

**Mechanical & Electrical Services
Specification and Form of Tender**

for the

Motorised Combined Smoke & Fire Dampers

at

Kedleston Unit

for

Derbyshire Healthcare 
NHS Foundation Trust

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Section ONE

Preliminaries

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1.1 Contract Preliminaries

The following preliminaries clauses are supplemental to and shall be read in conjunction with all preliminary clauses included within these bid documents and available from the Trust.

1.2 Definition of Terms

The following definitions to this Specification are deemed to apply unless there is something in the subject or context inconsistent with such construction.

The **Client and Employer** shall mean:

Derbyshire Healthcare NHS Foundation Trust
Kingsway House
Kingsway Hospital
Kingsway
Derby
Derbyshire DE22 3LZ

The **Project Manager** shall mean:

Derbyshire Healthcare NHS Foundation Trust
Estates Capital Team
Kingsway House
Kingsway Hospital
Kingsway
Derby
Derbyshire DE22 3LZ

The **Engineer** shall mean:

EP Consulting
Alpine House
16A Alpine Street
Old Basford
Nottingham NG6 0HS

The **Mechanical Contractor** shall mean the Contractor appointed to execute the works, which are subject to this Specification and should include the Contractors Personal Representative, Successors and Assignees.

The **Site** shall mean the actual place or places to which materials, equipment, goods and other items to be used in the execution of the Contract shall be delivered or where the work shall be done by the Contractor with so much of the areas surrounding a certain place or places as the Contractor shall, with the consent of the Client, actually use in connection with the work, otherwise than merely for the purpose of access to the set place or places.

1.3 Guarantee

The whole of the works are to be guaranteed and maintained for a period of 12 months after completion and any defects that may make themselves apparent in that period shall be made good at the Contractors expense, provided always that the fault has not arisen from causes outside the Contractors control.

The bid shall be based upon the specified equipment. Any bidder wishing to submit alternatives to comply generally with the Engineering Standards required by the Specification may do so on a Schedule of Variations and include it with the bid.

1.4 Inspections of Existing Conditions

Arrangements should be made to visit site by contacting the site:

Nik Rawlings, Capital Projects Manager
Derbyshire Healthcare NHS Foundation Trust
Tel: 01332 980109 / 07879 602237
Email: nik.rawlings@nhs.net

The Mechanical Contractor is strongly advised to visit site to ascertain the full extent of the existing services.

Any claims arising out of any matter whose grounds are a lack of familiarity with the existing conditions will not be considered.

1.5 Extent of Works

The bidder shall include for the provision and supervision of an adequate suitably qualified labour force equipped with all necessary plant, tools, equipment and access equipment required for the execution of the works.

The works shall be the Mechanical and Electrical Installation associated with the Damper Works as set down in this specification, Schedules and the accompanying drawings together with all additional associated work, both temporary and permanent which may be required to ensure the correct functioning and fixing of the installation.

The bid submitted shall also include the following:

- a) All costs in respect of delivery of materials required to carry out the work together with the specialist plant and equipment.
- b) All costs relating to Clients safety requirements, such as flame arrestors and total compliance with.
- c) All costs relating to submission of Health & Safety Policy together with production of Method Statements for approval by the Principal Designer.
- d) All costs relating to the necessary management, supervision and maintaining records in accordance with Construction (Design & Management) Regulations 2015.

1.6 Discrepancies

In the event of any discrepancies between the Drawings and the Specifications, the bidder shall include for all items shown or described. The bidder shall inform the Consulting Engineer in writing at the time of bid of any such discrepancies.

Claims for additional costs for items shown on the Drawings but not specified or vice versa will not be considered after the date of submission of the bids.

1.7 Health and Safety

The bidders attention is drawn to all provisions contained within the Health & Safety at Works Act 1974 and Electricity at Works Act 1989.

The bidder shall pay full regard to the requirements of this legislation as far as it applies to the work and include for all costs incurred in pursuance or compliance with the same.

1.8 Schedule of Rates

Within 14 days of receipt of notification, the successful bidder shall submit a detailed and Quantified Schedule of Rates to the Consulting Engineer.

The costs of additions and / or omissions to the Contract shall be calculated using the Schedule of Rates wherever possible.

1.9 Liaison

The Mechanical Contractor shall examine all available information pertaining to furniture and equipment layouts, together with prevailing site conditions in conjunction with other Contractors as appropriate before commencing any work.

Where repositioning of equipment is required as a result of this consultation, this shall be agreed with the Consulting Engineer before installation works commence.

Claims for extra costs for repositioning arising from lack of consultation with the other Contractors and the Consulting Engineer will not be considered.

1.10 Continuity of Labour

The Contractor shall endeavour to maintain the same personnel on the works for the complete Contract.

Changes to personnel shall only be made as a result of unforeseen circumstances.

The Consulting Engineer shall be advised in writing of any proposed changes and replacement personnel shall be fully conversant with the development, nature and standards required by the works.

1.11 List of Drawings

The Drawings listed below are those upon which the bid is deemed to be based. The drawings are a representative of the requirements for this works package.

The Drawings shall be read in conjunction with the Specification.

2071/M/01	Ground Floor CSFD Sheet 1 of 2
2071/M/02	Ground Floor CSFD Sheet 2 of 2
2071/M/03	Ceiling Void CSFD Sheet 1 of 2
2071/M/04	Ceiling Void CSFD Sheet 2 of 2
2071/M/05	CSFD Schematic

1.12 Dayworks

No daywork will be allowed unless specifically requested by the Engineer.

Daywork rates shall be those as detailed in the Form of bid.

1.13 Quality of Materials

All materials to be used for the installation shall be of British/European manufacture except where specifically stated otherwise.

All items of plant, equipment, motors, starters and ancillary equipment, etc shall be the best of their particular type and shall be fit for the purpose intended.

All equipment shall carry the CE marking.

All materials must comply with the current British Standard specification.

The Technical Specification details the specific materials to be used.

1.14 Builder's Work

The Contractor shall note that he will be responsible for all of his own builder's work in connection with the installation of the mechanical services.

The Contractor shall also be responsible for ensuring all fire dampers installed are adequately housed within the fire compartment they serve to ensure fire integrity of the barrier is maintained.

The Contractor shall allow for all costs associated with cutting holes, making good, providing plant bases etc., as necessary for the entire installation to take place.

1.15 Clearance of Site

The Contractor shall remove at his own expense, any rubbish and surplus equipment arising from his works that may have accumulated during the Contract.

Surplus materials and rubbish that are not removed will be disposed of by the Main Contractor, the cost of which shall be deducted from the final invoice.

1.16 Type of Construction

The bidder shall inspect the Plans and Proposals and site inspection to acquaint himself with sufficient details to carry out the installation, etc.

Close liaison is required to determine all finishes, such as for suspended ceilings, walls etc.

1.17 Coordination of Services

The Mechanical Contractor shall allow within his bid for full site coordination of the Mechanical installation with the Electrical Contractor and all other trades. Prior to any works starting on site, he shall make due allowance for meeting with the Electrical Sub-Contractor, Builder and all other trades to ensure full coordination of the mechanical and electrical services takes place.

Any clashes between services should be brought to the attention of the Consulting Engineer prior to the installation works commencing.

Section TWO

General Technical Clauses

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2.1 Extent of Works

The Mechanical Services Contractor hereinafter referred to as the Contractor, must include in his Tender for the supply, delivery, storage and installation of all materials and equipment necessary to complete the installation in accordance with his Standard Specification, Drawings and any other supplementary information issued by the Engineer.

The term Contractor shall also be taken to mean Sub-Contractor where this term applies. The expression Engineer will be taken to mean the Consulting Engineer responsible for the design installation.

2.2 Visiting Sites

The Contractor must visit the site to ensure his being conversant with all local conditions, as on no account will any extras be permitted due to his failure to do so.

Where systems are to be installed within existing buildings, the Contractor shall, before tendering, examine the scheme as shown on the Drawings and as specified in relation to the building, or buildings and shall then be deemed to have good knowledge of the scheme or schemes and claims for costs for extra labour and / or materials will not be allowed when it can be shown that this examination has not been closely carried out.

2.3 Plans and Specifications

The Contractor shall allow for all works to be carried out in accordance with the scheme Drawings, this Standard Technical Specification and the Particular Specification for the Project. Any discrepancies between the relevant elements of the documentation shall be identified to the Engineer.

2.4 Samples

Any materials which are offered as an alternative to those specified may involve the Contractor in having to furnish samples of the proposed materials to the Engineer for his approval.

2.5 Workmanship and Measurement of Work

All materials and workmanship throughout the entire Contract is to be new and to the best of the respective kinds and to the complete satisfaction of the Engineer (acting for the owner) under whose supervision the work will be carried out. Any pipework delivered to site in a rusty or defective condition will be rejected.

The Contractor is to take his own measurements on site and is to be entirely responsible for the quantities required.

2.6 Local Bye-Laws and Regulations

The Contractor shall ascertain and act in accordance with any local bye-laws and regulations which may affect the work under this Contract. Any cost for the stamping of valves, fittings and the like must be covered by the Contractor in his Tender.

2.7 Reception and Storage of Materials

The Contractor shall provide a proper storage area for materials, tubes, fittings, etc delivered to site which must be received at the site by the Contractor.

Tubes and fittings stored on the ground at the site will not be approved for use. The Contractor will be fully responsible for reception and storage.

Where tubes, radiators, boiler sections, etc are stored outside, proper sheeted racks and other supports must be provided.

2.8 Liability for Defects

The Contractor is to make good any defects in his work due to faulty workmanship or materials provided by him which arises in 12 months from the date of acceptance of the completed installation by the owner. This applies to all materials, equipment and completed work.

2.9 Testing and Regulations

The Contractor shall include for testing as specified in Clause 2.38 and below at all various sections of the installation.

All labour and equipment required for carrying out the tests shall be provided by the Contractor.

Seven days' notice of all tests shall be given to the Engineer to enable him or his authorised representative to be present.

For water pipes, the Water Undertaking's Plumbing Inspector shall also be given at least seven days' notice before the test is applied.

If any portion of the works fails to pass the test, tests of the said portions shall be repeated within a reasonable time upon the same terms and conditions, save that all reasonable expenses to which the Main Contractor may be put to the repetition of the tests shall be deducted from the Contract price.

The repeat of any test required shall be at no additional cost to the Employer.

The Contractor shall include in his Tender for the proper filling, venting and draining of all installations or sections of installations and make due provision for suitable disposal of the testing media and shall make good all defects arising out of, or caused by tests.

If the test pressure is not maintained for the specified period, the Contractor shall make good any weak joints, defective fittings, etc and repeat the test in the presence of the Engineer or his appointed representative until the specified test conditions are maintained at no additional cost to the Employer.

All pipework concealed in the building structure, fixed behind partitions or false ceilings, roof spaces, in trenches or buried shall, in addition to the following applicable tests, be pressure tested and passed as satisfactory before concealment.

The Contractor shall give due notice in writing to the Engineer and Main Contractor when the said concealed or buried work is ready for inspection and the Engineer shall, without unreasonable delay, carry out his inspection and / or witness the tests unless he informs the Main Contractor and the Contractor in writing from time to time that he considers such inspection unnecessary, but in no instance shall concealed work or buried work be covered without being tested by the Contractor in the manner described in the Specification.

All tests shall be carried out and approved before any paint, thermal insulation or similar cladding is applied to the installation.

The accuracy of the Contractor's testing instruments shall be demonstrated to the satisfaction of the Engineer, as required.

Due allowance shall be made by the Contractor for testing in such sections as necessary due to the programming of the work.

The standard precautions shall be taken to protect spring loaded valves, pressure gauges and any other fittings or plant which could be damaged due to excess pressure above the normal operating range.

2.9.1 Hot Water Installation

The whole of the hot water heating system shall be subjected to a hydraulic test pressure of twice the working pressure of 3.5 bars g. (50 p.s.i.g.) whichever is the greater. The test shall be maintained for a period of not less than one hour, or as long as is necessary to inspect the whole of the installation, if the time required for this is greater than one hour.

Welded pipework shall be separately subjected to a hydraulic test of twice the working pressure or 7.0 bar g. (100 p.s.i.g.) whichever is the greater for a period of not less than one hour or as long as is necessary to inspect the whole of the pipework involved.

2.9.2 Hot and Cold Water Services

The whole of the hot water and cold water supply systems shall be subjected to a hydraulic test pressure of twice the working pressure of 7.0 bar g. (100 p.s.i.g.) whichever is the greater, for a period of one hour or as long as is necessary to inspect the whole installation.

2.9.3 Gas Pipework

All pipework shall be tested in accordance with The Gas Safety (Installation and Use) Regulations (GSIUR) and British and European Standards.

2.9.4 Existing Services

The Contractor shall note that existing services shall not be subjected to any pressure tests

All new services shall be hydraulically tested before connecting to any existing service.

Should the Contractor fail to observe the above before any pressure test is applied to existing pipework, the Contractor will be held responsible for the complete removal and replacement of any sections of the existing system which the Engineer considers necessary at no additional cost to the Contract.

2.9.5 Equipment

No equipment shall be subjected to a pressure test with the associated services except where stated to the contrary.

2.9.6 Heating Installation

The main flow and return temperature shall be observed by reference to test thermometers. When a steady flow temperature has been reached, the return temperature shall be noted.

The circulations shall be balanced as follows:

All main circuits have been designed for an equal drop and therefore, the main return temperatures should all be the same. The first step is balancing, therefore, compare the main return temperature.

The circuit with the lowest temperature (ie the largest drop) shall be taken as the index, and the control valve in each of the other circuits adjusted as necessary until all return temperatures do not vary by more than 1.5 Deg. C.

On completion of the above, the control valve on each radiator, unit heater and convector shall be adjusted to give equal temperature drop within the following limits.

Radiators, Convectors Flow Temperature or coils (Deg. C.)	Max variation in Temp. Drop across individual (Deg. C.)
82 +	1.5
71 +	1.0
60 +	0.5

The Contractor shall establish the frictional resistance of coils and the respective control valves from the manufacturer's data.

The Contractor shall first ensure that the by-pass and control valves are hydraulically balanced with the respective coils.

The Contractor shall then regulate the branch circuit valves to ensure that the correct quantity of water is passing.

The Contractor shall include for carrying out approved tests during the heating season at a time agreed with the Engineer which shall not be outside the 12 months Defects Liability Period.

These tests shall include the recording of external and room temperatures and the records shall be submitted to the Engineer.

The Contractor shall note that the tests shall be carried out during the heating season and this may entail returning to the site after completion. The Contractor shall make due allowance for all such costs in his Tender.

2.9.7 Hot and Cold Water Outlets

Cold water connections shall be on the RIGHT HAND side of the fittings when facing the actual fittings. This shall be confirmed with the Main Contractor prior to installation.

The Contractor shall demonstrate to the Site Engineer that an acceptable pressure flow rate can be maintained on the outlet fittings.

2.9.8 Heat Test

On completion of the installation and before insulation is applied, the separate heated systems installed by the Contractor shall be heat tested for a period of not less than 8 hours during which time, all circuits are to be regulated.

If any leaks occur during the period of the test, the Engineer shall require the Contractor to rectify the leaks and re-test all systems until they are satisfactory.

The Contractor shall note that HEAT TESTS shall be carried out during the heating season or at any time selected by the Engineer. This may entail returning to the site after completion. The Contractor shall make due allowance for all such costs in his Tender.

The provision of all fuel and energy used during the testing and until such times as the plant is accepted shall be provided free of charge to the Contractor.

2.9.9 General

Normally, the Contractor will ensure that the installation is operating in accordance with the specification before inviting the Site Engineer to witness a test. By mutual agreement between the Contractor and the Site Engineer, the latter may be present during the balancing. In this case, the operation will be a combined balancing and witness test.

The Contractor shall note that he will be required to provide suitable charts to record all test results. Two copies of the suggested format for the charts shall be submitted to the Engineer for comment in good time for any comments to be incorporated prior to testing.

A copy of all test results shall be included in each of the Instruction Manuals or alternatively, separate books may be made. A preliminary copy of all results shall be made available 10 days after testing from site.

2.10 **Drawings sent for Approval**

Drawings shall be sent to the Engineer for general approval, but approval of such Drawings will not exempt the Contractor from his liabilities under the Specification.

These Drawings shall show any special bracket, anchor or guide arrangements. The Contractor shall not use the Tender Drawings for installation purposes unless the Engineers agreement is granted and on provision that these Drawings are supplemented with the necessary notes and working details. The Contractor will still hold full responsibility for such Drawings and their subsequent revisions.

2.11 **Record Drawings**

On completion of the works, the Contractor must supply one complete set of polyester Drawings showing all the services covered by the Contract, all equipment, panels, radiators, pipes, taps, valves, etc to be shown in their correct positions together with one set of 1 / 20th detailed Drawings of the boiler room plant, including automatic stokers, oil burners, gas burners and thermostatic controls, catering, ventilation and all plant included in the Sub Contract or Contract plus a valve chart to be positioned in the boiler house.

In addition, a hardwood framed and glazed valve chart shall be mounted in the boiler house / s or plant room / s.

2.12 **Builders Work**

Where the Engineering Contractor is the Main Contractor, the Engineering Contractor must include in his Tender and be responsible for carrying out all builders work necessary to complete the installation to the complete satisfaction of the Engineer.

2.13 **Delivery Forecast**

When submitting his Tender, the Contractor shall give the manufacturers delivery forecasts for materials.

2.14 Pipework Sleeves and Covers

All pipes passing through walls, floors, and ceilings, partitions, etc shall be inserted through sleeves of similar materials to the pipe.

Sleeves shall be free from internal burrs and shall have an internal diameter sufficient to allow free movement of the pipes. In order to reduce fire risk, the distance between the pipe and sleeve shall not exceed 6mm.

Sleeves passing through floors and fire walls shall be packed with an approved material, ie leadwool. Sleeves shall not be used as supports for the pipes and pipes shall be fixed clear of sleeves at all points.

Pipes passing through sleeves in external walls of buildings, duct subways, etc shall be caulked between pipe and sleeve with an approved material ie leadwool, to form an effective and permanent vermin-proof and weatherproof seal.

Sleeves passing through kitchen floors or other areas where water is present shall have an upstand of 100mm.

All sleeves required to be built into the structure shall be handed to the Main Contractor for building in before the concrete, etc is placed and proper steps must be taken by the Contractor to ensure that sleeves remain in the correct position whilst concrete, etc is set and that the sleeves allow free movement of the pipes.

The Contractor will be held responsible for ensuring that no pipes are "bedded in" by any making good carried out by the Main Building Contractor or by any other cause.

Cover plates shall be fitted on all pipes passing through walls, floors, ceilings, partitions, etc and shall be plastic plates. The installation of the pipes must be such that the plates may be accommodated without cutting away either the plate or floor / wall. Cover plates shall have white finish and shall be securely fixed.

2.15 Open Ends

During the progress of the work, open ends of pipes, tees, fittings, etc must be closed with metal or plastic plugs. Plugs made from paper or other material will not be allowed.

Work not protected in accordance with this clause will not be accepted.

2.16 Pipe Burr

Suitable reamers must be provided for completely removing the inside burr from steel and copper pipes.

The Contractor should understand that if evidence of unremoved burr is found on one small portion of the work during the installation, the Engineer will require the remaining work to be dismantled for his inspection. This will be carried out at the expense of the Contractor.

2.17 Tubes

All tubes shall be of British manufacture and shall comply in all respects with British Standard Specification.

2.17.1 Heating

The whole of the system shall be in heavy weight or medium weight tube as laid down in the Particular Specification.

2.17.2 Hot Water

If carried out in steel, this shall be galvanised medium weight tube.

If pipework is carried out in copper, this shall comply with EN1057 R250 Half Hard.

In separate hot water service installations, the pipework used for the primary circulation shall be similar to that used for the secondary pipework.

2.17.3 Cold Water

This shall be as previously specified for the hot water.

2.17.4 Gas

This shall be heavy weight steel tubing.

Where dissimilar metals are used, the Contractor must provide and fit approved insulating joints to prevent corrosion due to electrolytic action.

2.18 Pipe Fittings and Joints

Fittings shall be screwed malleable for all sizes up to and including 50mm (2") and should be flanged for 65mm (2-1 / 2") work and over. Should copper be chosen for pipework systems, the type of fitting required will be indicated in the supplementary Specification or on the Drawing.

During the progress of work, sections of pipework will, after erection, be partially dismantled to enable the Engineer to examine the joints, and where any fault is found, the section of work affected will not be accepted.

Threads must be cut to engage fully with the fitting and must not be too long or too short.

Threads must be correctly and cleanly cut and must be of the right length for each pipe size.

Screwed joints on domestic water services shall be made with Silicon Tape Spray or PTFE Tape. Screwed joints on closed heating systems may be made using Boss white or equivalent jointing compound in addition to the above list. Any jointing material used must first be checked with the local Water Authority approved list for compliance. Flanged joints must be machined, faced and ground, or made with graphited non-asbestos jointing gaskets or rings.

All capillary joints shall be made using flux and solder to Water Authority approval.

Some welding joints on heating mains in trenches and in boiler rooms, pump rooms or other accessible positions will be allowed, where this method will benefit the installation without jeopardizing the easy renewal of sections of the pipe-work during future maintenance work.

Welded joints will not be allowed in exposed positions in rooms with the exception of plant areas. Bends must be used wherever possible.

Elbows will not be allowed in positions where bends can be used.

Sweep tees on tongue tees will be used in preference to ordinary square tees.

Pipe runs must follow the line of the building and sets must be made around all piers and other projections.

Pipes must also be set to follow the lines of all recesses unless specifically agreed otherwise for aesthetic reasons.

Where details have not been approved, the Contractor must discuss all pipe runs with the Engineer and obtain permission before proceeding with the installation.

Provision for proper drainage for all runs must be made.

Special attention must be made to the installation of vertical pipes. Careful arranging of pipework, especially where more than one service occurs or occupies the same trench or chase will be insisted upon to achieve the neatest appearance possible.

Clean joints will be insisted upon and tool marks or imprints on valves and fittings will not be tolerated.

2.19 Valves

Valves for heating and hot water shall be approved manufacture and shall be fullway gate pattern of gunmetal throughout, up to and including 80mm (3"), and cast iron for 100mm (4") diameter and over; with screwed ends up to and including 50mm (2") diameter and flanged for pipes 65mm (2 1 / 2") diameter and over.

Cast iron fullway valves shall be fitted with renewable gunmetal seating rings.

Valves fixed in rooms shall be easy clean pattern.

Radiator valves shall be of approved British manufacture and a polished brass finish unless specified otherwise in the Particular Specification.

Keys and dust caps must be provided for lockshield valves.

For steam, condensate and for cold water unless otherwise specified, gunmetal globe pattern valves shall be used.

On the hot, tanked, cold water and gas services, where draw offs or pipes serving a fitting or series of fittings occurs, an approved screw down stop cock with pinned jumper shall be used.

On mains cold water service, where draw offs or pipes serving a fitting or series of fittings occurs, an approved screw down stop cock with a loose jumper shall be used.

2.20 Hangers and Supports

The Contractor shall supply and fix all the necessary brackets, clips, hangers, rollers and chairs and the like, to adequately support all mains, branch pipes and the like installed by him within the scope of this Contract.

The Contractor shall allow for supporting all pipework at centres not exceeding those stipulated in the following table, and at closer intervals if warranted by the arrangement of pipework, fittings or valves. Additional brackets shall be provided as necessary at the

beginning and ends of runs, and at junctions and bends and at the base of vertical shafts and risers.

All brackets and hangers shall be installed with special attention to freedom for lengthwise expansion either in horizontal or vertical plant and to levels for air elimination and drainage.

Valves 50mm and above shall be individually supported.

Supports for rise and drop pipes shall be arranged to allow freedom for expansion movement of horizontal runs.

All pipe lines shall be separately supported - Pipes slung from other pipes will not be allowed.

Where School Board pattern pipe brackets are used to support copper pipes, they shall be cast brass and when copper pipes are supported by wrought iron or purpose made brackets, a chafing sleeve of suitable material ie lead shall be fitted to prevent damage to the copper and in such a manner that it cannot be displaced by repeated expansion and contraction of the pipework.

All necessary metal supports, tees, angle or channel sections, screws, bolts, etc shall be provided and fixed by the Contractor except where stated otherwise. The Contractor shall also be responsible for the accurate setting out of same.

Gunmetal saddles shall not be used unless special permission has been obtained from the Engineer. This permission will only be given if other suitable types of fittings are not available.

The Contractor shall provide all necessary brackets and supports at all heavy items of plant such as valves, traps, vertical pipework, reducing valves, etc to ensure that no strain is transmitted to the pipework.

Anchors and guides shall be independent and shall not form part of the main pipework support system.

Except where otherwise stated on the Drawing, the spacings between pipe supports shall not exceed the values in the following table:

All hanger rings and pipe clips (except with the exception of School Board pattern) for copper pipe lines may be of ferrous metal. Suitable liners shall be used to protect the pipes. The width of the liner shall be enough to allow for expansion of an internal dimension to suit the pipe.

Bronze rollers shall be used in conjunction with non-ferrous pipe lines.

All supports shall be arranged in such a manner that the required gradient can be obtained.

Drawings of all purpose made supports shall be submitted to the Engineer for comment prior to fabrication.

With the exception of non-ferrous supports, all brackets and parts of bracket assemblies shall be delivered to site with a protective coat of paint or similar.

Where proprietary items are shown, these shall have the manufacturers standard finish. All other brackets and the like shall be given one coat of red oxide before delivery to site. Brackets fabricated in site shall be painted immediately after making.

Supports fixed external to the building where exposed to atmosphere shall be galvanised after fabrication prior to fixing. All associated steelwork, fixings, etc shall be similarly treated.

The Contractor shall ensure that no dangerous edges are exposed. Any that could be harmful or could injure the maintenance staff should be removed and rounded off prior to painting / galvanising.

All fixing bolts, rawbolts, etc shall be provided by the Contractor.

The Contractor shall be responsible for marking the positions for all supports by the provision of Drawings issued by the Contractor to the Main Contractor.

Retention hoops shall be fitted over pipes and rollers at every fourth bracket, changes of direction and elsewhere as required to ensure the pipe remains on the roller.

Retention hoops shall be fitted with a gap approximately 3mm between the pipes and retention hoop to ensure free movement of the pipe.

Supports shall be generally as detailed below as applicable.

a) Ceiling Voids

Pipework shall be supported by means of a swinging type support which permits the movement of the pipes. The supports shall be generally supported by means of drop rods from angle cross members attached to the roof beams of joists, through a hemispherical washer.

b) Internal Ducts

Pipework in the new ducts shall be supported by means of rollers and chairs.

The Contractor shall be responsible for correctly setting out all supports and for ensuring that same are correctly installed.

Chairs shall be securely fixed to ensure no movement.

c) In Builders Casings

Pipework shall be supported by means of screwed School Board pattern brackets.

d) Exposed to View in Rooms

The Contractor shall supply and fix all clips of the School Board pattern where pipes are adjacent to walls. These shall be of the screw on type for screwing to woodwork and screwing into the blockwork walls (Crane Ltd fig. No. 501 or Yorkshire fig. No. 108 or 100).

Where pipes are suspended from the ceiling or support from the floor, brackets as above could be used if and where practical. As an alternative, single or double hanger rings shall be provided with back plate whereas double hangers with locknuts. In all cases, brackets shall not be of the stamped pattern or formed with straps.

Saddle straps will not be accepted except where specifically instructed by the Engineers.

When erecting supports, the Contractor shall ensure that any equipment or pipework adjacent to the support can be easily maintained and that no obstruction or withdrawal space is made by the installation of the supports.

The Contractor shall give full dimensions to the Main Contractor regarding the fixings for all supports and shall be responsible for the correct positioning and installation of same.

All brackets and supports shall be to BS 3974 Part 3 1980.

The Contractor shall note the requirement for applications where thermal insulation is to be continuous. (See THERMAL INSULATIONS) when designing pipe supports for such application.

PIPE BORE (mm) Nominal	MAXIMUM SUPPORT SPACING (M)					
	STEEL PIPE		COPPER PIPE		IRON PIPE	
	Horizontal	Vertical	Horizontal	Vertical	Horizontal I	vertical
Up to 15	1.8	2.4	1.2	1.8		
20	2.4	3.0	1.4	2.1		
25	2.4	3.0	1.8	2.4		
32	2.7	3.0	2.4	3.0		
40	3.0	3.6	2.4	3.0		
50	3.0	3.6	2.7	3.0	1.8	1.8
65	3.7	4.6	3.0	3.6		
80	3.7	4.6	3.0	3.6	2.7	2.7
100	3.7	4.6	3.0	3.6	2.7	2.7
125	3.7	5.4	3.0	3.6		
150	4.5	5.4	3.6	4.2	3.7	3.7
200	5.6	6.0			3.7	3.7
250	5.0	6.0			4.5	5.4
300	6.1	10.0			8.0	10.0
350	10.0	12.0				
400	10.5	12.6				
450	11.0	13.2				
500	12.0	14.4				
600	14.0	16.8				

PIPE BORE (mm) Nominal	MAXIMUM SUPPORT SPACING (M)					
	UPVC PIPE		POLYETHYLENE PIPE		GLASS PIPE	
	Class OBC	Class D,E,6,7	Type 32	Type 50		
	horizontal	horizontal	horizontal	horizontal	horizontal	vertical
Up to 10		0.6	0.3	0.45		
15		0.6	0.4	0.6		
20		0.65	0.4	0.6		
25		0.75	0.4	0.6		
32		0.8	0.45	0.7		
40		0.9	0.45	0.7	0.9	1.7
50	1.1	1.2	0.55	0.85	1.2	1.7
65	1.2	1.4	0.55	0.85		
80	1.4	1.5	0.6	0.9	1.2	1.7
100	1.5	1.7	0.7	1.1	1.2	1.7
125	1.7	1.9				
150	1.8	2.1		1.3	1.2	1.7
175	2.0	2.3				
200	2.1	2.5				
225	2.3	2.7				
250	2.4	2.9				
300	2.6	3.1				
350	2.9	3.4				
400	3.1	3.7				
450	3.4	3.7				
Above 450	3.7	3.7				

2.21 Spacings

Space pipe runs in relation to one another, other service runs and building structure, allow for specified thickness of thermal insulation and ensure adequate space for access to pipe joints, etc.

The following are recommended as minimum clearances in spacing of pipe runs:

Between	And	Clearance (mm)
Pipeline – insulated or uninsulated	Wall finish	25
	Ceiling finish or soffit	50
	Floor finish	150
Insulated pipeline	Adjacent service runs	25
Uninsulated pipeline	Adjacent service runs	50
Adjacent pipelines	Both uninsulated	150
	One uninsulated	75
	Both insulated	25

2.22 Air Venting

The Contractor must allow in his Tender for the proper air venting of all steam, condensate, heating, hot and cold water pipes and appliances whether provision for this is shown on the Drawings or not.

Open vents, automatic air vents, air bottles and wheel operated air vents will be allowed as approved by the Engineer. Loose key air cocks or valves will not be allowed on pipes, radiators or other equipment unless specified.

2.23 Draw Offs

The Contractor will provide and fix all hot water and cold water taps to draw offs, except those actually secured to or serving a sanitary fitting when he shall run his pipes to within a distance of 500mm from the actual connection to each fitting and the Builders Plumber will connect to the fitting.

All drinking water points shall be so labelled with an label marked "DRINKING WATER".

2.24 Draining

The Contractor must allow in his Tender for the proper drainage of all mains and branches, storage and pressure vessels, boilers, steam, condensate, heating, hot water, cold water and gas installations whether provision for this is shown on the Drawings or not.

Provision for drainage shall consist of gland cocks or other approved valves as detailed in the Particular Specification. Every cock or valve shall be fitted with a hose connection.

2.25 Painting, Polishing and Cleaning

The decorative painting of all unlagged pipes and radiators etc supplied and installed by the Contractor in the 'user' areas, except where stated in the previous Clauses, will be carried out by the Contractor.

Pipework in all other areas, if after installation the pipework condition is found to be unsatisfactory, will be painted two coats of red oxide at the Engineers request.

This shall also include user areas and shall be done prior to any decorative painting.

All steelwork supports, hangers etc shall also be painted together with all pipework except galvanised and copper in plant rooms.

This painting is to consist of thorough wire brushing and painting two coats red oxide.

Pipework which is to be insulated shall be painted by the Contractor as above prior to thermal insulation being applied.

Thermal insulation shall be further painted as specified under the appropriate Clause.

The Contractor shall provide a chart giving the colour identification for the various services which shall be mounted in a glazed frame and fixed in an approved position on site.

All welds shall be painted with two coats of a red lead based paint immediately upon completion and before application of the heat insulation.

In the case of control panels and similar items for which special finish is provided, great care is taken that these are not damaged during erection. Any damage is to be made good to the satisfaction of the Engineer.

The Contractor shall, before handover of the Contract Works, clean all items of plant and equipment. Bright parts and polished parts shall be burnished and any adhesive protection removed.

The fact that certain items of plant and pipework etc are painted to manufacturers standard prior to delivery, does not release the Contractor from final painting on completion of the works, to colour schemes as laid down by the Engineer.

Any painting of unlagged pipework shall be to BS 1710:1984 to the same colour code as the Thermal Insulation.

The final painting shall not be commenced until the entire installation or agreed sections of the installation have been completed, tested and approved by the Engineer.

During the thermal insulation, the Contractor will be required to attend on the Thermal Insulating Sub Contractor for the purpose of pipework identification.

The Contractor shall include for the identification of all pipework painted by the Contractor. The identification and identification marks, generally as Thermal Insulation. The Contractors attention is also drawn to Clause "WITNESS OF PAINTING".

All paint, red oxide etc shall be of a high quality manufacture.

The type of paint and red oxide to be used by the Contractor shall be approved by the Engineer before any painting is undertaken. It is the Contractors responsibility to clean out the floor ducts prior to the duct covers being fitted.

It should be noted that it is the Contractors responsibility to ensure that all filters, including those in fan convectors, etc are clean and if throwaway type filters are used in the air handling units, then these shall be replaced if found necessary.

2.26 Welded Joints for Mild Steel Pipework

All flanges, branches, bosses, drain pockets, butt joints, etc shall be welded by the oxy-acetylene or electric arc process.

For joints in straight lengths of pipe, butt welds shall be used in which the pipe has been cut using a tube cutter or a machine controlled oxy-acetylene torch, burrs removed by rammer and ends trimmed and bevelled to make a fair faced joint.

For welds to seamless butt welded fittings and butt welded pipe joints, the joint shall be fused by a penetration weld and finally finished off with a fillet weld of ample dimensions. All welds shall be hammered finally and finished smooth. Care shall be taken to ensure that no weld is located within 1.00M of any anchor joint.

Each joint shall be of sufficient strength to withstand the stresses imposed by internal pressure and thermal expansion, the weight of the pipe fitting and thermal insulation. Metal-arc welding shall be in accordance with requirements of BS 2971.

All butt, branch and mitre welds for use with pipes of below 50mm nominal bore shall be made using the oxy-acetylene process in accordance with the requirements of BS 2640 with the use of mild steel filler rods which shall be in accordance with the requirements of BS 1453 type A2.

Branch mitre connections shall be made by the use of approved forged welding fittings.

Only qualified welders shall be employed and they shall have passed 12 months before the start of the works, the tests set out in Clause 4 and 10 of BS 2645 Part 2.

Operators with current certificates for welding from the authorities following will be accepted.

Lloyds

The Association of Heating and Ventilating and Domestic Engineering Employers

British Oxygen Company Ltd

Insurance Companies - Associated Officers Technical Committee

Particular attention is drawn to the following:

- a) The name of each welder to be employed on the Contract shall be given to the Engineer in writing before the welder commences work.
- b) Each welder on the Contract shall be provided with a steel marker die and after he has completed a weld joint, he shall mark the same with an identifying symbol.
- c) Where necessary, staging and protection from the weather shall be provided to enable the welding operation to be performed correctly; and screened from view in the case of arc welding.
- d) Segmented and cut-and-shut bends will not be allowed.
- e) Immediately welded joints have been made, cleaned and inspected, they shall be protected by two coats of red lead paint.
- f) Welded pipe assemblies shall be such that welded joints do not affect each other.
- g) Every precaution must be taken to prevent damage by scorching or fire. Suitable heat resistant mats must be used and two portable fire extinguishers shall be provided by the Contractor for use by the welders in an emergency.

Brazed and silver soldered joints on copper pipe lines shall be carried out to BS 1723 / 63 and BS 1845 / 66 and filler rod and flux (if necessary) shall comply in all respects to BS 1845 / 66, type CP2, except that type CP1 rod shall be used where specifically called for in any subsequent Clause.

A similar proprietary equivalent may be used providing that it will produce a joint at least equal to those using the filler rod specified including immunity to the effects of dezincification.

Proof of composition of filler rod proposed shall be submitted to the Engineer prior to commencing work on site.

Test specimens will also be required for copper joints as previously specified in this Clause, for steel pipework joints.

All brazed seams in calorifiers to BS853:1996 Part 2, shall be fabricated using a filler rod specified as being free from the risk of dezincification.

See also the paragraph concerning the provision of welding plants, under a separate Clause 2.03.

2.27 Ductwork

The Contractor shall include for the manufacture, supply and installation of the ventilation ductwork and the installation of ventilation plant by a Specialist Sub Contractor. The Contractor shall give the name of this Sub Contractor in the sub-letting section of the Tender Documents.

The supply and installation of the ductwork and installation of the associated Ventilation Plant shall be by a specialist Sub Contractor under the terms and conditions of the JCT Form of Sub Contract and the Standard Form of Tender for Nominated Sub Contractors.

The Contractor shall obtain from his Specialist Sub Contractor, a priced schedule of rates for the Works. The schedule shall include manufacturer, supply and erection rates of the various sizes of ductwork, bends, offsets, dampers and all other work included as part of the Sub Contract.

The prices shown in the schedule shall include all profits, overheads and Main Contractors discount and shall be used as a basis for pricing any variation to the Sub Contract Works.

Acceptance of the schedule of prices shall not absolve the Contractor of his responsibility for the accuracy of the contents of the document.

- (i) Ductwork materials and general Specification applicable to either form of sheet metal ductwork construction specified.

The ductwork shall be adequately supported by purpose made hangers and supports and shall be installed truly horizontal and vertical. All duct sections shall be truly square, rectangular and circular as specified and any twisted, deformed or unsatisfactory ductwork shall be replaced as directed by the Engineer at no additional cost to the Contract.

All sheet metal ductwork shall be manufactured from strip mill cold reduced mild steel / coil continuously hot dip galvanised to BS 2989:1967:Group 2:Class 2A. For black steel ductwork the material shall be cold rolled close-annealed or strip mill cold reduced black mild steel sheet.

All mild steel section components of all duct systems such as angle flanges, stiffeners, brackets and supports shall be painted two coats red oxide or zinc chromate paint before fixing to ductwork.

The Specialist Sub Contractor shall note that whilst erecting the ducting on site, it is his responsibility to ensure that his workmen thoroughly seal all joints before the fixing screws are inserted and that screw heads and the external surfaces of the joints are also given a coat of sealer. After 24 hours, a second coat of sealer shall be applied to all joints and allowed to dry at least 24 hours before carrying out any test.

The Contractor shall ensure that during all stages of erection, any open ends of ductwork or grilles and diffusers are protected from the ingress of dirt by the application to those ends of a suitably reinforced paper covering, securely held in place with adhesive tape or other approved means. The Engineer reserves the right to have any length of ductwork removed and cleaned should these precautions not be observed.

Where ducts run together, a 6mm (1 / 4") felt insertion piece shall be placed between the ducts to avoid vibration being conveyed from one duct to the other.

Where ductwork is located in corners of rooms, the Specialist Sub Contractor shall fit as close to the wall as possible, preferable flush, to prevent traps.

All the ductwork dimensions, as indicated on the Drawings, are internal dimensions and hence clean edges shall be maintained at all joints so that at no time should there be any ductwork material projecting into the air stream. The use of self-tapping screws for fixing ductwork where the screws project into the air stream will not be accepted.

The runs of the ducting are shown as accurately as possible on the Drawings, but the Specialist Contractor shall be responsible for taking his own site dimensions and preparing all necessary working Drawings.

The Specialist Sub Contractor shall take into full consideration, all problems concerned with the installation of this ductwork and adequate allowance must be made to take up all expansion or contraction during working conditions.

Test holes 25mm (1") diameter shall be provided downstream of all fans, supply junctions and dampers and upstream of all extract junctions and dampers. Test holes shall also be provided on each side of all items of plant. Covers fitted with spring clips shall be fitted to all test holes.

Test hole spacings shall generally be in accordance with BS 848 and shall be indicated on the ductwork Sub Contractors Drawings and approved by the Engineer.

Any mild steel sheet ducts exposed to outside weather conditions shall be galvanised after manufacture and shall be of 18 gauge thickness up to 1067mm (42") across the longer side, and 16 gauge thickness over 1067mm (42") across the longer side.

Ductwork between inlet louvres and the first item of plant shall be protected by painting one coat of Calcium Plumbate Primer and two coats of bituminous paint.

A suitable jointing compound shall be used on all slip joints, the sealer being applied before the joint is made and, after rivetting, any excess sealer shall be wiped off to leave a clean and neat finish.

Flanges shall be sealed with 6mm (1 / 4") thick strip. The flanges shall be sealed to the duct with the sealer used for slip joints.

Plastic sealing tape shall only be allowed at the discretion of the Engineer.

All joints shall be completely airtight.

All ductwork connection to plant or equipment shall be sealed with a suitable jointing material and the angle size used for mating flanges shall be the same size and thickness as that provided on the plant to which connection is being made.

Any part of the ductwork where galvanised protection is damaged during manufacture or erection shall be retouched with two coats of aluminium or other corrosion resisting paint.

The Contractor shall supply and fix a 20mm (3 / 4") BSP tapped and plugged boss without internal lip to ensure water is not retained in any duct systems where water may collect.

Where bends in the ducting are indicated, they shall be of the type shown. Where square bends are installed, they shall incorporate correctly design aerofoil vanes or

airturns.

In positions where round bends are shown, the centre line radius shall be as large as possible. $R / D = 1$ shall be the minimum for low velocity ductwork.

All tapers shall be so formed that they have a maximum reduction ratio of 1 in 7 unless site conditions do not allow. If the reduction ratio is greater than 20° then the taper shall be fitted with guiding vanes.

Airtight access doors shall be provided on both sides of all fans, filters and heater batteries for inspection, cleaning and maintenance purposes. At any fire damper, an access door shall be provided large enough for the blade to pass through and in such a position that the maintenance staff will be able, without undue trouble, replace the fusible link.

Access doors shall also be provided adjacent to each regulating and isolating damper to allow inspection of the blade. In these cases, the size of the opening shall be sufficient to allow the blade to pass through.

Access doors up to 457mm (18") on the longest side shall be constructed from 18 swg galvanised sheet with edges folded through 90° to suit a 25mm (1") x 5mm (3 / 16") flat iron frame rivetted to the duct. The door shall be hinged on one side. A foam rubber gasket shall be stuck to the inside face of the door to seat onto the 25mm (1") x 5mm (3 / 16") frame.

Doors with the longest side over 457mm (18") shall be manufactured from 18 swg galvanised sheet with edges folded and flattened over a 32mm (1 1 / 4") x 5mm (3 / 16") angle iron frame. A sealing frame constructed from 25mm (1") x 5mm (3 / 16") angle shall be rivetted to the duct.

The doors shall be hinged along one side with a heavy quality continuous hinge and secured on the other side. A foam rubber gasket shall be stuck to the inside edge of the door to seat against the angle frame. All MS framing shall be galvanised after manufacture.

No site welding shall be permitted on galvanised components except at the discretion of the Engineer and all approved welds on any part of the sheet metal ductwork shall be wire brushed on both sides to remove zinc oxides and the burnt areas shall be treated with two coats of zinc base paint.

All cut edges of galvanised sheets and deep scratches such as caused by scribes shall be painted two coats of zinc based paint as each length or item of duct be finished manufacture.

Bolts, nuts and washers shall be manufactured from bright mild steel and shall be cadmium plated or electro galvanised.

(ii) Sheet Metal Ductwork Construction

Sheet metal ductwork shall be manufactured in accordance with the latest editions of the HVCA Publications or the Nov 82 CIBSE Guide recommendations.

The form of ductwork construction proposed shall be indicated where applicable on the Tender Documents.

All ductwork shall be low velocity.

a) Sheet Metal Ductwork Construction - CIBSE Nov 82 Guide.

Where this Specification deviates from the recommendations of the Guide, this Specification shall be deemed the correct instruction.

Longitudinal seams shall be staggered on each succeeding section and shall be of Pittsburgh lock formed type and arranged wherever practicable on the top side of the duct.

Where rivetted seams are necessary, the pitch of the rivets shall in no case be greater than 50mm spacings.

Solid rivets where used shall be neatly finished with a button snap tool. Any cut rivets shall be replaced with new.

During the course of the manufacture, in the Specialist Sub Contractors works, a sealer shall be applied to rivets, grooved seams, etc on the internal side of the metal whilst the pocket formed during the folding of the "Pittsburgh" lock shall be flooded with sealer. The sealer shall also be brushed into all lap and corner joints.

Joints between duct sections in ducts up to longest side 584mm (23") shall be made with a correctly formed socket and pigot slip joint, joggled to ensure a smooth internal finish and made to suit the direction of the airflow.

Joints whereby the area of the duct is reduced shall not be acceptable. All joints between sections shall be rivetted. Joints in ducts over 584mm (23") to have angle mating flanges of the sizes and at the centre shown above.

Joints in ducts up to longest side 584mm (23") shall be rivetted at 50mm (2") pitches as shown above, sealing compound having applied between spigot and socket.

Intermediate lateral joints between flanges on ducts with longest side over 584mm (23") shall have a stiffener fixed over the slip joint and secured with nuts and bolts or hickbolts at 64mm (2 1 / 2") pitches.

Stiffeners are to be provided as shown above and where else necessary to ensure adequate rigidity and to prevent sagging or drumming by the sides.

Angle mating flanges shall have a 9.5mm (3 / 8") of the sheet metal duct returned over the flange face to ensure no leakage occurs.

b) Sheet Metal Ductwork Construction - HVCA Publications.

Where this Specification deviates from the HVCA Publications, this Specification shall be deemed the correct instruction.

2.28 Calorifiers

New hot water storage calorifiers, tanks or other vessels for direct or indirect hot water supply must be provided and fixed as indicated in the Supplementary Specification, or as shown on the Drawing. Pressure test certificates from the manufacturers must be sent by letter to the Engineer before any pressure vessel of this type is fixed.

Where more than one cylinder or other hot water storage vessel is to be fixed to serve the same system, stop valves must be fitted to enable any vessel to be emptied completely

and isolated from its neighbours without interrupting the hot water supply to the building or buildings.

These valves must be fitted whether shown on the Drawings or included in the Supplementary Specification or not, unless their omission is specifically called for on the Drawings or in the Supplementary Specification.

The Contractor must arrange gravity systems to the calorifier fixing height to ensure the greatest possible circulating head. The calorifier being fixed as high as possible; or the horizontal centre line of the boiler or other heater, as low as possible.

The Contractor shall supply all fixings, supports or brackets other than brickwork or concrete. Where vessels are supported upon steel or iron cradles or other supports, the soft metal liner must be rigidly fitted between all bearing surfaces on the vessel and the cradle or other support.

Actual building in of supports will be done by the Builder. Where a Builder is not employed on the Project, the fixing must be included by the Contractor.

All vessels shall have fitted to sizes detailed in the Particular Specification and Drawings, the following tappings / connections and equipment:

Primary flow and return

Secondary flow and return

Cold feed (if required)

1 No. 25 gland cock draining

1 No. open vent

1 No. safety valve

1 No. 100mm dial altitude / pressure gauge with syphon

1 No. 100mm dial thermometer and ancillary control or thermostat bosses

Where the primary medium is steam, a further pressure gauge shall be fitted to the steam chest.

Should the Particular Specification call for steel vessels, they must be galvanised after manufacture.

2.29 Circulators and Pumps

The Contractor shall provide and fix in the positions shown on the Drawings, electrically driven pumps or circulators of an approved make.

The pump capacity must be as stated in the Supplementary Specification. Where two or more pumps or circulators are to be installed, the Contractor must make full arrangements for valving to ensure the complete isolation and removal of any machine without interruption to the services, whether shown on the plans or not.

Every machine must be designed for super silent running.

Machines for hot water supply must be designed with a suitable overload characteristic to enable sudden heavy water draw off to take place without damage to pump or motor.

Each machine must be provided with motor, stop valves, drain valves, counter flanges, lubricators, spanners and sufficient packing for one complete repacking of the glands.

The Contractor shall also include for the fixing of machines and for connecting to the piping system as shown on the Drawings or as instructed on site.

Electrical wiring will normally be carried out under a separate Contract, except where indicated otherwise in the Supplementary Specification and or on the Drawing.

2.30 Anti-Vibration

The Contractor shall provide under all pumps, circulators and machines, an approved anti-vibration pad or other approved anti-vibration mountings.

2.31 Expansion

The Contractor shall make all the necessary arrangements and provide the necessary fittings to take up expansion of all heated pipes under working conditions, as generally indicated on the Drawings.

Wherever possible, expansion of pipework shall be taken up by natural offsets and changes of direction of pipe runs.

Branch connections on high temperature (above LPHW) main pipe lines generally shall be made such that the branch main will run at the side of the mains for a distance of 2 metres and consequently transfer any stress due to expansion and contraction off the connection and on to the bend.

All expanding pipes shall be allowed to move in a free, proper and pre-determined manner and direction.

The joints to all expansion bends or bellows shall not be drawn up until the anchorages have been rigidly fixed and the Engineer, or his representative has checked and "unsprung" position in each case and authorised work to proceed.

All pipes shall be fixed with sufficient clearance from walls, joists, floors and other obstructions capable of resisting lengthwise expansion and special care shall be taken to avoid pipe fixings preventing free movement of branches near junctions with main pipe runs.

2.32 Electrical Work

The electrical work or plant items must comply in all respects with the current edition of the Institute of Electrical Engineers Regulations for electrical equipment in buildings.

2.33 Removal of Old Materials and Debris

Unless specified otherwise or indicated on Drawings, the Contractor must dismantle and remove all old equipment, pipework, fittings and materials which will become redundant when the installation as shown and specified is completed. Where equipment is to be retained by the Client, then the Contractor will allow for removal and delivery to a designated location.

The Contractor shall remove all debris caused by his work as it accumulates and on completion, leave all parts clean.

Where the works require complete removal of existing, then this shall be done in a neat and orderly fashion with due regard for the Main Contractors building programme.

Items of plant shall be stored on site for inspection by the Client, large items of equipment being inspected prior to removal, unless the Particular Specification deems otherwise.

Where the works require part removal of existing then the Contractor shall inspect all relevant existing valves and equipment being retained and allow in his Tender for replacing such items, if in his opinion, progress of work would be hindered by their continued use. Such replacement items shall be included in item 'U' of the Tender Summary and separately scheduled by the Contractor for form part of the Tender documentation.

2.34 Overtime

When submitting his Tender, the Contractor must allow for all payments to the workmen and staff necessary to complete the installation as shown on the Drawings and specified.

This applies particularly to the existing building where it becomes necessary to execute certain work without interrupting the routine and services to the occupants.

Extra costs will not be allowed for overtime where it can be shown that the Contractor should, by his experience, have allowed for the cost in his Tender.

Should the Contractor require guidance on this point when preparing his Tender, he should make early communication with the Engineer who will be glad to advise him.

2.35 Commissioning Manuals and as Fitted Drawings

The Contractor shall always include for specialist equipment such as boilers, controls, etc to be commissioned by the manufacturer when complete.

1. A schedule shall be produced showing the room temperature obtained in each separate area of the building. In the case of large areas, a grid system of measurement shall be employed.

These readings shall be logged against the prevailing ambient conditions and submitted to the Engineer.

2. Noise levels shall be taken in any area served by fan assisted or ducted heating and schedules with (1).
3. Where regulating valves are employed then a diagrammatic drawing of the system shall be produced showing the valve setting, pressure drop and resultant flow rate.
4. Ductwork systems shall be dealt with in a similar manner by use of the balancing dampers.
5. Heater batteries shall be logged with their respective flow and return and air on and off temperatures.
6. All fans shall have a total volume check carried out.
7. All pumps shall have a volume check carried out using the altitude gauges and the pumps curve to determine total flow rate.
8. Temperature readings taken during mild or summer conditions shall be repeated under cold conditions during the defect liability period.

9. Labels shall be fitted to each valve and shown on a valve chart which shall also indicate the valves purpose.

Labels shall be fitted to each item of equipment which shall show the plants identification, eg "HWS Boiler No. 1" and in the case of pumps or other like equipment, the relevant duty, eg "Htg Pump No. 2, 2.3 kgs at 20.0 kn / msq."

Valve labels shall be minimum 25mm diameter with 6mm lettering.

Plant labels shall be minimum 80mm x 40mm with lettering of 6mm.

Valve charts shall be traffolyte fixed with brass "S" hooks and chain.

Plant labels shall also be traffolyte fixed with "S" hooks and chain or other means suitable for the equipment. Adhesive will not generally be used.

10. A commissioning manual for approval of test figures by the Engineer shall be produced enclosing the relevant information detailed in items 1 to 8.

Three copies of the manual are required in a black plastic A4 size ring binder, containing clear plastic A4 size sleeves for each document.

11. The Contractor shall allow for attendance and supervision for commissioning of all specialist items relating to the system or systems whether or not the equipment or controls form part of the Contractors supply or Contract.

2.35.1 As Fitted Drawings

The Contractor shall include within his Tender, for the production of suitable As Fitted Drawings. These shall be available in CAD format.

The Contractor will provide one CAD disk containing the As Fitted Drawings and shall provide a minimum of two sets of paper prints of the As Fitted Drawings and these shall be contained within the Manuals for future reference.

2.36 Thermal Insulation

The materials and complete installations shall conform as applicable with the following Standard References:

British Standards

BS 5422:2009 Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C

Note: BS 5422:2009 tables for refrigeration, chilled water and process pipework are specified as the minimum thickness of insulation required to qualify for the DECC Enhanced Capital Allowance scheme. New guidance for the insulation of hot water and heating pipework has been published in the revised Energy Technology Criteria List – July 2013 <https://etl.decc.gov.uk/etl/site/criteria.html>. Thickness tables for phenolic foam insulation are included in Tables 8 & 9 of this specification.

BS 5970:2012	Thermal insulation of pipework, ductwork, associated equipment and other industrial installations in the temperature range of -100°C to +870°C – Code of Practice
BS EN 14303	Thermal insulation products for building equipment and industrial installations – Factory made mineral wool (MW) products – Specification
BS EN 14304	Thermal insulation products for building equipment and industrial installations – Factory made flexible elastomeric foam (FEF) products – Specification
BS EN 14306	Thermal insulation products for building equipment and industrial installations – Factory made calcium silicate (CS) products – Specification
BS EN 14314	Thermal insulation products for building equipment and industrial installations – Factory made phenolic foam (PF) products – Specification
BS 476	Fire tests on building materials and structure Part 6 1989 Fire propagation test for materials Part 7 1997 Surface spread of flame tests for materials
Approved Document B (Fire Safety)	Appendix A12 - Definition of Class 0 Fire Resistance

Heating & Ventilating Contractors Association

DW 144 Specification for sheet metal ductwork materials

All pipework, ducting, vessels and equipment operating up to 100°C, including refrigeration, chilled water, cold water, domestic hot water, heating installations and air conditioning shall be insulated with Foil Faced, CFC-free, Class O Phenolic Foam having a declared thermal conductivity of 0.025 W / m·K at 10°C mean temperature aged in accordance with BS EN 14314. Kooltherm Pipe Insulation or Kooltherm Duct Insulation as manufactured by Kingspan Industrial Insulation or equal and approved.

All pipework, vessels and equipment operating above 100°C, including medium and high pressure hot water and steam installations shall be insulated with Foil Faced Mineral Wool having a thermal conductivity of 0.040 W / m·K at 75°C mean temperature. Rockwool H&V Pipe Insulation as manufactured by Rockwool UK Ltd or Crown SA Pipe Insulation as manufactured by Owens Corning-Alcopor Ltd or equal and approved.

New materials shall be:

- Completely free of CFC's / HCFS's.
- Completely free of asbestos in both insulation and surface finish.
- Of the specified material, thickness, quality and thermal conductivity.
- Free of chemicals which may contribute to corrosion of the insulated surface.
- CE Marked in accordance BS EN 14314:2009 as required by the Construction Products Regulation (EU) No 305 / 2011 (CPR) for Phenolic Insulation.

- Of a thermal conductivity of 0.025 W / mK at 10°C mean temperature in accordance with BS EN 14314 and based on the time averaged value over 25 years, plus a safety increment for phenolic insulation
- Where mineral fibre materials are referred to, resin bonded glass or rock based fibres.

Fire performance of new materials shall be:

- Class 'O' as specified in the Building Regulations, Approved Document B (fire safety), Appendix A12 as follows:
 - A material that is non-combustible in accordance with BS 476 Part 4.
 - or;
 - A material having a combined Class 1 Spread of Flame Rating in accordance with BS 476 Part 7 and Fire Propagation Indices, main-index $I < 12$ and sub-index $i < 6$ in accordance with BS 476 Part 6.
- Less than 5% Smoke Obscuration Rating in accordance with BS 5111:Part 1.
- Not capable of producing large quantities of toxic fumes or dripping burning particles when involved in a fire.
- Pipe insulation shall have a European fire classification of BL-s1,d0 or better to BS EN 13501-1:2007+A1:2009.

Existing materials shall be:

- Removed or disturbed taking the necessary precautions in accordance with the Health & Safety at Work, etc Act with particular reference to the Asbestos Regulations of asbestos is confirmed as being present in the insulation or finish.

Factory applied reinforced aluminium foil finishes shall be:

- Factory applied 'Bright Class O' type glass reinforced aluminium foil laminate with lacquered finish fully bonded to the insulation. Note the term 'Bright Class O' foil is generally used by manufacturers of all types of insulation materials to describe their factory applied vapour barrier facing.
- Where provided, overlapped joints shall be sealed with the insulation manufacturers approved adhesive or self-adhesive overlap strip. Otherwise, longitudinal and circumferential joints shall be sealed with matching Class O dead soft aluminium foil tape not less than 100mm on mineral fibre and 50mm wide on phenolic foam insulation.
- Not punctured by fixing devices particularly where finish is a vapour or moisture barrier.

Metal clad finishes shall be:

- Of aluminium sheet, plain, reeded or hammered finish applied to all insulated pipework in plant rooms and to calorifiers and hot wells.
- Secured by aluminium rivets, stainless steel self-tapping screws or aluminium bands. On cold insulation services, care shall be taken to avoid puncturing the moisture vapour barrier. Banding shall be used where possible on cold services.

- Fabricated into removable covers secured by self-tapping aluminium screws and rivets on calorifiers and hot wells.

Of the following gauge sheet:

- 0.75mm thick minimum on pipes 125mm dia. and under.
 - 0.9mm thick minimum on pipes 150mm dia. and above.
 - 1.2mm thick minimum on calorifiers, hot wells, cisterns, etc or 0.9mm if ribbed sheet suitable.
 - 1.6mm thick minimum for removable covers.
- Neatly finished at service connection points with cut-outs reinforced by aluminium rings.
 - Provided with additional support brackets as may be necessary on larger vessels.
 - Kept clear of direct contact with dissimilar metals to avoid electrolytic action.
 - Installed with allowance for expansion and contraction to take place.
 - Where installed as a weather-proof finish, all overlapped joints, cut-outs and protrusions through the cladding shall be sealed and made water-tight with Fosters 95-44 flexible mastic sealant. The overlaps shall be positioned to shed water where possible.

Valve and flange boxes shall be:

- Fabricated from plain flat aluminium sheet equal to thickness on pipework; made in two halves hinged at the centre; secured by easy-release catches and with space inside for access to bolts.
- Insulated inside with the same insulation and thickness as on the pipework, except on vapour sealed services where the insulation is to be applied and sealed to the adjacent insulation. Provided on services as indicated on the tables.
- Alternatively, if specified in Part D, flanges may be insulated with oversize “removable” sections to cover the flange and bolts and finished as on the pipework, with removable securing bands. This shall apply only to foil covered insulation on CWS, HWS and LTHW and is the method to be used for unions on vapour sealed services.
- Materials in Food Preparation and Storage Areas, Clean Rooms, Pharmaceutical and Medical aseptic areas shall be:
- Free from fine mineral fibres and use made of alternative materials as indicated in the tables.

2.36.1 Alternative Fibre Reinforced Plastic Finish

Glass fibre reinforced plastic shall be used in locations where a seamless waterproof, chemical resistant finish with high mechanical strength is required.

Glass fibre finish is particularly suitable where plant is exposed to chemical and hose down cleaning, weather conditions and for buried pipelines.

The cladding shall be a mouldable coating which is cured by exposure to natural light or metal halide / LED artificial light sources which do not emit any harmful radiation.

Materials on potable water cisterns shall be:

- As Clause 02 / 07.

Protective coatings, vapour barriers and adhesives shall be:

- To the manufacturers recommendations suitable for the service conditions and compatible with the insulation materials and / or metal surfaces.
- Non-toxic and non-flammable when being applied and when dry.
- Class 'O' fire rated indoors and Class 'I' to BS 476 Part 7 outdoors.
- When required as a vapour barrier, have permeance values of not more than; 0.05 g / (s.MN) for cold water supplies at 10°C; 0.015 g(s.MN) for chilled water at 0°C to 5°C and to BS5422:2009 Table 1 for refrigeration services to suit working temperatures.

2.36.2 Installation Practice

Insulation and Finishes shall be:

- Carefully applied in accordance with good practice as outlined in BS 5422:2009 and BS 5970:2012 and without disturbing or damaging pipework and equipment.
- Installed only after the service if it requires pressure testing first has satisfactorily passed the tests.
- Installed only after the surfaces to be insulated have been cleaned and are free from moisture, oil, grease, surplus soldering flux and building materials debris or dust.
- Under no circumstances, shall overlaps of the aluminium foil jacket be tucked inside the insulation joints where they may make contact with the underlying insulated surface.
- Arranged to allow access to all removable parts without need to damage insulation.
- Matched and sealed as necessary to insulated load bearing supports installed by the mechanical services engineers for specified services.
- On hot services terminate at each side of fire compartment or sub compartment walls and floors. On cold services, to avoid condensation damage to the building fabric the vapour sealed phenolic foam insulation shall be carried through the wall with an additional intumescent fire protection sleeve covering.
- Arranged as mitred sections or moulded shapes at bends and fittings and finishes as on the pipes.
- With non-corrodible metal bands where necessary to secure heavy insulation sections in addition to sealed seams and joints, generally 3 bands per metre section. Phenolic foam pipe insulation shall be secured by additional bands of 50mm self-adhesive foil joint sealing tape, generally 3 bands per metre section.

Cisterns, calorifiers, hot wells and feed tanks shall be:

- Insulated all over including top, also underside as practicable except feed and expansion cisterns.

- Arranged with removable insulation to manhole covers, heater batteries, etc with insulation heating finished at cut outs and sealed.
- Provided with any necessary cleats, brackets, pins, etc as required to support the insulation with those requiring attachment during vessel fabrication by others to be as specified in Part D.

Vapour sealed insulation shall be:

- Arranged with the insulation sealed over its full length and sealed to insulated supports and to valves, flanges and unions. Vapour sealed insulation carried through the walls and ceiling of cold rooms without a break with the hole in the wall or ceiling sealed to the insulation vapour seal.
- Where passing through fire compartment or sub compartment walls and floors it shall be covered with an intumescent sleeve to maintain the integrity of the specified fire resistance of the structure.

2.36.3 Pipe Supports

Pipework supports shall be insulated from the pipework on all HVAC services. On cold and chilled applications Kooltherm Insulated Pipe Support Inserts shall be used to minimise the risk of thermal bridging, limit the formation of condensation and facilitate the installation of a continuous vapour barrier. On hot water and LTHW services Kooltherm Insulated Pipe Support Inserts shall be used to limit overall system heat loss, and to minimise the risk of heat transfer through supporting structures.

2.36.4 Final Inspection of Insulation

All insulation work shall be inspected by the Engineer in conjunction with the Contractor as areas are completed and before any areas are covered or hidden by subsequent building operations.

The arrangements for the inspection will be made by the Contractor allowing sufficient notice for the Engineers visit. During such inspections, the work will either be accepted, rejected or accepted with remedial work to be carried out.

Particular attention will be paid to the standard and quality of aluminium cladding and patches and ill-fitting sheets will not be allowed for example.

Once accepted, the Contractor will advise the Main Contractor of such areas as finally complete.

Subsequent damage will be made good by the Contractor within two weeks of a final inspection which will be carried out prior to handover. Such remedial works shall be carried out at no expense to the Contract.

Contractor should note that damage to lagging or insulation by other trades should, where practical, be logged and reported to the Main Contractor from whom reimbursement should be sought. Delays in repairs to lagging will not be accepted because of reimbursement problems.

2.36.5 Removal of Asbestos Insulation

2.36.5.1 General

The Contractor shall include for all the removal of existing insulation whether asbestos or not. The removal of asbestos insulation shall comply with all the latest regulations and the Contractors attention is drawn to the Asbestos Regulations and the Health and Safety at Work Act.

The Insulation Contractor shall be allowed to erect site and shower facilities for execution of the Contract. The siting of these huts, etc shall be near to the contaminated area but the exact location shall be confirmed.

2.36.5.2 Site Hygiene

The Contractor shall be required to clean-up adjoining walls, floors, scaffolding and equipment.

Clean-ups shall be carried out daily, after work has ceased, with additional clean-ups as necessary.

2.36.5.3 Protective Equipment

Respiratory protection and protective clothing shall be required where stripping of thermal insulation is taking place. Unless dust can be reduced by wetting or controlled by dust extraction equipment, all stripping operations shall require respiratory protective equipment of the new sophisticated type such as positive pressure respirators or airline breathing apparatus.

2.36.5.4 Respiratory Protection

The Contractor shall provide respirators of a type approved by the Factory Inspectorate for use in asbestos containing atmospheres and must be issued on a personal basis. These respirators shall be kept in a dustproof container when not in use, eg a plastic bag sealed with tape.

Respirators shall be cleaned, checked and maintained at regular intervals by a designated person. Before reissue to another person, respirators are to be disinfected.

The Regulations require that all persons required to wear respirators shall be fully instructed in the proper use of the equipment.

2.36.5.5 Protective Clothing

The Contractors shall provide overalls and head gear which must be worn during the working period, but not during "walking time" to and from the work place if, during this time, the asbestos worker will be in contact with other people or will pass through "clear" areas.

Before being removed, overalls, caps and shoes shall be cleaned by a vacuum cleaner - not blown clean - and after removal, stored in a dust tight container such as a tape sealed plastic bag.

Due to the extent of the Contract, the Contractor shall make provision for segregation of insulation workers by providing separate changing rooms and accommodation for clothing together with shower facilities. Other clothing shall be stored in a clean building where asbestos dust cannot penetrate.

The Contractor shall be responsible for the maintenance and laundering of the protective clothing. For laundering, the clothing should be packed in plastic bags and marked "Asbestos Contaminated Clothing" in bold letters.

The Contractor shall remove from site immediately, any employee found not complying with the Regulations with regard to correct protective clothing including respirators, overalls, etc.

2.36.5.6 Protective Screens

The Contractor shall supply screens made from plastic sheeting which shall be erected to isolate the area being worked and prevent unnecessary spread of contaminated dust.

The Contractor shall seal off the area being worked and "DANGER ASBESTOS" notices shall be positioned at all entrances to the working area. Under no circumstances shall notices be removed before air borne concentrations are below the recommended levels.

2.36.5.7 Removal of Insulation from Site

Due to limited space, safety, etc the Contractor shall remove from site all waste material as it accumulates at regular intervals (ie at the end of each working day).

The Contractor shall be responsible for advising the Local Authority and making arrangements for disposal of the asbestos contaminated insulation removed under the Toxic Waste Disposal Act.

The Regulations require all loose asbestos or asbestos waste to be carried in closed receptacles which prevent the escape of dust.

The Regulations require that the Contractor shall use containers clearly and boldly marked with 'Asbestos - do not inhale dust'. Suitable polythene bags printed with this legend shall be used.

2.36.5.8 General Codes of Practice and Recommendations

The Contractor shall be required to carry out the Contract as laid down in the Asbestos Research Council Recommended Codes of Practice for the handling and disposal of Asbestos Waste Materials (revised March 1975). These are all in accordance with the Asbestos Regulations.

Recommended Codes of Practice
The Asbestos Research Council
Environmental Control Committee Secretary
P O Box 18
Clekeaton BD19 3JU

No young person under eighteen years of age may be employed where the Regulations call for use of protective equipment.

2.36.6 Handing Over Insulation

Before handover certificates are issued, the Contractor shall have passed over to the engineer, all of the following as provided in the Contract:

- a) Makers instruction manuals of servicing and maintenance.
- b) Makers operating instructions.

- c) Schedules of plant and equipment lubrication.
- d) Test and Guarantee Certificates.
- e) Insurance and inspection authority reports.
- f) Local or other Authority Certificates.
- g) List of tools, keys and special equipment of any sort handed over.
- h) Completion certificate prescribed in the current issue of the IEE Regulations for the Electrical Equipment of Buildings.

Three copies of this manual are required and each shall comprise of a black A4 size ring binder suitably indexed containing clear plastic A4 size sleeves for each document.

2.36.7 Insulation Thickness Tables - In Accordance with BS 5422:2009

Thicknesses shown in the tables are based on manufacturer's typical declared thermal conductivity values at the appropriate mean temperature of insulation as follows:

Insulating material	Mean temperature of insulation (°C)				
	0	+10	+50	+75	+100
	Thermal conductivity (W / m·K)				
Phenolic foam (PF)	0.025	0.025	0.025	X	X
Mineral wool (MW)	0.032	0.034	0.037	0.040	0.044
Calcium silicate (CS)	X	X	0.050	0.053	0.055

X = Not recommended for use at these mean temperatures.

Calcium Silicate to be used as alternative to mineral fibre on services above 100°C in non-fibrous areas.

TABLE 1

Thickness of insulation for chilled and cold water supplies to prevent condensation on a low emissivity outer finish (eg Bright Class O Foil) in an ambient still air temperature of 25°C and relative humidity of 80%.
(Reference BS 5422:2009- Table 8)

Steel pipe size (mm)		Temperature of water (°C)					
		+10		+5		0	
		Thickness of insulation (mm)					
NB	OD	Phenolic foam	Mineral wool	Phenolic foam	Mineral wool	Phenolic foam	Mineral wool
15	21	15	20	20	25	25	30
20	27	15	25	20	30	25	40
25	34	20	25	25	30	30	40
32	42	20	25	25	30	30	50
40	48	20	30	25	40	30	50
50	60	20	30	25	40	35	50
65	76	20	30	30	40	35	50
80	89	20	30	30	40	40	50
100	114	25	30	35	40	40	50
150	168	25	40	35	50	45	60
200	219	30	40	40	50	50	60
250	273	30	40	40	50	50	70
300	324	30	40	40	60	55	70
Vessels and flat surfaces		35	50	50	65	65	80

TABLE 2

Minimum thickness of insulation for non-domestic heating installations to control heat loss.
(Reference BS 5422:2009 - Table 15)

Steel pipe size (mm)		Hot face temperature of installation (°C)				
		+75		+100	+150	
		Thickness of insulation (mm)				
NB	OD	Phenolic foam	Mineral wool	Mineral wool	Mineral wool	Calcium silicate
15	21	15	30	40	50	80
20	27	20	40	40	60	80
25	34	20	40	50	60	100
32	42	20	40	50	65	100
40	48	25	40	50	65	100
50	60	25	40	60	65	100
65	76	25	50	60	75	100
80	89	25	50	60	75	100
100	114	30	50	70	75	105
150	168	30	50	70	75	105
200	219	30	50	70	80	110
250	273	30	50	80	80	110
300	324	30	50	80	80	110
Vessels and flat		35	50	80	90	115

TABLE 3

Minimum thickness of insulation for non-domestic hot water services.
(Reference BS 5422:2009 - Table 17)

Steel pipe size (mm)		Water temperature of 60°C	
		Thickness of insulation (mm)	
NB	OD	Phenolic foam	Mineral wool
15	21	15	25
20	27	15	30
25	34	20	30
32	42	20	30
40	48	20	35
50	60	20	35
65	76	25	35
80	89	25	40
100	114	25	40
150	168	25	50
200	219	30	50
250	273	30	50
300	324	30	50
Vessels and flat		35	50

TABLE 4

Environmental thickness of insulation for domestic central heating installations (+75°C) and hot water supply systems (60°C) to control heat loss in potentially unheated indoor areas with ambient air temperature of -1°C.

Outside diameter of copper pipe (mm)	Water temperature of 60°C / 75°C	
	Thickness of insulation (mm)	
	Phenolic foam	Mineral wool
10	15	25
12	15	25
15	15	30
22	20	40
28	20	40
35	25	40
42	25	40
54	25	50
Cylinders	35	50

TABLE 5

Environmental thickness of insulation for ductwork carrying warm air.
(Reference BS 5422:2001 - Table 10a)

Temperature difference between air inside ductwork and ambient air (°C)					
10		25		50	
Environmental thickness of insulation (mm)					
Phenolic foam	Mineral wool	Phenolic foam	Mineral wool	Phenolic foam	Mineral wool
20	40	25	50	35	65

TABLE 6

Thickness of insulation for condensation control on ductwork carrying chilled air in ambient conditions 25°C, 80% rh.
(Reference BS 5422:2009 - Table 12 – low emissivity finish 0.05)

Minimum air temperature inside the ductwork (°C)							
15		10		5		0	
Thickness of insulation (mm)							
Phenolic foam	Mineral wool	Phenolic foam	Mineral wool	Phenolic foam	Mineral wool	Phenolic foam	Mineral wool
20	30	25	50	40	75	50	100

TABLE 7

Minimum thickness of insulation required to give protection against freezing under specified commercial and institutional conditions.

(Reference BS 5422:2009 - Table 29)

Initial water temperature		+ 2 °C		+ 2 °C	
Minimum ambient temperature		-6 °C (Indoor unheated areas)		-10 °C (Outdoor)	
Evaluation period		12 h		12 h	
Permitted ice formation		50 %		50 %	
Pipe size (mm)		Thickness of insulation (mm)			
O.Dia	Bore	Phenolic foam	Mineral wool	Phenolic foam	Mineral wool
Copper pipes					
15.0	13.6	35	59 (size not available)	130	269 (size not available)
22.0	20.2	10 (15)	19 (20)	20	46 (50)
28.0	26.2	7 (15)	12 (20)	20	24 (25)
35.0	32.6	5 (15)	9 (20)	9 (15)	16 (20)
42.0	39.6	4 (15)	7 (20)	7 (15)	12 (20)
54.0	51.6	3 (15)	5 (20)	5 (15)	8 (20)
76.1	73.1	2 (15)	4 (25)	4 (15)	6 (25)
108.0	105.0	2 (15)	3 (25)	3 (15)	4 (25)
Steel pipes					
21.3	16.0	30	40 (40)	75	126
26.9	21.6	10 (15)	19 (20)	30	42 (45)
33.7	27.2	7 (15)	13 (20)	20	25 (25)
42.4	35.9	5 (15)	8 (20)	9 (15)	15 (20)
48,3	41.8	4 (15)	7 (20)	7 (15)	12 (20)
60.3	53.0	3 (15)	6 (20)	5 (15)	9 (20)
76.1	68.8	3 (15)	4 (25)	4 (15)	6 (25)
88.9	80.8	2 (15)	4 (25)	3 (15)	5 (25)

Note: Thicknesses given are minimum calculated specifically against the criteria noted in the table. Adopting these thicknesses may not satisfy other design requirements. Thicknesses shown in brackets are nearest standard thicknesses normally available from manufacturers.

Some of the insulation thicknesses calculated are too large to be applied in practice but are included to highlight the difficulty in protecting small diameter pipes against freezing under extreme conditions. In these cases, to provide the appropriate level of frost protection to certain sizes of pipes, it may be necessary to provide additional heat to the system, for example by controlled periodic circulation of the water or by heat tracing.

Thickness calculations ignore the specific heat capacity and surface resistance of the insulation in order to allow for a common situation where the temperature of the insulation is lower than the initial temperature of the water.

TABLE 8

Minimum insulation thickness to satisfy the requirements of Enhanced Capital Allowance Scheme Maximum Permissible Heat Losses for Non-Domestic Hot Water.

Steel pipe size (mm)		Water temperature of 60°C	
		Thickness of insulation (mm) Phenolic foam	Maximum permitted heat loss (W / m)
NB	OD		
10	17	15	6.04
15	21	20	6.45
20	27	25	7.00
25	34	25	7.71
32	42	25	8.46
40	48	25	9.01
50	60	30	9.94
65	76	30	11.25
80	89	30	12.17
100	114	35	14.29
125	140	35	16.09
150	168	35	18.24
200	219	35	22.06
250	273	40	25.95

TABLE 9

Minimum insulation thickness to satisfy the requirements of Enhanced Capital Allowance Scheme Maximum Permissible Heat Losses for Non-Domestic Heating Supplies.

Steel pipe size (mm)		Water temperature of 75°C	
		Thickness of insulation (mm) Phenolic foam	Maximum permitted heat loss (W / m)
NB	OD		
10	17	20	7.78
15	21	20	8.42
20	27	20	9.05
25	34	25	9.86
32	42	25	10.83
40	48	30	11.42
50	60	30	12.61
65	76	35	14.12
80	89	35	15.28
100	114	35	17.51
125	140	40	19.72
150	168	40	22.34
200	219	40	26.61
250	273	45	30.91

Section **THREE**

Specific Project Conditions

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3.1 Programme of Works

The Tendering Contractor is to provide an outline programme of works for the scheme with the submission of their tender.

3.2 Regulations and Standards

The Mechanical Contractor shall ensure that his installation and works are installed in accordance with the Local Water Bylaws, Requirements of Gas Undertakers, Local Authority Building Regulations, Local Fire Officers Requirements, and any specific Manufacturer's instructions and recommendations.

The Mechanical Contractor shall ensure that all installations are designed, installed, inspected and tested in accordance with the following:

1. CIBSE Guides, Technical Memorandum and Application Manuals.
2. IET Regulations for Electrical Installation 18th Edition 2018 including Amendments and Guidance Notes.
3. Statutory Acts including Health & Safety at Work Act, Electricity at Work Regulations 1989 and Workplace (Health, Safety and Welfare) Regulations.
4. British Standards and British Standard Codes of practice. Where an appropriate standard does not exist, CENELEC Harmonisation or IEC Standard shall be used where relevant.
5. National Inspection Council for Electrical Installations, Contractors Standards for Installation.
6. D.O.H. Health Building Notes and Health Technical Memorandum.
7. Local Authority Building Regulations.
8. Local Fire Officers Requirements.
9. Any specific manufacturers' instructions or recommendations.

3.3 Drawings and Manuals

The contractor must conduct a survey and provide a drawings prior to works commencing showing the building layout, the ventilation routes and type of service (i.e. supply, clean extract, dirty extract), together with the location of the new CSFD's and Smoke Control Panel and the location of existing fire dampers being removed. The contractor shall also indicate on the drawing the access points within the ceiling to maintain and test the CSFD's.

The Contractor shall provide drawings to show necessary builders work to be undertaken in connection with the installation of new CSFD's and the removal of existing fire dampers (including alterations of other mechanical and electrical services) which will be identified during the survey.

The Mechanical Contractor shall allow for providing for the approval of the Consulting Engineer, full CAD Working Drawings and As Fitted Drawings as required throughout the Contract.

These shall be updated on a regular basis for any room layout changes. The Mechanical Contractor shall allow for all necessary printing costs and for distributing these Drawings to both the Design Team and the General Contractors carrying out site works.

All "As Fitted" Drawings shall be available in CAD format compatible with AutoCAD LT 2020 or Revit 2020 as a DWG or RVT file, in addition to providing the standard printed Drawings for insertion into the As Fitted Manuals.

In addition to the hard copies of drawings & manuals specified here and in Section 2, the contractor is to provide an electronic version in PDF format on a USB Flash Drive.

3.4 General Description

This Specification covers the works to be carried out and the materials to be used for the installation of Combined Smoke Fire Dampers (CSFD) to the existing ventilation system in Kedleston Unit, including but not limited to:

- Ventilation Modifications (as required by damper installations)
- Combined Smoke Fire Damper installation
- Access Panels for cleaning and Maintenance
- CSFD Control Panel Installation
- Electrical Wiring and Interfacing
- Fire Alarm Modifications

under the supervision of:

EP Consulting
Alpine House
16A Alpine Street
Old Basford
Nottingham NG6 0HS

3.5 Contractor Survey and Design

EP Consulting have provided drawings for the Kedleston Unit, these drawings have been constructed by estimation only as there are currently not existing ventilation drawings readily available. The drawings provided by EP Consulting on this project show the general specification and an estimation of size and quantity of new damper works for pricing purposes only. The contractor shall make allowances within their tender to undertake a detailed survey on site to provide a detailed design and equipment schedule for the installation of a new Combined Smoke & Fire Damper System and associated equipment and services. The contractor within their survey/design shall complete the following:

- Undertake a detailed survey utilising the proposed fire compartment drawings as a base to identify the size of new Combined Fire & Smoke Dampers where ductwork crosses compartment lines.
- Identify the required builders work in connection with installing new CSFD's, removing existing fire dampers and alerting mechanical and electrical services to allow the works to be carried out. This work shall be quantified during the contractor's survey and presented on a drawing.

- Identify existing electrical distribution boards and ensure suitable spare capacity is available to serve all new combined fire & smoke dampers, smoke control panels and other electrical items. Where boards are insufficient the contractor shall provide a quotation to replace the boards with suitable sized distribution boards with 20% future spare capacity.

3.6 Fire Dampers above Fire Rated Ceiling

It should be noted that the scope of works for various areas within the work package will include the removal and replacement of thermal link fire dampers with CSFD above fire rated ceilings. Ductwork connecting supply diffuser or extract grille to new CSFD will be encased in fire rated material to stop the potential outbreak of fire into the ceiling void before it gets to the CSFD.

3.7 Kitchen Extract Ductwork

Existing kitchen ductwork can not have CSFD within the system due to potential grease build up. When the extract system penetrates the fire rated ceiling. The Contractor will allow a provisional sum for forming fire rated enclosures around the ductwork.

3.8 Contract Conditions

The Contract will be JCT Minor Works 2016 Edition.

Section FOUR

Combined Smoke Fire Damper System

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4.1 General Description

The contractor is to install a Combined Smoke & Fire Damper system to all of the existing ventilation systems at Kedleston Unit to the areas indicated in the overall plans.

Drawings of Kedleston Unit have been included within the tender pack to illustrate the extent of works in each of the areas within the building. It should be noted that the drawings have been created by undertaking an estimation against the proposed compartment drawings because existing ventilation drawings are not readily available. The contractor shall use the drawings and schedules to provide a tender cost for the final survey and detailed design of this work package are down to a remeasure basis by the contractor.

Each of the existing ducts crossing through a fire barrier are to be fitted with a CSFD.

Each duct in which a CSFD is fitted will require a suitably sized access panel to be installed in the ductwork both sides of the new CSFD as required in the HTM, BESA DW144 and TR19.

Each CSFD will have an Electro Thermal Link (ETL) with a test button. The ETL is to shut-down the damper independently in the event of fire in the absence of receiving a signal a signal from the fire alarm system.

In normal operation, the fire alarm will detect smoke before heat has increased to the level where the ETL will activate. The smoke detected will set off the fire alarms, which will in turn signal the Smoke Control Panel to shut all dampers.

Each of the Fire Dampers will be wired back to a centralised Fire Smoke Panel located adjacent to the existing Fire Alarm Panel.

Two supplies will be required to each damper – a 2-core 230V supply and a 3-core monitoring cable. The two cables will interface to the CSFD motor through a junction box. The supplies from the junction box to the motor are 1 x 230v 2-core and 2 x volt free 3-core.

All existing fire dampers in the work package shall be removed from the ventilation systems and the ductwork made good. Where fire dampers are situated in proposed compartment walls, these are to be replaced with new CSFD.

4.2 Combined Smoke Fire Dampers

The Contractor shall supply and install new Combined Smoke Fire Dampers to be located in every fire barrier within and entering / leaving rooms. This includes fire rated ceilings which must have CSFD dampers installed above and fire rated ductwork down to the grille / diffusers to ensure that the fire compartment integrity is maintained.

The CSFD are to be mode 6 operation, which is 230 volt supplies, open on energise with open / close monitoring

The CSFD's are to be SS501 or SS601 dependant on being rectangular or circular duct spigots.

Control Mode 6

Installation Method – dependant on fire compartment wall in which they are located.
Options are:

IF –	for Concrete / Masonry Walls and Floors
DWFX-C -	for Dry Walls
DWFX-F –	for Concrete / Masonry Walls and Dry Walls
Sleeve and Angle -	for Concrete / Masonry Walls and Floors and Dry Walls

The CSFD Mode 6 damper actuator has a visual indicator pointer on the front of the actuator to indicate damper position.

It is the contractor's responsibility to identify the suitable installation method for each new combined fire and smoke damper to be installed, we would highly recommend the contractor liaises with the product manufacturer to ensure the correct installation methods are used. The location and type of construction shall be taken from the contractor's survey.

Combined Smoke and Fire Dampers are to be supplied by Messrs:

Swegon Air Management Ltd
Joseph Wilson Industrial Estate
South Street
Whitstable CT5 3DU

4.3 Electro Thermal Links

Every CSFD is to be supplied with an Electro Thermal Link (ETL). The ETL is mounted on the side of the ductwork with a sensing probe penetrating through the ductwork to detect heat above 72 degrees C within the duct.

The ETL is wired directly into the CSFD damper actuator. The ETL is supplied with a fly-lead for wiring into the damper actuator.

The ETL contains a Green indicating LED to display correct operation of the ETL.

The ETL also has a manual test switch integrated to allow periodic activation of the damper for testing purposes simulating actual fail-safe release under smoke/fire conditions.

4.4 Damper Connection Box

The contractor shall supply and install the optional Damper Connection Box (DCB) with each of the CSFD's

The DCB simplifies connection of the incoming cable connections from the Smoke Control Panel to the Mode 6 damper actuator.

The DCB acts as an interface to accept the 2x3-core monitoring cables from the damper actuator into a single 3-core monitoring cable back to the Smoke Control Panel.

4.5 Smoke Control Panel

The contractor shall supply and install a Smoke Control Panel in the Kedleston unit. Which must be zoned in line with the clients cause and effect strategy for the Healthcare facility.

The Smoke Control Panel will provide Control and Monitoring Functions of all CSFD's.

The panel type will be in the Actionpac LNS5 range (Mode 6).

The contractor is to allow for wiring of all CSFD's including accessories from the Smoke Control Panel. Each CSFD requiring a 2-core 230V supply and 3-core monitoring cable. It is expected these will be run in an enhanced fire rated cable to the manufactures required specification.

The contractor shall allow for the provision of power supplies to the panel, repeater panel, fire alarm interfaces and connections to the fire alarm system including any reprogramming required by the fire alarm manufacturer / maintainer.

The contractor will also allow for the running of a 3-core screened BMS cable back to an agreed interface point with the Hospital Engineers for incorporation into the Hospital BMS system and allow for a provisional sum for re-configuring of graphical interfaces of the front end of the BMS system.

The contractor is to allow for the panels to be commissioned by the Manufacturer and a certificate of conformity and operation issued by them. In order to stage the commissioning per wards multiple visits are required by the Manufacturer, these are to be incorporated into the tender price. The contractor shall propose the commissioning sequence in line with their projected programme of completion.

The contractor is responsible for the final specification, size and location of new control panels and managing the integration of the NHS cause and effect.

4.6 Imperative Ductwork Local Clean

The contractor shall ensure that prior to cutting into ventilation ductwork that each diffuser/grille situated on the same branch is 'bagged' to ensure any loose dust due to vibration is captured. Thereafter, once the contractor has cut into the ductwork (to install a new combined fire and smoke damper or to remove an existing fire damper) they must clean the ductwork internally 1.5m either side of cutting location and provide a 'local' clean to the surrounding walls, floors and ceilings that were affected.

4.7 Ventilation Ductwork

The Contractor is to allow for the modification of the existing ductwork to incorporate new Combined Smoke and Fire Dampers into each of the ducts crossing a fire compartmentation line. The Contractor shall be aware that there may be some local modification of ductwork locally to the CSFD to allow them to fit. It may also be necessary to move other services which may pass close to the CSFD, preventing them from being installed.

The Contractor will also need to ensure a straight length of ductwork is installed adjacent to the new CSFD with an access panel installed to allow cleaning and internal inspection of the CSFD

The entire ductwork installation on this project shall be carried out in sheet metal ductwork to DW144 Specification. Ductwork is to be Class A, Low Pressure with a combination of Rectangular and Circular ductwork.

Rectangular ductwork is to be constructed from single galvanized sheet with a minimum thickness of 0.6mm and a single Grooved Longitudinal Seam (Fig. 1) or Grooved Corner Longitudinal Seam (Fig. 2). Ensure that all necessary stiffeners are fitted.

Straight connections of ductwork lengths will be with integral or slide on flanges (Fig. 83). Slip joints of any kind will not be acceptable.

Bends on ductwork will be medium radius bends (Fig. 87).

Tees will be radius tees with turning vanes (Fig. 90).

Offsets will be mitred offsets (Fig. 97).

Branches will be Shoe branches (Fig. 106).

Air terminal connections will be Plenums with top or side connections as necessary (Fig. 120 or Fig. 121), cover plate connections are not acceptable (Fig. 122).

Circular and Flat Oval ductwork is to be spiral wound with straight connections being carried out using Socket and Spigot with connectors (Fig. 125 - Male). Slip joints will not be acceptable.

Bends on ductwork will be pressed bends (Fig. 127).

Tees will be pressed twin bends (Fig. 131).

Tapers will be concentric or eccentric (Fig. 132), short tapers will not be acceptable (Fig. 133).

Offsets will be mitred offsets (Fig. 134).

Branches will be Shoe branches (Fig. 136 or Fig. 140). Square and pressed branches will not be acceptable (Fig. 139 or Fig. 141).

Flexible ductwork to be foil faced Helix wired and be pre-insulated on ductwork connected to insulated galvanised ductwork.

The Contractor will be required to produce scaled dimensioned working drawings for all ventilation ductwork prior to installation. Any work carried out by the contractor without dimensioned working drawings being officially approved by the Engineer will be at the Contractor's risk.

4.8 Access Panels

The Contractor shall install a new access panel adjacent to either side of the new CSFD's to allow cleaning and internal inspection.

The Contractor shall provide the access panels in accordance with the requirements of DW144, TR19 and HTM 03-01.

The access doors shall be insulated to at least the same level as the existing ductwork insulation.

4.9 Insulation

Where new sections of ductwork and CSFD's are installed, the existing insulation shall be made good by replacing the sections closest to the CSFD's and making good to the existing and insulation to the new sections of ductwork installed. The insulation levels applied should be to the standards shown elsewhere in the specification or to match the existing, whichever is the greater.

Insulation needs only to be applied to systems previously insulated (note some existing extract systems are not insulated).

The contractor shall allow for all plenums and ductwork from the ceiling to the CSFD to be clad in fire rated insulation to achieve 1hr fire rating.

Section FIVE

Controls and Wiring

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5.1 System of Wiring

Wiring to the fire damper control system shall be carried out utilising Enhanced Fire Rated Cables concealed above ceilings and within the fabric of the building. The contractor should ensure that the wiring type chosen is one of the CSFD manufactures approved types and has passed through the CSFD manufacturers test procedures.

It should be noted that the Electrical Contractor must take into consideration BS5839-1-2002 recommendation 26F which states the method of cable support shall withstand a similar temperature and duration to that of the cable whilst maintaining adequate support. This, in effect, precludes the use of plastic cable clips, cable ties or trunking where these products are sole means of support of the cable.

As detailed above, the fire smoke panel will require a 230V mains supply fed via dedicated fuse spur from the local distribution board and a fire alarm interface, which will also require a 230V mains supply from an unswitched fused spur. Allowance should be made for integration of the fire alarm interface onto the existing incumbent fire alarm system for the site.

Allowance should be made for all necessary recommissioning of the existing fire alarm system to incorporate new interface units.

Allowance should also be made for a 3-core BMS cable to be linked back to the site-wide BMS system. Subject to agreement with the Trust, from the main smoke panel location each fire damper the Electrical Contractor shall provide a 230V 3 core supply feed via a 3A fused switched spur adjacent to the fire damper.

From the main fire alarm smoke panel an additional 3-core indication cable shall be wired back from the junction box.

Allowance should also be made for connections from the junction box to the fire damper and for the linking of an electro-thermal link and test switch from the smoke damper, which shall be positioned local to the damper.

As previously stated, all wiring between the main fire smoke panel and damper equipment and main fire smoke panel and repeater panel is to be carried out an Enhanced fire rated cables, suitably sized for the distances involved and meet the required specification by the manufacturer.

The operation of the fire alarm interface unit shall be integrated into the site-wide 'cause and effect' strategy for the site. The contractor once appointed shall request the existing fire alarm strategy drawings for each fire alarm panel in the work package.

It is strongly recommended that liaison is carried out with Panel / Damper Manufacturers engineers to ensure all their recommendations and standards are met during the installation of the wiring system.

Section SIX

Associated Builder's Work

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6.1 General Description

This specification covers the works to be carried out and materials to be used for the Builder's Works associated with the motorised fire damper works at Kedleston Unit for Derbyshire Healthcare NHS Foundation Trust under the supervision of:

EP Consulting
Alpine House
16A Alpine Street
Old Basford
Nottingham NG6 0HS
Tel: 0115 924 4433

6.2 Contract Conditions

Contract Conditions can be obtained from the main Contractor. It is envisaged that the successful building contractor will become a domestic sub-contractor to the mechanical Contractor.

6.3 The Works

The works include replacement of existing thermal link fire dampers with motorised smoke and fire dampers which penetrate fire barriers and make good. A new smoke panel, repeater panel and mimic panel to be installed and works to be made good.

The general term `Making Good` shall mean the following:

- Re-instatement of the building fabric to the same construction, specification and finish as that of the adjacent/existing building fabric.
- Provision of any `Fire Stopping` required to bring the affected building fabric to the required fire integrity rating, which in this case shall be 1 hour fire rating.
- Decoration of the building fabric to the same specification and colour as that of the adjacent/existing building fabric.

6.4 Programme of Works

Please refer to the main Contractor for the programme of works.

6.5 Type of Construction

Full details of type of construction of the building can be ascertained from visiting site.

6.6 Standards

The works shall be carried out in accordance with the Building Regulations and the latest British and harmonized European Standards including the following:

- British Standard Code of Practice for Brickwork CP 121.101
- Bricks BS EN 771-1
- Concrete Blocks BS EN 771-3&4
- Plastering & Plasterboards BS 8481:2006
- Masonary Cement Mortar BS EN 413-1:2004
- Building Sand BS 1200

Section SEVEN

Tender Summary and Form of Tender

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DHFT Kedleston Unit, Motorised Fire Dampers

Summary of Tender – Mechanical Services

1. Preliminary Schematics and Drawings	£
2. Removal of existing Fire Dampers	£
3. Installation of Combined Smoke Fire Dampers	£
4. Installation of new Smoke Control Panel	£
5. Installation of Wiring to CSFD System	£
6. BMS Interface	£
7. Fire Cladding new CSFD's to Fire Barriers	£
8. New Kitchen Fire Rated Ductwork	£
9. Commissioning of new Smoke Control System by manufacturer	£
10. Demonstration of System to Client	£
11. "As Installed" drawings and O & M Manuals	£
Sub Total	£
Provisional Sum – Additional fire dampers not indicated	£ 2,000.00
Contingencies	£ 10,000.00
TOTAL TENDER SUM	£

For and on Behalf of:

Signed:

Date:

Note: Tender will not be valid unless submitted on this form.

DHFT Kedleston Unit, Motorised Fire Dampers

Mechanical – Daywork Rates

Labour

Normal Time

Advanced Fitter/Welder	Rate	£
Fitter	Rate	£
Assistant/Mate	Rate	£
Refrigeration Engineer	Rate	£

Rates for overtime working, excluding statutory holidays:

Labour

Time and half

Advanced Fitter/Welder	Rate	£
Fitter	Rate	£
Assistant/Mate	Rate	£
Refrigeration Engineer	Rate	£

Labour

Double Time

Advanced Fitter/Welder	Rate	£
Fitter	Rate	£
Assistant/Mate	Rate	£
Refrigeration Engineer	Rate	£

Daywork Percentage Additions

Materials	nett cost	+ %
Labour (HVCA/RICS Definition)	nett cost	+ %
Sub Contracts	nett cost	+ %
Plant	nett cost	+ %

Signed Dated

Name of Company

Address

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