stick pin insulation hangers protrude through the insulation and foil facing shall be securely taped with a minimum 100mm wide Idenden T303, class 'O' plain soft aluminium foil tape particular attention being paid to the application of the foil taping to ensure maintenance of the vapour barrier.

e. The tanks are to be finally finished with 20 gauge stucco embossed aluminium cladding as specified in clause number 3.26 (e) and (f).

3.29 EXTERNALLY FLANGED SECTIONAL WATER STORAGE TANKS - EXTERNAL

a. To be insulated with mineral wool slabs as specified in clause number 3.28 (a), (b), (c) and (d).

b. The final finish is to be weatherproof as specified in clause number 3.27 (b) and (c).

3.30 WATER CHILLERS

a. Water Chillers shall be insulated on all surfaces below ambient temperature by the water chiller manufacturer.

3.31 ACOUSTIC DUCT LAGGING

a. Acoustic duct lagging shall be as specified in part 'D' of this specification, systems and equipment.

3.32 FIRE PROTECTION CLADDING

3.32.1 General

a. Where indicated within the specification, or detailed on the drawings, ductwork shall be provided with a fire protection cladding material as described in the following clauses.

b. The fire protection material shall have an inherent structural strength and be capable of retaining shape and resistance to heat transfer throughout the period of exposure to fire.

c. Generally all ducts shall be protected on all four sides. Where an adjacent slab or wall in conveniently placed to form one side of the enclosure it may be utilised subject to its fire rating being as that of the required enclosure being adequately connected and sealed to that wall or slab.

d. The recommendations of the manufacturers shall be strictly adhered to in constructing the fire cladding enclosures.

e. The following constructions are given as guidance and represents the minimum required. All material thickness, adhesive and final installation shall in all ways comply with the requirements of the building regulations and building control officer.

3.32.2 "Vicuclad" Board Cladding

a. "Vicuclad" board cladding or equal shall have a density 430kg/m^3.

b. Where ducts are to be protected, the ducts shall initially be encased with mineral wool slabs having a minimum density of 64kg/m^3 with a factory applied class 'O' bright reinforced aluminium foil laminate facing.

c. The mineral wool slabs are to be securely fixed by means of a suitable non-flammable adhesive and self adhesive stick pin insulation hangers applied in accordance with the manufacturers recommendations. The "dab" method of applying adhesive will not be permitted.

d. Longitudinal and butt joints and where stick pin insulation hangers protrude through the insulation and foil facing shall be securely taped with a minimum 100mm wide Idenden T303, class 'O' plain soft aluminium type.

e. On ductwork carrying chilled air particular attention shall be paid to the application of the foil taping which shall be carried across the Vicuclad board bearers to ensure maintenance of the vapour barrier.

f. The minimum thickness of “Vicuclad” board cladding shall be as detailed in the particular specification and as indicated on the drawings.

g. The tender drawings shall indicate the thickness of Vicuclad and mineral wool to be applied.

h. Bearers manufactured from Vicuclad board of depth equal to that of the mineral wool thickness shall be located top and bottom of the ducts and fixed into place by means of tee or angle sections at the top and by channel or sections at the bottom. These shall be secured by means of threaded rods.

i. Between the spaces formed by the bearers and at the sides of the ducts, the mineral wool insulation shall be applied as detailed above in clause number 3.32.2 (b), (c), (d) and (e).

j. the whole of the above shall then be covered with Vicuclad.

k. Horizontal cross joints where the steel sections occur shall be further clad with Vicuclad cover strips.

l. The ductwork hangers shall also be clad or covered with Vicutube. Where hangers on ductwork are too insubstantial to cope with the additional weight of the cladding, supplementary hangers to support the cladding shall be installed.

m. Where fixings are from a concrete or composite concrete slab, an area of 150mm from the centre of the fixing shall protected by a minimum of 45mm thickness of Vicuclad bonded to the slab.

3.32.3 “Conlit” Rigid Insulation Fire Protection Board Cladding

a. “Conlit” 150 resin bonded mineral rock fibre rigid single layer insulation fire protection board shall have a density of approximately 165 kg/m^3, having a factory applied reinforced bright aluminium foil to one face and complying with Building Regulations class ‘O’ requirements

b. “Conlit” 150 board joints at ductwork corners to be 45 degrees mitred. Square butt joints to be used elsewhere.

c. All joints to be filled with “Conlit” glue and held tightly closed.

d. Mitre joints to be held tightly closed with nails (Length approximately twice the “Conlit” 150 board thickness) until the glue has fully cured. Two nails juxtaposed at 90 degrees to be located at three points per 1200mm length of mitre joint and four points per 1800mm length.

e. One of three methods of protection to duct joints and hanger positions shall be used, these are as follows:-

1. Detail ‘A’ - Rebate.

   Used where Conlit 150 board is 70mm or greater. A rebate is cut in the insulation to accommodate the duct joint or angle bearer. The rebate should be no larger than that necessary to cover the joint/bearer. The Conlit 150 thickness must give a 40mm minimum cover at the joint/hanger location.

2. Detail ‘B’ - ‘T’ Section

   Used where Conlit 150 board is 40mm or greater. A “T” section is cut from Conlit 150 board and used as cover strip at joints in the insulation.

3. Detail ‘C’ - Conlit 150 Block

   Used with Conlit 150 boards of any thickness and consists of a block of Conlit 150 board glued and pinned to the duct insulation.

f. All joints are to be securely taped with a minimum 100mm wide Idenden T303, class ‘O’ plain soft aluminium tape to ensure maintenance of the vapour barrier.

g. Drop rods and bearers shall be arranged at 1500mm maximum centres and to be a minimum M10 diameter steel rod and 30 x 30 x 3mm steel angle.

h. The drop rods and exposed bearers shall be insulated with “Conlit” 150 blocks or “Conlit tube as convenient, thickness as in following table.

i. Rebates or cover pieces shall be used at duct flange and bearer locations according to site conditions and subject to Rockwool Ltd’s recommendations and approval.

j. Where fixings are from a concrete or composite concrete slab an area of 150mm from the centre of the fixing shall be protected by a minimum of 50mm thickness of “Conlit” 150 bonded to the slab.

k. Where the duct system penetrates walls or floors support to the duct wall is required for stability. This support shall be provided by:-

1. Riveting a 30 x 30 x 2mm mild steel angle frame to the duct at the penetration mid-point using steel rivets at 300mm maximum centres.

2. Location of a duct joint at the penetration mid-point.

In both cases, low density Rockwool RW2 insulation is to be packed tightly into the void between the Conlit 150 and wall/floor opening. 120mm wide blocks of Conlit 150 are to be glued at both sides of the penetration. All Conlit to wall and Conlit to Conlit joints are to be glued using the recommended Conlit adhesive.

l. The minimum thickness of Conlit 150 single layer insulation fire protection board shall be as detailed within the particular specification and as indicated on the drawings.

1. Where duct sizes exceed those given in the above table, additional support is to be provided to the “Conlit” 150 boards. This support shall be provided by a central row(s) of 2.5mm diameter welded steel pins and 38mm spring steel washers at 500mm maximum centres along the duct. These pins shall be employed on all duct sides (except on top of horizontal ducts).

m. Where fire protection of circular ductwork is required two methods can be used both of which are to be applied strictly in accordance with the manufacturers installation recommendations as follows.

n. Circular ducts, up to a maximum of 1,000mm diameter, are to be protected using a boxed Conlit 150 board system. The protection is to be supported independently from the steel circular duct supports, using external hangers at 1500mm maximum centres. The hangers shall consist of M10 steel studding supporting a 30mm x 30mm x 3mm steel angle bearer and protected with Conlit 150. Where a duct system penetrates walls or floors the spaces between the outside of the circular duct and the inside of the circular duct and the inside of the boxed Conlit 150 protection must be filled with Conlit 150 over the thickness of the wall or floor.

o. Circular ducts are to be protected using Conlit pipe section Mat (PSM) which is bonded at all joints, in the grooves and to the steel duct with Conlit adhesive. Steel bands or wires are to be strapped around the Conlit PSM at 300mm maximum centres to hold the glued joints tightly closed whilst the adhesive sets. Cover strips and hanger protection pieces are to be located on the Conlit PSM circumference and are to be cut from Conlit PSM of the appropriate diameter. Nails are to be used to hold the cover strips in position until the adhesive sets. The hangers shall consist of M10 steel studding supporting 30mm x 30mm x 3mm steel angle bearer formed into a semi-circular shape to suit the diameter of the steel duct or the Conlit PSM depending on whether the hanger is inside or outside the protection. Where the duct system penetrates walls or floors, the penetration must be fire stopped allowing for extra protection if the opening in the wall or floor is rectangular.

3.33 PAINTING GENERAL

All items of painting covered by this section of the Specification shall be carried out by an approved specialist painting sub-contractor. Only skilled operatives in this field of work shall be employed. The Tenderer shall be deemed to have included for all works specified to be carried out by the aforementioned specialist.

The Tenderer shall ensure that the specialist painting sub-contractor is acquainted with all of the conditions of the works, specification, hours of working, completion date(s), etc at tender stage and he shall complete all works within the programme specified. The painting work shall not be commenced, unless otherwise approved in writing, until the whole of the installation has been completed and tested as set out in the relevant pipework, plant and air distribution sections of the Specification.

All painting shall be as detailed hereafter, unless specifically detailed otherwise under the relevant clause of the Technical Specification.

All painting materials shall be as manufactured by Mebon Paints Ltd, Blackwell Road, Huthwaite, Sutton-in-Ashfield, Nottinghamshire NH17 2RL, and shall be delivered in sealed containers clearly labelled with type of material and intended use.

The following surface treatments shall be applied to all areas detailed under this section of the Specification, unless stated elsewhere in the Specification.

3.34 TYPES OF SURFACE TREATMENT

a) Method 1

The surface shall be thoroughly wire brushed, de-greased and given one coat of MEBAQUA primer as the installation proceeds.

b) Method 2

The surface shall be hot dip galvanised in accordance with BS 729. After installation the surface shall be thoroughly de-greased by solvent washing followed by one coat of MEBOPRO 80 to suit the final coat of MEBON HIGH BUILD ALKYD GLOSS, to suit the Architect's colour scheme from the BS 4800 or RAL range of colours.

Any damage caused to the galvanising by burning or cutting shall have all weld splatter and swarf removed and patch primed with MEBOPRIME 80 prior to the paint system detailed above.

c) Method 3

Shot blast all surfaces to SA 2.5 at manufacturer's works, and within 4 hours (or before corrosion sets in, whichever is sooner) apply one coat of Zinc Phosphate primer 2-1-10 to 75 micron thickness and one coat of Micaceous Iron Oxide 2-4-01 to 60 micron thickness.

After installation apply one coat of Micaceous Iron Oxide 2-4-01 to 60 micron thickness, followed by one coat of Mebon High Build Alkyd Gloss to suit the Architect's colour scheme from the BS 4800 or RAL range of colours.

d) Method 4

The surface shall be shot blasted to SA 2.5 to give a minimal profile (maximum profile 50 microns), followed by one coat of MEBOSIL HT Silicone Aluminium paint in the manufacturer's works.

Any damage to the treatment caused in transit or installation shall be made good.

e) Method 5

The surface shall be wire brushed and de-greased, painted one coat of MEBAQUA primer as installation proceeds, followed by one coat of MEBOPRO 80 to suit the final coat of Mebon High Build Alkyd Gloss to suit the Architect's colour scheme from the BS 4800 range of colours.

f) Method 6

The surface shall be painted with one coat of Mebon C.R. High Build, Ref 2502, suitably thinned with type 2 thinners, followed by one coat of Mebon Spread Velvet Undercoat to suit the final coat of Mebon High Build Alkyd Gloss to suit the Architect's colour scheme from the BS 4800 or RAL range of colours.

3.35 PAINTING IN BOILER HOUSES AND PLANT ROOMS

a) All uninsulated pipework, ductwork, flanges, unions, valves, trench covers and handrails shall be treated as Method 5.

b) All steel pipework to be insulated shall be treated as Method 1.

c) All boiler flues, grit arresters, chimney flues and other surfaces designed to operate at temperatures in excess of 200°C shall be treated as Method 4.

d) All supports detailed in Clause 3.14 to be galvanised shall be treated as Method 2.

e) Supporting steelwork for hoppers, gantries, hotwells, silos, tanks and all other structural steelwork shall be treated as Method 3.

f) All black steel hotwells, hoppers, silos, tanks and other fabricated mild steel equipment not detailed elsewhere shall be treated as Method 3, unless stated otherwise elsewhere in the Specification.

g) All insulated ductwork shall be treated as Method 6.

h) All equipment and plant delivered to site in a pre-finished condition shall have all damage made good prior to handover.

3.36 PAINTING IN VOIDS, BOXINGS AND DUCTS

a) All uninsulated pipework shall be treated as Method 5.

b) All steel pipework to be insulated shall be treated as Method 1.

3.37 PAINTING EXTERNALLY

Painting externally shall be in accordance with that detailed for Boiler Houses and Plant Rooms with the following exceptions:-

a) Where supports, as detailed in Clause 3.14, are installed in concealed positions, ie underground trenches, etc, they shall be hot dip galvanised only.

b) Insulated ductwork shall be treated as detailed under 'Insulation'.

c) External pylons and brackets to be treated as Method 2.

APPENDIX I

LIST OF APPROVED INSULATING MATERIALS

AI Mineral Wool Pipe Insulation

Rigid bonded "Class O" mineral wool, pre-formed pipe sections having a nominal density of 100 kg/m³ and thermal conductivity of 0.034 W/m·K at 10ºC mean temperature. Supplied complete with a factory applied "Bright Class O" reinforced aluminium foil facing. Rockwool H&V Pipe Insulation as manufactured by Rockwool (UK) Ltd.

A2 Mineral Wool Rigid Slabs

Rigid bonded "Class O" Mineral Wool slabs having a nominal density of 45 kg/m³ and thermal conductivity of 0.034 W/m·K at 10ºC mean temperature. Supplied complete with a factory applied "Bright Class O" reinforced aluminium foil facing. Rockwool Ductslabs as manufactured by Rockwool (UK) Ltd.

A3 Mineral Wool Flexible Mat

Flexible bonded "Class O" Mineral Wool mat having a nominal density of 45 kg/m³ and thermal conductivity of 0.034 W/m·K at 10ºC mean temperature. Supplied complete with a factory applied "Bright Class O" reinforced aluminium foil facing. Rockwool Ductwrap as manufactured by Rockwool (UK) Ltd.

A4 Mineral Wool Lamella Mat

"Class O" Mineral Wool mat having a nominal density of 33 kg/m³ and thermal conductivity of 0.040 W/m·K at 10ºC mean temperature. Supplied complete with a factory applied "Bright Class O" reinforced aluminium foil facing. Rockwool Lamella Mat as manufactured by Rockwool (UK) Ltd.

A5 Phenolic Foam Pipe Insulation

Rigid cfc-free "Class O" phenolic foam, pre-formed bore-coated pipe sections having a nominal density of 35 kg/m³ and thermal conductivity of 0.018 W/m·K at 10ºC mean temperature. Supplied complete with a factory applied "Bright Class O" reinforced aluminium foil facing. Kooltherm Pipe Insulation as manufactured by Kingspan Industrial Insulation Ltd.

A6 Phenolic Foam Rigid Slabs

Rigid cfc-free "Class O" phenolic foam laminated slabs having a nominal density of 40 kg/m³ and thermal conductivity of 0.018 W/m·K at 10ºC mean temperature. Supplied complete with a factory applied "Bright Class O" reinforced aluminium foil facing. Kooltherm Ductslabs as manufactured by Kingspan Industrial Insulation Ltd.

A7 Load Bearing Phenolic Foam Inserts for Pipe and Duct Supports

Rigid cfc-free "Class O" high density phenolic foam purpose designed pre-formed pipe support inserts and duct support strips supplied with a factory applied "Bright Class O" reinforced aluminium foil facing. Kooltherm K-Blocks and Duct Support Strips as manufactured by Kingspan Industrial Insulation Ltd.

APPENDIX II

COLOUR CODE INDICATIONS FOR GENERAL BUILDING SERVICES BS 1710:1975

Pipe Contents	Basic Colour (Approx 150 mm)	Colour Code Indication	Basic Colour (Approx 150mm)
Water:			
Drinking	Green	Blue	Green
Cooling (Primary)	Green	White	Green
Boiler Feed	Green	Crimson/White/Crimson	Green
Condensate	Green	Crimson/Em.Green/Crimson	Green
Chilled	Green	White/Em.Green/White	Green
Central Heating <100°c	Green	Crimson/Blue/Crimson	Green
Central Heating >100°c	Green	Blue/Crimson/Blue	Green
Cold, Down Service	Green	White/Blue/White	Green
Hot Water Supply	Green	White/Crimson/White	Green
Hydraulic Power	Green	Salmon Pink	Green
Sea, River, Untreat	-------	Green	-------
Fire Extinguishing	Green	Safety Red	Green
Compressed Air	-------	Light Blue	------
Vacuum	Light Blue	White	Light Blue
Steam	-------	Silver Grey	-------
Drainage	-------	Black	-------

APPENDIX II

COLOUR CODE INDICATIONS FOR GENERAL BUILDING SERVICES BS 1710:1975

Pipe Contents	Basic Colour (Approx 150 mm)	Colour Code Indication	Basic Colour (Approx 150mm)
Electrical Conduits and Ducts	-------	Orange	-------
Town Gas			
Manufactured Gas	Yellow Ochre	Emerald Green	Yellow Ochre
Natural Gas	Yellow Ochre	Yellow	Yellow Ochre
Oils			
Diesel Fuel	Brown	White	Brown
Furnace Fuel	-------	Brown	-------
Lubricating	Brown	Emerald Green	Brown
Hydraulic Power	Brown	Salmon Pink	Brown
Transformer	Brown	Crimson	Brown
Acids and Alkalis	-------	Violet	------