



**SECTION E
MECHANICAL ENGINEERING SERVICES
SPECIFICATIONS**

Danesholme Communicare Centre,

Kingswood Children's Centre,

The Autumn Centre

**PLANT, PIPEWORK AND FAN CONVECTORS REPLACEMENT
WORKS.**

15 May 2019

ISSUE 2

P02 Date 28.05.2019: Autumn Centre Boiler Room 1 replacement works are excluded form the scope of works, refer to page 37-39.

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The Autumn Centre
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MECHANICAL ENGINEERING SERVICES

STANDARD SPECIFICATIONS

GENERAL

The Mechanical Engineering Services Standard Material & Workmanship Clauses shall be applicable to all mechanical engineering works, unless otherwise stated in the Particular Specification, or on the drawings. It shall be read in conjunction with any standard preliminary clauses, any Particular Specification and/or drawings applicable to the works. Where discrepancies arise between these documents the order of precedence shall be as follows: -

Drawings.

Particular Specification.

Standard Material & Workmanship Clauses.

The symbols used on drawings shall be in accordance with those appended to this specification.

S1 COMPLIANCE WITH REGULATIONS AND CODES OF PRACTICE

The works shall be carried out in accordance with all relevant statutory requirements, the requirements of the gas and water utility, British Standard Codes of Practice, Approved Documents of the Building Regulations, and recognised trade association and professional institution practices.

All regulations, standards etc., referred to shall be deemed to incorporate all current amendments and guidance notes in force.

Where applicable the recommendations of the Building Services Research and Information Association (BSRIA) shall be complied with.

Where an interpretation or a recommendation concerning any of these requirements has been published by Gas Safe this shall be taken as the definitive version.

S2 MATERIALS AND WORKMANSHIP

All materials used shall be new and unused, and shall both before installation and on completion, be free from rust, scale, deformation or discolouration and be of the type and manufacture specified. They shall conform to the requirements of any appropriate British Standard Specification and be CE marked.

No materials generally known to be deleterious shall be used.

Any materials which show deterioration due to neglect in storage or installation will not be accepted.

The specific instructions of original equipment manufacturers shall be adhered to in every respect.

Workmanship shall conform to the standard of first class engineering practice.

Equipment shall be erected plumb and true with fixings capable of sustaining a minimum weight of 40kg or three times the weight of the item, whichever is the greater. No item shall rely on one fixing only.

S3 CONTRACT DOCUMENTATION

The Contract documents shall be deemed to include those drawings and specifications on which the Contract for the works are based. Drawings may include Sketch Drawings, Schematic Drawings or Detailed Design Drawings.

The determination of unspecified parameters may form part of the works. This could include the production of Co-ordination Drawings and Schedules where these are not included as part of the Tender Documentation or stated as to be produced during the Production Information Stage.

The Particulars of Contract shall state whether the Construction (Design and Management) Regulations (CDM) apply in full. In such instances the Planning Coordinator's pre-contract Health and Safety plan will accompany the tender documents.

Where a tender summary and schedule of rates are included in the Particular Specification these shall be completed fully and submitted with the tender to be used for pricing any variations, additions, omissions etc.,

S4 INSTALLATION DRAWINGS AND BUILDERS WORK DETAILS

Installation Drawings, Shop Drawings, and Builders Work Details shall be produced by the Contractor for the construction of the works.

These shall be submitted for comment prior to any installation and/or manufacture taking place. Two sets of drawings shall be required showing details of plant rooms, general arrangements of the installation, wiring diagrams for control circuits, layouts of panels etc.

In all cases installation drawings shall be required for ductwork and for all major items of plant to be installed.

S5 HANDOVER INFORMATION

Record Drawings

Prior to Practical Completion a complete set of drawings showing the installation as installed shall be provided. They shall beforehand be submitted for comment for suitability of purpose (but not accuracy) and shall include all the requirements detailed in BSRIA Technical Note 15/95.

The drawings shall initially be prints for inclusion in the O & M Manual (inserted into clear PVC envelopes). Subsequently an electronic copy on CD or DVD shall be issued on contract Practical Completion.

Operating and Maintenance (O & M) Manuals

Two copies of an Operating and Maintenance Manual shall be provided 14 days prior to Practical Completion as part of the works. It shall include all the information necessary to provide for the safe and efficient operation and maintenance of the engineering services which comprise these works.

The manual shall meet the requirements of the following:

BS 4844	Specification for Technical Manuals.
BS 4940	Recommendations for the presentation of Technical Information etc.,

BG1/2007

Building Applications Guide Handover, O&M Manuals and project feedback

Health and Safety at Work Act 2007 (HSWA)

Construction (Design and Management) Regulations 2015 (CDM)

Control of substances Hazardous to Health Regulations 2010 (COSHH)

Manuals shall be either Class B or Class D as described in BSRIA BG1/2007. The appropriate type of manual shall be specified in the Particular Specification or on the drawings. Where not so specified the manual shall be Class B.

Class B manuals shall generally comprise:

- Record drawings and drawing symbols.
- Manufacturer's operating and maintenance instructions.
- Test and commissioning certificates.
- Warranties.
- Equipment inventories with manufacturers names and addresses.

A Class B manual **may** be prepared by the Contractor.

Class D manuals shall comprise the contents detailed in BSRIA BG1/2007, which shall generally be as follows:

- Record drawings, symbols, charts and schedules
- How to use the manual
- Emergency information
- Contractual and legal information
- Systems description and design intent
- Asset list/equipment schedule
- Parts identification and recommended spares
- Spares policy
- Commissioning data
- Operation
- Maintenance recommendations and records to date
- Fault finding
- Lubrication
- Modification information
- Disposal instructions
- Names and addresses of manufacturers
- Index of plans and drawings
- Manufacturer's literature

A Class D manual **shall** be prepared by a specialist author as recommended by BSRIA or as approved by the Contract Administrator.

Both classes of O & M manual shall include full details of start-up and shut down procedures, any necessary schematic drawings showing the location of control valves and plant etc., including where appropriate a coloured drawing to indicate areas of zoning. Also included, shall be copies of valve charts.

Manuals shall comprise loose-leaf A4 pages on good quality paper suitable for heavy usage, inserted in four-ring PVC covered hardback binders having stepped overlapping card dividers between sections.

An information sheet shall be provided in the front of the manual listing the names and addresses of the installation, the author, the consulting engineer (Kier Business Services Ltd) and the installation Contractor.

Manual details and the relevant information shall be provided on the front cover and the spine.

The Client shall have sole copyright.

Practical Completion may be withheld until the O & M manual has been substantially provided.

Maintenance

All systems shall be properly maintained in accordance with the manufacturer's requirements, and relevant British Standards and trade practices etc., to the date of Practical Completion (unless ongoing maintenance comprises part of the specified works). As part of the O & M manual, comprehensive maintenance recommendations and records of maintenance to date shall be provided. From the date of Practical Completion, the Client will assume the responsibility for maintenance (unless maintenance is part of the works).

Where the O & M manual, record drawing or any other relevant maintenance information is not handed over prior to Practical Completion, the Contractor shall be responsible for the cost of maintenance and the consequences of a lack of proper maintenance during the period between Practical Completion and approval of the relevant documents, as detailed in BSRIA BG1/2007.

Health and Safety File

The O & M manual, inclusive of all record drawings, shall comprise an integral part of the Health and Safety file as defined by the Construction (Design and Management) Regulations (CDM apply in full to the works) irrespective of whether these regulations apply in full to the works.

Where the CDM Regulations apply in full to the works, the Planning Coordinator shall approve the Health and Safety File and may not approve Practical Completion until a suitable file is prepared.

S6 DEMONSTRATION AND INSTRUCTION

At Practical Completion the building occupier shall have the whole of the works described and demonstrated to them. This shall include instruction in the use of all plant, operation of all equipment, systems, controls, isolation and minor maintenance procedures, etc., all as is necessary to enable the systems to be fully understood and correctly operated.

It should be noted that the Instruction cannot properly take place until the Operation and Maintenance Manual has been provided and that the said Instruction is subject to those Health and Safety Implications detailed for O & M Manuals.

S7 VISITS TO SITE

Where the work involves the alteration, extension or modification of an existing installation in an existing building, the Contractor is advised to visit the site prior to submitting a tender to ascertain the full extent of the work. No claims for additional work, which should have been identified by a site visit, will be considered.

S8 ASBESTOS OR OTHER SUBSTANCES HAZARDOUS TO HEALTH IN EXISTING BUILDINGS

The Contract Administrator shall inform the Contractor where asbestos or other substances which are hazardous to health are **known** to exist.

The Contractor shall inspect the premises' Health and Safety File for records of asbestos or other substances prior to commencing the works. The employer may have records additional to those in the Health and Safety File. Where the Health and Safety File is not present or in the opinion of the Contractor is not complete, the Contractor shall request additional records from the employer, and such records shall not unreasonably be withheld.

Attention is drawn to the fact that works may be required near asbestos of one form or another.

The Contractor will be required to inspect the Property Asbestos Log Book (for buildings where they exist) prior to carrying out any works on existing buildings and must sign in the appropriate column to confirm he has done this. He will be required to follow the procedures set out in the Log Book. If the Log Book indicates that the area of works will disturb asbestos, the Contractor must inform the Contract Administrator and await instructions.

If asbestos is specifically mentioned in the Particular Specification, then the specified instructions shall be executed.

Where during the course of the works, asbestos or other substances are found, which in the opinion of the Contractor are hazardous to health, any work which involves the disturbance of such a substance shall be immediately stopped. If working within a ceiling void or duct, close the access covers, or if working in a boiler or plant room, close the door and put up a notice "NO ENTRY". Inform the Contract Administrator immediately and await further instructions.

If an accident occurs whereby asbestos or other substances are inadvertently disturbed in no circumstances attempt to sweep up or dispose of it but report to the Contract Administrator after complying with the above requirements.

S9 WORK ON EXISTING SYSTEMS

Where work is carried out on systems serving an existing building, and the building is to remain occupied for the duration of the contract, allow for the fitting and if necessary removal of temporary valves and bypasses to enable the services to be maintained to the occupied part of the building. The Contractor shall therefore be clear about the programme to enable this to be included in the tender. All draining and refilling to enable fitting of these temporary valves etc. shall be done outside of normal working hours.

S10 VALVE AND GAS CHARTS

Provide and fit in glazed wooden frames, either in the boiler house or meter room as appropriate. The charts shall have the name of the installer clearly visible and shall be of the standard size called for in the particular specification.

Valve Charts

These shall contain a schematic drawing of the system which shall be fully noted with each valve referenced according to the labels/discs fitted. A full schedule shall be included to give details of the valve number, description, function, size and

make. Where valves are labelled and shown on the drawing but are not actually fitted in the boiler house their location shall also be noted on the drawing.

Gas Charts

These shall be fitted in the main meter room and show the exact route and location of all gas pipework installed in trenching, floor ducts etc., and where it enters and leaves any parts of the building. The drawing shall be noted to include details of size, location of isolating valves etc. Where pipework is buried in the ground at other than the minimum depth stated in clause S16.2 then this too shall be noted.

S11 MAINTENANCE AND ACCESS KEYS

The Contractor shall ensure that sufficient keys are handed over to the Responsible Person to enable routine maintenance and inspection of the plant to be carried out. This includes keys for control panels, fan convectors and other plant, and radiator vent keys.

S12 VISIBLE AND CONCEALED POSITIONS

Throughout the whole of this Specification the words "visible position" shall mean a position within the building and is to include such areas as the Boiler House, Plant Room etc.

The words "concealed position" shall indicate locations not normally seen by a person within the building such as floor and wall ducts and chases, ceiling voids and roof spaces, and those areas behind fixed items of furniture and within appliance casings etc. Pipework within stores and cupboards shall also be deemed to be concealed.

S13 PIPEWORK GENERALLY

No structural steel shall be drilled for the passages of pipes unless the Contract Administrators approval has been obtained in writing.

During constructional work on the pipework, great care shall be taken to prevent any foreign matter entering the pipes. All open ends shall be temporarily capped or plugged with the appropriate pipe fittings until the pipe line is complete. Wooden plugs and the like shall not be used.

Transverse cuts in pipes shall be made with a hacksaw or pipe cutting tool and shall be square with the axis of the pipe. The use of oxyacetylene cutters on pipes will not be allowed.

The ends of the pipes when cut shall be well reamed to give an unrestricted bore, and to remove burrs before fixing. Include to disconnect any two sets of pipes nominated by the Contract Administrator. Should inspection reveal any neglect of the reaming referred to, then as much pipework as deemed necessary by the Contract Administrator will be removed, reamed as necessary and re-fixed at no additional cost to the contract.

Except in the case of galvanised pipework the use of fire-made or cold-pulled sets or bends shall be used wherever possible on 65mm and larger tubes up to a bend of 45° from the straight, but for larger angles, welding fittings shall be used.

In concealed positions on 50/54mm and smaller pipes, the maximum use of bending is preferred irrespective of the angle of deviation. In either case, the bends must be carefully formed so that there is no distortion of the true section of the tube, no thinning of the tube wall and no damage to the metallic structure.

In general, pipework in boiler rooms shall have the horizontal pipes run on the walls with vertical pipes passing in front to avoid multi-crossing of pipework. Wherever possible pipes or any other systems in boiler rooms shall not cross access areas and walkways at low level, these pipes being set up to 2100mm and down again with the necessary drain and vent points.

Allow 90mm space minimum between pipes where insulation is to be applied.

In visible positions fittings shall be used except where otherwise directed by the Contract Administrator.

No welding will be permitted on galvanised pipework.

S14 PIPEWORK & DUCTWORK IDENTIFICATION

General

All heating, hot water, mains water mains, cold water down services including cold feeds and open vents, refrigeration pipework within all plant rooms, ceiling voids, duct risers, floor ducts typically, shall be service colour identification banded after application of insulations, at no greater than 10m maximum intervals and in any other locations where it is necessary for ease of service identification, fully in accordance with BS 1710.

Gas Pipework

All gas installation pipework shall be installed fully in compliance with The Institution of Gas Engineers IGE/UP/2 "Gas Installation Pipework, Boosters and Compressors on Industrial and Commercial Premises".

All internal gas pipework shall be painted Ochre Yellow throughout its entire length.

S15 EXTERNAL SERVICES LAID DIRECTLY IN THE GROUND (OIL, GAS, COLD WATER, HEATING AND HOT WATER)

Where Medium Density Polyethylene (MDPE) is utilised for both external underground gas and water pipework, magnetic marker tape shall be installed above these services, suitably inscribed, such that services can be traced. For other than MDPE pipework normal external underground service identification tapes shall be utilised.

These specialist tapes shall be installed fully in accordance with the manufacturer's requirements.

Oil

All external oil line piping laid in the earth shall be carried out in black heavy grade welded steel tube to BS 1387.

Oil lines shall be welded throughout unless specifically called for to the contrary in the Particular Specification.

After testing, the pipes shall be Denso pasted and wrapped with the standard grade of Denso tape with 55% minimum overlap and then wrapped in Denso self-adhesive PVC tape, all in accordance with manufacturer's recommendations.

All oil pipes shall be laid in trenching that provides a minimum of 600mm cover when backfilled.

Gas

All external gas services below ground, shall be carried out using: -

MDPE 11 Bar Operating Pressure pipe to BS 7281.

Fusion Fittings shall be to BS 7336.

Where steel pipework is called for in the Particular Specification and where gas pipes enter and exit the ground, to and from buildings this shall be carried out in accordance with clause S16.1

All external gas services shall be laid in trenching that provides the following minimum cover when backfilled: -

All gas pipework under a roadway shall be sleeved and laid with not less than 750mm cover.

All other gas pipework shall be laid with not less than 600mm cover.

Cold Water

All external cold-water services run in the earth shall be as follows: -

Pipes up to and including 63mm Outside Diameter

Medium Density Polyethylene Pipe (MDPE) manufactured to BS 6572 and based on Water Industry Specification (WIS) 4-32-02 1987. Blue in colour. Tested to 12 Bar. Installed where possible without buried joints. Very long runs shall be jointed using plastic fittings.

Pipes 90mm Outside Diameter and Above

Medium Density Polyethylene Pipe (MDPE) based on the Water Industry Specification (WIS) 4-32-03 1987. Blue in colour. Tested to 10 Bar. Jointing to be by means of electro-fusion socketed polyethylene fittings to WIS 4.32.04, carried out only by approved trained operatives.

Alternatively, mechanical joints shall be to Water Industry Specification (WIS) 4.24.01: 1987, and 2013 (updated version)

All external cold-water pipes shall be laid in trenching that provides a minimum of 900mm cover when backfilled.

Heating and Hot Water Services

Heating or Hot Water Service pipes shall not be laid directly in the earth, excepting where proprietary pre-insulated and mechanically protected external underground pipework is specified.

S16 EXTERNAL SERVICES IN PURPOSE MADE DUCTS OR COVERED WAYS ETC.

Oil and Gas

As Clauses S16.1/2

Hot and Cold Water

All hot and cold-water pipework shall be carried out in either copper tube to BS EN 1057 R220 with a 25-year guarantee, or galvanised heavyweight steel to BS 1387, as called for in the Particular Specification.

Heating

All heating shall be executed in black heavy grade welded steel tube to BS 1387.

S17 INTERNAL SERVICES

Oil

All internal oil lines shall be in black heavy grade steel tube to BS 1387 or in copper pipe to BS EN 1057 R250 as called for in the Particular Specification.

Screwed fittings will not be permitted except for final connections to oil burners, fusible link valves, isolating valves etc., lines shall be welded throughout or use suitable grade capillary fittings for copper pipelines, as appropriate.

Heating and Gas

All heating and gas installation pipework within the main fabric of the building shall be executed in medium grade black tube to BS 1387 or copper tube to BS EN 1057, R250 (with a 25-year guarantee), as called for in the Particular Specification.

Where copper is used for the gas installation then capillary fittings only shall be used.

Gas Pipework

All gas installation pipework shall be installed fully in compliance with The Institution of Gas Engineers IGE/UP/2 "Gas Installation Pipework, Boosters and Compressors on Industrial and Commercial Premises".

In addition to the above, within Educational Establishments, the gas installation pipework shall be installed in accordance with British Gas Publication IM25 "Guidance Notes on Gas Safety in Educational Establishments".

Jointing by compression fittings will not be permitted.

Hot Water and Cold-Water Services

Hot and cold-water pipework shall be carried out in light gauge copper tube to BS EN 1057 R250 with a 25-year guarantee.

Where the work involves additions and/or alterations to an existing system containing galvanised pipework then all new pipework shall be carried out using galvanised steel to BS 1387 medium weight with final connections to basins etc. carried out in light gauge copper tube as detailed above.

NB. Copper tubes and fittings must not be used on galvanised, hot water systems where it forms part of the circulating pipework.

All screwed joints on potable supplies shall utilise a jointing material approved by the WRAS and in compliance with The Water Supply (Water Fittings) Regulations henceforth known as the Water Regulations.

S18 SCREWED STEEL PIPEWORK AND FITTINGS

Screwed joints and fittings to BS 143 & 1256 and BS EN 10242 shall be used in all visible positions up to and including 50mm diameter with malleable fittings. All galvanised tubes irrespective of size shall have screwed joints, and galvanised fittings.

All tubes shall have clean cut ends screwed to BS 21.

Generally, sweep tees, twin elbows and bends shall be used throughout the installation. However, no screwed fitting shall be installed such that part of it is buried in the building structure/sleeve. Therefore, square tees and elbows shall be used at all 'through the wall positions' and where tees are used for venting.

Reduction in the sizes of all pipes to be made with reducing fittings, concentric in the case of vertical pipes and eccentric in the case of horizontal pipes; bushes will not be permitted.

All screwed joints on non-potable supplies are to be made with a suitable approved jointing compound and hemp.

The amount of hemp used shall be a minimum necessary and all joints shall be cleaned to remove all visible traces on completion of a sound joint.

S19 WELDED STEEL PIPEWORK AND FITTINGS (EXCLUDING GALVANISED PIPEWORK)

Welded joints shall be used on all steel pipework in concealed positions and on pipework 65mm diameter and over in all visible positions, unless specifically detailed otherwise in the Particular Specification.

All pipework shall generally be in accordance with Clause S19 with the provision that all lengths shall be supplied with plain ends.

Welding may be of the oxyacetylene or electric-arc process and is to be carried out in accordance with the recommendations issued by the Heating and Ventilating Contractors Association booklet "Welding of Carbon Steel Pipework - Specifications and Guide to Good Practice" TR5 and shall comply generally with the British Standards BS 2971 and BS 26402. Welding to be undertaken by CITB/City & Guilds qualified welders. Current competency of welding shall be provided either by Current Certification or site demonstrated by appropriate weld type test pieces production and examinations.

The Contract Administrator may, from time to time during the progress of the work, select welded joints which shall be either radiographically tested or cut out and examined in such a manner as may be required. The Contractor shall allow for this in his tender.

Tack welds must be performed by operatives of the same qualifications as the welders and must fully penetrate the pipe walls. The use of properly constructed welding clamps to ensure correct alignment for welding is essential.

Where welding is carried out in proximity of inflammable material, the installer shall take special precautions to protect the building fabrics from the risks of fire and any other damage.

Upon completion all welded joints shall be thoroughly cleaned and painted the same day.

On welded steel pipework to BS 1387 seamless steel butt welding pipe fittings shall be used to BS 1965: Part 1.

All branch connections shall be of the easy sweep type and shall be of the seamless steel butt welding branch bend type fittings, or in the case of pipework 32mm and below, the branch may be formed from piping carefully formed to an easy sweep.

Carefully shaped holes shall be used for all drain valves and air venting points.

Reducing pieces shall be of the butt welded concentric type on vertical pipes, eccentric type on all horizontal pipes.

No segmental or cut and shut bends shall be used.

S20 COPPER PIPEWORK FITTINGS AND WELDING

Capillary joints to BS EN 1254/1 shall be used in all visible positions up to and including 54mm diameter. Pipework 67mm diameter and over may be bronze welded or joint formed.

Flanged fittings shall not be provided unless specifically called for in the Particular Specification.

All pipework which is welded must conform to the requirements of BS 1724 (Bronze Welding).

All copper pipe fittings used in conjunction with both external and internal installations shall conform to BS EN 1254/1. All fittings shall be potable type i.e. containing lead free solder. Where end feed fittings are used the solder shall be of the lead free type. The Contract Administrator may at any time request the removal of a joint for testing and if the solder is found to contain lead then as much pipework as the Contract Administrator considers necessary will be removed and replaced, using the correct materials, at no additional cost to the contract.

Under no circumstances will fittings of duplex brass (i.e. hot-pressed fittings and fittings containing beta brass) or fittings prone to dezincification be permitted.

The ends of tubes shall be correctly cleaned, and all rough edges removed before any joint is made. Tube formed bends may be used in concealed positions only, and shall be smooth and free from corrugation, backs of bends shall not be overstretched.

Where fittings are used on pipework 67mm diameter and over they shall be Gunmetal to BS 1400.

The correct size of adapter shall be used in all cases when it is necessary to extend from Imperial pipework.

S21 FLANGES AND UNIONS (STEEL)

Fit malleable iron unions on pipes up to and including 50mm diameter and flanges on 65mm and above at all major items of equipment - Boilers Pumps, Calorifiers, etc.- and where necessary to facilitate maintenance in addition to those required for erection purposes.

On pipework 65mm and over where mild steel flanges are used, the flanges shall be of the slip-on pattern with boss, faced and drilled and welded externally.

Drilling and dimensions of flanges shall be in accordance with BS 10 Table 'D' imperial flanges or BS 4504 - Part 3 metric flanges.

Flanges shall be smooth machined for the full width across the face of the flange and on edge but may be rough turned on the back. The two flanges forming a joint shall be flush with each other when in position and all bolt holes shall be in correct alignment with those of the mating flanges.

The face of the pipe shall be flush with the face of the flange in the case of steel flanges.

The flanges shall be bolted together with the necessary BS hexagonal nuts and bolts with washers under the nuts.

When fitted and pulled up tightly, no bolts shall project more than 4 threads through the nut.

Flanged joints on pipework shall have a Lingerie ring inserted between the flanges with the centre of the ring concentric with the bore of the pipe and in no way obstructing the bore of the pipe. The jointing ring shall be painted each side with an approved jointing compound before insertion between the flanges and shall lie inside the bolt pitch circle diameter (PCD).

Items of equipment supplied with flanges other than the above shall have joints completed with the manufacturer's special mating flanges and recommended jointing material.

S22 PIPE SUPPORTS

All pipework shall be supported by substantial brackets, hangers or clips of approved type.

The layout of the piping shall consider expansion and contraction particularly at the ends of runs where changes of direction occur.

Include for all drilling of walls and slabs etc. for fixing screws, rawlbolts, resin bonded bolts etc. and for the fixings themselves.

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

Care must be taken to ensure that the axis of the pipe is parallel with the axis of the pipe ring or hanger.

Pipes shall have sufficient clearance behind for the proper application of the insulating material where necessary. The finished surface of any covering shall be at least 5mm from the walls etc., and the bare pipes shall be at least 10mm clear from adjacent walls etc. except in the case of installations in kitchens where the minimum clearance of all pipes shall be 25mm.

Pipe supports shall be positioned at intervals not more than those given in the following table.

All Dimensions are in millimetres

Nominal Bore	Horizontal Pipes		Vertical Pipes	
	Steel	Copper	Steel	Copper
15	1800	1200	2400	1800
20	2400	1200	3000	2400
25	2400	1800	3000	2400
32	2700	2400	3000	3000
40	3000	2400	3600	3000
50	3000	2700	3600	3600
65	3000	3000	4500	3600
80	3600	3000	4500	3600
100	3900	3000	4500	3600

The following methods of support shall be used: -

Boiler House

Where possible horizontal pipes shall be run on the walls with vertical pipes passing in front. Up to 50mm pipes use malleable iron hangers and brackets. Above 50mm and up to 100mm pipes use malleable iron hangers and brackets supported from angle or channel irons. Above 100mm use steel split rings, manufactured from flat iron supported from angle or channel irons. Include all necessary steelwork. NB Pipes to in general be individually supported and not hung in banks.

Main Ducts (crawl way)

Pipes situated in the main ducts to be supported on cast iron roller brackets secured to the side of the duct. These supports are to be fixed at not more than 3 metres centres. Small bore sub-circuit pipes are to be supported at closer centres on build-in pattern pipe clips in accordance with the distances specified in the above table.

Work in collaboration with all other trades to ensure that all services are run correctly and neatly and ensure that all pipes of any one service occupy one side of the duct only.

Main Ducts (non-crawl way)

Pipes situated in main ducts which are to be permanently sealed and which are of insufficient size to enable access on completion shall be supported by drop rods and hangers from mild steel channels which are to be built into the sides of the duct, and to be of such length so as not to protrude through the sides of the duct.

In ducts over 1500mm wide then the method of support shall be detailed on the drawings.

These supports are to be mounted at 3000mm centres with smaller pipes having intermediary supports from larger pipes.

Subsidiary Ducts (less than 450mm wide)

Pipes in subsidiary trenches are to be supported on bearer pipes of not less than 40mm diameter laid on the floor of the trench at right angles to the pipe supported, the diameter of the bearer pipe being varied to suit the grading of the pipework supported and to be the full width of the duct.

Suspended Ceilings and Roof Spaces

Pipes shall be supported as shown on the standard drawings or on the detail drawing. Where no such drawing is given the pipes are to be supported on split ring hangers and drop rods secured to either roof or floor joists or through the floor structure over.

Structural Steelwork

Structural steelwork shall not be drilled unless written approval is obtained from the Contract Administrator.

Pipework secured to structural steelwork shall be supported on split ring brackets secured to purpose made steel clamps, the exact design of the clamp depending upon the form of the structured steelwork and the design of such clamps being approved by the Contract Administrator.

The use of explosive driven fixings may be permitted in certain circumstances, but written approval must be obtained from the Contract Administrator in all cases.

General Exposed Pipework

Pipework outside the boiler house and ducts shall be secured to the walls by School Board pattern clips. The pipes at low level to have the additional support of floor stands at regular intervals where suitable or sufficient wall fixings cannot be used.

Copper Pipes

Clips or hangers for copper pipes shall be as detailed above but constructed from Gunmetal or brass. Clips formed out of pressed metal will not be permitted.

S23 ANCHOR POINTS

The direction of expansion of all long pipe runs shall be controlled by securely anchoring the pipes to the building steelwork or structure.

The saddle clips shall be manufactured from flat section mild steel to the following sizes: -

Pipe Size	Saddle Clip
15mm - 22mm	25mm x 4mm
25mm - 54mm	32mm x 4mm
65mm - 108mm	40mm x 6mm

Supply all necessary mild steel sections, for the complete anchor point, the channel section being rigidly built into the building structure.

S24 PIPEWORK EXPANSION

Wherever possible the layout of the pipework shall consider expansion. Ensure that hangers, anchors and expansion points meet this requirement. Adequate provision shall be made at all connections to plant and appliances to avoid stresses due to expansion and contraction.

Where the available pipework layout does not permit the above, proprietary manufacture guided stainless steel pre-expanded expansion bellows shall be used. In addition, at the recommended positions indicated by the bellows manufacturer, additional pipework guides and the necessary anchors shall be installed.

S25 GRADING OF PIPEWORK

Generally, pipes to have a gradient set to allow for venting and draining the system of not less than 25mm in 6 metres and pipes to be fitted clear of all walls and floors. Careful observation of parallels and symmetry of arrangement is required throughout and in special instances the gradient of pipework may be lessened in order that this may be maintained.

S26 PIPE SLEEVES

All pipe passing through walls, floors, ceilings, etc. shall be provided with an oversize pipe sleeve of the same material as the pipe cut to finish flush with the surface of the building fabric. Sleeves in kitchen and toilet floors to project 25mm above floor, packed and then sealed with mastic. Sleeves shall be fitted as the installation proceeds. Split sleeves will not be permitted.

S27 WALL & CEILING PLATES

White plastic clamped pipe wall and ceiling plates shall be used at all wall and ceiling penetrations. Pipework centres and set off shall be such that plates are installed without cutting.

S28 DRAINAGE AND VENTING

Full provision shall be made whether or not shown on the drawings, for the drainage, and air venting of the system.

A drain cock is to be fitted at the lowest level on all sub-circuits.

Automatic air vents shall be installed to so vent all systems as required. These shall be British Steam Specialists (or agreed equivalent) type 'C' brass material complete with integral isolating valve and integral non-return valve. Copper BS EN 1057 R250 automatic air vent discharge drainpipes shall be either routed (preferably internally to discharge safely over an internal cleaner's sink) or externally utilising a suitable tundish to safely discharge at 150mm above ground level.

Existing Systems

When draining, or partially draining a closed system that contains treated water, include to replace or top up with the same treatment, to the correct level when the system is finally filled.

S29 THERMOMETERS

Dial thermometers shall be fitted in the following positions: -

- Either
 - On each boiler/boiler module or each boiler/boiler module heating flow
 - On common boiler/boiler module return
 - On each heating zone flow and return
 - On each hot water service primary flow and return
 - On hot water indirect cylinder/water generator or common hot water secondary flow local to unit

On common hot water secondary return at indirect cylinder/water generator unit
On all air handling unit flow and return connections local to coils

Each thermometer shall be 100mm diameter dial, straight or angle type as appropriate with a separate pocket screwed BSPT having a white dial with black numbering, graduated from 25°C to 110°C.

The thermometers shall be the gas pressure type having a black exterior finish unless otherwise specified in the Particular Specification.

Thermometer wells shall be fitted on the pipe lines. Where the pipes are 32/35mm diameter or below, allow for increasing the diameter of each section to 40/42mm diameter minimum for a length of 150mm for the proper fitting and insertion of the thermometer well.

S30 TUNDISHES

Tundishes shall be provided for the collection of drains and wastes.

Each tundish shall consist of a 22mm x 54mm concentric copper reducing socket connected by means of a 22mm pipe to a 28mm drain line run to drain.

The whole shall be neatly fixed from the floor or adjacent base by means of a flat or angle iron stand or clip.

S31 ALTITUDE GAUGES

A 100mm diameter dial altitude gauge shall be supplied and installed on each pump section and delivery port complete with gauge cock and 'U' syphon tube. The gauge shall depict suitable range metres head and barometric pressure and be complete with Red adjustable pointer.

Altitude gauges shall also be provided as indicated within the Particular Specification and/or on the proposed installations drawings.

S32 VALVES (HEATING)

Boiler House and Concealed Circuits

Double regulating valves (DRV) complete with measuring stations (MS) shall be installed on all heating system main components.

Main components shall be deemed to be typically but not limited to boiler/boiler module, each diverting circuit on common incomer port and by pass.

On mixing circuits bypass and common outlet for flow circuit regulation of all zones and sub zone circuits. Hot water service secondary returns at each outlet shall have DRV installed to enable balance to be achieved.

All valves up to 50mm shall be bronze full way pattern with screwed ends. Valves to be fitted with cast iron serrated hand wheel and to have wedge discs.

See Particular Specification for specific valve selections.

Valves of the above pattern but with lockshield in lieu of hand wheels shall be fitted on all cold feed connections.

All valves 65mm and over shall be flanged cast iron body full way pattern non-rising stem with solid wedge bronze trimmed and complete with serrated hand wheel. Flanged ends to be to BS10 Table 'D' imperial or BS 4504 PN6 metric.

Alternatively, where called for in the Particular Specification butterfly or ball valves shall be installed. All these types of valves to be ¼ turn from on to off and shall generally be threaded copper alloy construction for valves 50mm or less and fully lugged cast iron above 65mm.

Visible Circuits

All valves shall be bronze full way pattern with composition moulded hand wheel or lockshield as required.

Radiators and Other Heat Emitters

All Radiators and Natural Convectors shall be provided with an accessible head chrome plated angle built in sensor thermostatic radiator valve (TRV) on the flow and an accessible chrome plated angle lockshield (L/S) radiator regulating valve on return.

All heating pipe coils shall be provided with straight pattern (TRV) on flow and L/S straight pattern regulating valve on return.

Fan convectors and unit heaters and all other forms of heating shall be fitted with a wheel valve on the flow and a lockshield valve on the return. The valves shall be straight, or angle pattern as required. Valves both TRV and regulating on radiators installed on single pipe systems shall be suitable for this application and shall utilise diversion tees on the radiator return connection where necessary.

S33 VALVES (HOT AND COLD-WATER SERVICES)

Boiler House and Concealed Circuits

As specified for heating.

Where butterfly valves are specified they shall incorporate a nitrite body lining.

Visible Circuits

All valves to be bronze gate valves non-rising stem lockshield type.

Towel Rails

All valves to be chrome plated and as specified in Clause S33.3

Stop Cocks

All water outlets whether hot, tank or mains water fed shall be provided with a service isolating valve.

Stop cocks up to 54mm shall conform generally to the requirements of BS 1010 and in the case of the low pressure tank feed cold water service and hot water service they shall have pinned jumpers or positive rise valve stems, i.e. non-rising spindle type.

All stop cocks shall have lead free solder, be gunmetal or non dezincifiable and lockshield.

Double Check Valves

Double check valves shall be fitted to all external water points etc. as required by The Water Regulations.

S34 GAS ISOLATING VALVES

Gas manual isolating valves shall be provided to enable all items of fixed gas equipment and laboratory gas taps to be isolated. They shall be of the ball valve pattern as called for in the Particular Specification.

Within all food technology/domestic science classrooms, all existing to be reused gas cookers, and all new gas cookers, shall be connected to the gas pipework utilising 1200mm long by 15mm diameter rubber flexible gas connection hoses complete with plug bayonet end and self-sealing bayonet socket gas isolating valve.

The bayonet gas isolating valve shall be so positioned as to not interfere with the cooker position.

Cooker steel plated restraining chains shall be provided.

Where additional gas isolation valves are required, these shall be in addition to the gas valves stated above and shall be described within the Particular Specification and/or shown on the drawings.

S35 VALVES USED IN CONJUNCTION WITH COPPER PIPEWORK

Where valves are used in association with copper pipework then the valve shall be arranged where possible for direct connection by means of capillary end connections.

S36 VALVES AND STOP COCKS GENERALLY

All water outlets whether hot, tank or mains water fed shall be provided with a full way brass quarter turn ball isolating service valve, Water Regulations Advisory Scheme (WRAS) approved. In all cases valves should be fixed in the most inconspicuous position available whilst at all times being accessible for operation. The Contract Administrator may order any valve to be removed if in his opinion a more suitable position is available on the circuit.

The numbering of valves and the preparation of a valve chart will be required.

Provide three sets of keys for operating each size of lockshield valve and stop cock.

Contractor's Certificate

Where a water fitting is installed, altered, connected or disconnected by an approved contractor, the contractor shall upon completion of the work furnish a signed certificate stating whether the water fitting complies with the requirements of these Regulations to the person who commissioned the work.

S37 RADIATORS GENERALLY

A Radiator Schedule shall be included within the Particular Specification and/or on the drawing. Each radiator is to be supplied with air release valve as standard fitment. Certain radiators are to be suitable for TBOE and TBSE connections as shown on the schedules. Where BOE connections are used in conjunction with cast iron radiators, a blind nipple shall be fitted between the first and second section.

Work in conjunction with builders, plasterers, painters, etc., and include for taking down and re-fixing twice the whole of the radiators as and when required by other trades.

Cast Iron Radiators

To be of the type and size as shown on the Radiator Schedule.

Radiators without feet shall be secured to the walls by means of top stays and bottom brackets manufactured by the radiator manufacturers. All top stays to have dome nuts and the number of top and bottom brackets used are to be in accordance with the manufacturer's recommendation.

Radiators with feet are to have the above type and number of top stays as recommended.

Steel Radiators

These shall be of the pattern and to the sizes shown in the Particular Specification Radiator Schedule. Radiators shall be secured to the wall by means of the screw-on type brackets recommended by the manufacturers using 50mm x 12 gauge screws. Brackets shall be fixed at the centres recommended by the manufacturers. Radiators shall be to BS EN 442-1, BS EN 442-2 and BS EN 442-3.

S38 PIPE COILS

Pipe coils shall be fitted where shown on the drawings and shall include a thermostatic straight pattern radiator valve on flow and a regulating valved return connection with eccentric reducing sockets as necessary, as specified elsewhere, and with air cocks.

S39 FAN CONVECTORS

Fan convectors to be as detailed on the schedule and/or shown on the drawings. All fan convectors to be fitted on a 100mm high plinth, either timber with skirting finish or proprietary metal, as detailed on the schedule and/or drawings, unless otherwise indicated.

S40 UNIT HEATERS

Unit heaters to be as detailed on the schedule and/or the drawings.

Each unit is to be connected in such a manner that all air venting will take place through the pipe connections. Where this is not possible an extending air pipe with cock shall be run to an accessible position to be decided by the Contract Administrator

Include for supplying and fixing special suspension units for all overhead unit heaters, but do not proceed with any form of suspension until such time as the proposals have been discussed and agreed with the Contract Administrator.

S41 WATER STORAGE CISTERNS AND FEED AND EXPANSION CISTERNS

General

Cold water main to each cistern ball valve, shall be complete with a stop cock.

Warning pipes shall be fitted to all cisterns and for cisterns of 1000 litres capacity or less shall be the only form of warning and shall discharge in a highly visible position.

Above 1000 litres capacity to 5000 litre capacity an overflow, in addition to the warning pipe, shall be run to discharge clear of the building in an agreed position.

For storage cistern capacities greater than 5000 litres capacity, but less than 10,000 litres capacity, the cistern shall be fitted with a suitable instrument which indicates when the water level is not less than 25mm below the overflowing level of the lowest overflow pipe.

For storage cistern capacity exceeding 10,000 litres the cistern shall be fitted with an audible or visual alarm operating independently of the ball valve or device that controls the inflow of water.

All cold feeds and down service pipes shall be fitted with valves. Boiler cold feed valves shall be lockshield, other valves to have a hand wheel. All valves to be as near as possible to the tank connection.

All valves and stop cocks to be fitted as close to the cisterns as possible and all must be accessible, where there is more than one water storage cistern these shall be interconnected and fitted with isolating valves.

The heating feed and expansion cistern shall be fitted with a long arm ball valve set so that not more than 100mm of water will be in the cistern under unheated conditions. The body of the valve shall be fixed above the cistern overflow level.

The cold water storage cistern shall be fitted with an approved pattern "Portsmouth" ball valve up to 25/28mm inlet size but above this size an approved type of equilibrium valve shall be used.

Water Storage Cisterns

Shall be WRAS approved and shall fully comply with the Water Regulations Schedule 2/16 requirements. Each cistern shall be suitable for cold water and have a rigid close fitting and securely fixed cover. Cisterns above 500 litres shall be fitted with a 450mm square tank and ball valve access cover. Cisterns to be complete with all necessary external reinforcement, built into the tank material to prevent the need of any maintenance. Internal stiffeners should not in general be used, but if stiffeners are necessary these shall be coated and built in. The tank to be capable of and tested to hold the

contents when full to the brim. Dimensions to be as the Drawings or the Particular Specification. NB the cisterns to be cut/drilled on site for tank connections and shall be provided with an overflow internal bend and extension pipe, lid air filter and overflow filter. Expansion pipe holes to be sealed. GRP tanks to be provided with drip trays, when fitted above ceilings, with drains run to suitable external position.

Feed and Expansion Cisterns

Feed and expansion cisterns shall be of GRP or polypropylene and specially constructed for heating systems, capable of holding boiling water for short bursts. Cistern to be complete with loose lids, in two sections on large tanks and slotted for the expansion pipe. Tested, cut and drilled as above. See Particular Specification for detail.

S42 CYLINDERS

Cylinders shall be copper for copper pipework installations and galvanised for galvanised pipework installations and shall be compliant with BS 853.

Indirect cylinders shall be: -

Up to 450 litres

Vertical cylinders shall be fitted with a heating coil of plain copper tube, and a clean out 100mm diameter hand hole.

Horizontal cylinder shall have annular heaters and bolted heads.

Above 450 Litre

To be fitted with a battery of 'U' tubes fitted into a chest. The 'U' tubes to be plain copper tube. A separate inspection and clean out raised manhole will also be required.

Annulars and heating coils/tubes in galvanised cylinders shall be tinned. Unless otherwise stated in the Particular Specification all cylinders to heat their contents from 10°C to 65°C with primary water at 80°C flow - 70°C return, in one hour.

Horizontal cylinders to be complete with lead lined cradles.

All cylinders to be brazed using silver rods, (lead free and non dezincifiable) the materials to be suitable for and the cylinders tested to twice their working head.

The manufacturers test certificate shall be provided for each cylinder installed.

S43 CIRCULATING PUMPS

Pumps shall be provided where shown on the drawings and as detailed in the Particular Specification. Each pump shall be complete with an air cock or other means for releasing air from the casing, and a drain plug. Each pump shall have flanged suction and delivery connections and shall be complete with a pair of mating flanges. Pumps having connections of 25mm and less may have screwed union connections in lieu of flanges in which case the pipework shall be so arranged as to enable the pump to be readily removed from the line for maintenance and repair.

Each pump having a 1000 watt motor, or more is to be complete with the requisite motor wound for a three-phase electric supply except where specified in the Particular Specification.

Where the specified pump is provided with a tapped drainage port for gland leakage etc. a drain pipe of equivalent size shall run to an adjacent tundish. Copper drain lines shall be provided with plugged tees and crosses for cleaning purposes.

Holding down bolts are to be provided for base mounted pumps for fixing into the concrete pump base. A 50mm laminated cork mat is to be supplied for the pump base. In all cases where the pumps are mounted other than on concrete bases then they shall be supported on purpose made steel supports either built into the wall or suspended from the ceiling/roof of the plant room.

All materials are to be included in the tender, but no support shall be installed until all details have been agreed with the Contract Administrator.

S44 SAFETY VALVES

Water safety valves of the totally enclosed type shall be fitted on each boiler and calorifier to the sizes as specified in the respective clauses.

The safety valves shall comply with BS 6759 - Part 1 and shall be of Gunmetal construction and spring loaded with a metal to metal seat. A padlock and key shall be provided to each safety valve, and fitted so that the valve can be rotated and lifted from its seat during testing without unlocking.

Valves shall be set to 1.5 times the working pressure of the system on which the valve is fitted, by the manufacturers, and stamped to show the bore and setting, before dispatch.

A full bore drip pipe shall be fitted from the outlet of each safety valve to carry any water discharge clear of the appliance being protected, and its insulation. This drip pipe shall terminate with a splay cut end 150mm from the floor in a safe, but in an easily visible position. The drip pipe shall be copper and fitted with a compression fitting elbow to enable removal for maintenance and testing of the valve.

S45 LABELS AND VALVE DISCS

Provide and fix labels to all items of plant and where necessary to indicate specific instructions and/or functions, e.g. Drinking water points, main incoming services isolation valves etc. Labels shall also be fitted, at high level, below any motorised valves installed in ceiling voids, roof spaces, etc.

All mains drinking water outlets shall have screw fixed pictorial drinking water labels provided e.g. fountains and outlets located in non-contaminated areas, i.e. not in WCs, laboratories or workshops etc.

Emergency lockable off gas isolation valves shall be provided as indicated within the Particular Specification.

At each valve the standard "Gas Isolation Valve" label shall be fitted. See indicative label in this Specification.

Labels shall be traffolyte, 6mm high black letters on white background except for gas labels which shall be on a yellow background. Labels shall be fixed with brass chrome plated screws.

Valve discs to be 40mm diameter brass with 12mm black lettering and fitted with appropriate length brass chains. The discs shall be fitted through the head of wheel valves and around the body of all other valves to ensure that a permanent fixing is achieved.

S46 INSULATION

The whole of the insulation work shall be executed by Specialist Contractors. Only first-class quality materials and workmanship will be accepted.

Include for making good any sections cut out by the Contract Administrator after completion to see that the thickness of insulation specified has been adhered to.

Insulation on plant and pipework shall not be commenced, unless otherwise approved by the Contract Administrator, until the whole of the installation has been tested and all joints proved sound.

The insulation at all connections to and from the mountings on plant, tanks, valves and the like shall be neatly capped so that the fixing bolts can be removed without damaging the insulation.

Pipes shall be separately insulated and marrying together will not be allowed. Any mitred joints shall be cleanly cut out and neatly finished. Insulation shall be close fitting to all pipes with joints sealed.

Flue and Smoke Pipes

All insulated flue and smoke pipes shall be stainless steel, twin wall insulated.

Where an existing flue or smoke pipe is to be reinsulated then this shall be carried out as detailed in BS 5970 and BS EN ISO 12241 with 50mm thick industrial wired glasswool or rockwool mat finished and protected with 22 gauge stucco embossed aluminium sheeting secured by means of pop rivets at 225mm centres.

Hot Water Storage Cylinders

Unless otherwise indicated in the Particular specification all cylinders shall be pre-insulated by the manufacturer.

Cylinders shall be insulated with 75mm thick Lamella mat and covered with Stucco aluminium sheeting as detailed in clause S47.1.

Bolted ends and/or inspection covers shall be provided with removable aluminium boxes lined with mattresses.

Where domestic type indirect copper cylinders to BS1566 are specified these shall be pre-insulated.

Heating, Hot Water Service and Cold Water Piping Exposed in Boiler House and Plant Room

All Heating, Hot Water, Cold Water mains and Down Services including cold feeds and vents shall be covered with preformed glasswool or rockwool rigid sectional insulation, minimum thickness as detailed in BS 5422 and BSEN ISO 12241. Insulation shall be carried over fittings and screwed valves.

The insulation is to be covered with Isogenopak PVC sheeting, light grey in colour and 0.35mm thick.

The Contract Administrator will pay particular attention to the neatness of finish, general workmanship and appearance of this work and will require replacement in a more acceptable manner any section or sections of the work which in his opinion could be improved upon. All such replacement work shall be carried out at no additional cost to the contract.

Boilers

All boilers shall be supplied and fixed with the boiler manufacturer's standard approved insulated covers.

Concealed Pipework including Tank Rooms (Heating, Hot Water, Cold Water, All Feeds and Vents)

All concealed pipework shall be insulated with preformed glasswool or rockwool rigid sections, with a factory applied facing which is laminate of close mesh reinforcement between two layers of aluminium foil including integral lap for fixing. The insulation shall be carried over all fittings, valves and air vents. Thickness as detailed in BS 5422. Tables 13 and 15.

Valves

All flanged valves shall be insulated with proprietary aluminium valve boxes, complete with quick release couplings.

External Concealed Pipework

All external pipework shall be insulated as clause S47.5 and the whole to then be covered in polyisobutylene 0.8mm thick, all joints well lapped and sealed and secured with 25mm mesh netting.

Hot and Cold Water Tanks (including Feed and Expansion Tanks)

All cisterns and tanks shall be pre-insulated by the manufacturer.

Where an existing cistern is to be reinsulated then this shall be carried out using 50mm thick foil faced glasswool or rockwool slabs secured by means of self-adhesive foil tape and further supported by means of 50mm, 22 gauge galvanised wire mesh netting ensuring that the foil facing is not damaged when applying the mesh.

Ductwork

All ductwork in plant rooms, roof spaces etc. shall be insulated. General extract ducts in ceiling voids shall be left uninsulated.

Rectangular supply air ductwork shall be insulated with 50mm aluminium foil backed rockwool ductwrap complying to BS 5422, stuck to the ductwork and all joints, edges etc. fully sealed with 75mm wide, self-adhesive aluminium tape.

Circular supply and all general extract ductwork shall be insulated as above using aluminium foil backed flexible rockwool.

All moisture laden air, e.g. kitchen extracts shall be insulated regardless of whether it is situated in a false ceiling or roof space.

S47 WATER TREATMENT

Cleaning

All systems shall be thoroughly cleaned prior to commissioning generally in accordance with BSRIA application guide AG8/91, HS(G)70 and BS 6700, and shall be undertaken by a Specialist Water Treatment Company. Where the work involves modification and/or connection to existing systems, then these shall be thoroughly de-sludged prior to connection of any new pipework and plant.

Certificates shall contain the following minimum information: -

- Unique Certificate Number/Reference
- Company details in full, including ISO 9000 Registration details
- Client & Premises details in full
- Systems being treated - full description
- Date of treatment
- Type of system water treatment being undertaken, e.g. softening/disinfection/dosing etc.
- Water treatment standard being utilised
- Chemical cleaning and hygiene service report
- Free chlorine and bacteriological sample readings and test results
- Certificate of conformity for each system water treatment duly signed and dated by Specialist Company Authorised operative
- Indicate recommended frequency of further water treatments
- Duplicate certificates - one to be left on site for Building Superintendent / Site Agent, the other issued to the Contract Administrator.

Heating

All heating systems shall, on the completion of all necessary tests be thoroughly flushed out and refilled with fresh water with the correct levels of corrosion inhibitor dosing.

Hot and Cold Water

All hot and cold water systems to be disinfected fully in accordance with BS 6700 & HS(G)70.

S48 PAINTING

All steel pipework together with steel hangers, brackets, anchors, provided and erected under this contract shall be painted with one coat of red oxide paint.

Where tubes are stored on site and have become rusty on the outside surfaces, the tubes shall be wire brushed and painted with red oxide prior to installation.

All welds on steel mains throughout shall be wire brushed and the weld given one coat of red oxide paint for 200mm either side of the weld, soon after welding and before any other painting. All steelwork including cast iron valves etc. exposed in the plant rooms and boiler houses shall be given two coats of black heat resisting paint.

Heating pump sets shall be left painted in the manufacturer's original colours and numbered.

All finishing coats shall be applied when the whole work is nearing completion.

Uninsulated non-ferrous valve bodies shall be thoroughly cleaned and left unpainted.

The oil storage tanks fill, and vent pipes shall be wire brushed and given two coats of black bitumastic paint externally only.

All ductwork that is visible behind grilles, diffusers etc., shall be cleaned, degreased, and painted with one coat of dark grey or black etching primer/undercoat and one coat matt black finish.

S49 INSPECTION AND TESTING

Make all necessary arrangements and provide all necessary labour and apparatus for conducting tests as specified and give the Contract Administrator due notice when such tests are to take place.

Include for the proper filling and emptying of the plant and pipes to be tested and make good any defects arising out of or made manifest under test or re-testing until the whole of the plant is free from defect and is in complete working order to the satisfaction of the Contract Administrator.

For a satisfactory and acceptable hydraulic test, the pressure shall be maintained for the period stated after dealing with any weak points, defective fittings and pipes disclosed by the initial application of the test, all in the presence of the Contract Administrator or his appointed representative. The test shall be repeated after any defects have been repaired.

Certificates of all hydraulic tests made at the manufacturer's works shall be forwarded (in duplicate) to the Contract Administrator. Certificates will also be required for compliance with the BS Specification named herein.

Certificates of all hydraulic tests made on site shall be forwarded to the Contract Administrator for his approval and such approval must be obtained before insulation is applied. A separate set of site plans will be provided by the Contract Administrator for the purpose of keeping an accurate record of site tests. All test certificates shall be drawn up in duplicate and signed and endorsed by the Contract Administrator or his representative who witnesses the test. All test certificates shall have the following particulars thereon: -

- Company details
- Unique certificate number and date
- Specific premises
- Specific service under test - full or part
- Nature, duration and condition of test
- Results of test
- Certification of test - signature
- Witness to test - signature

The duplicate endorsed copy of all certificates shall be returned to the Contract Administrator.

Include for carrying out the hydraulic and performance tests under actual conditions on the whole of the plant to the entire satisfaction of the Contract Administrator. Allow for all tests to be carried out either separately or in small groups to suit the general building progress.

Before the application of any of the following pressure tests remove from that section of the installation under tests any component or components which are not specifically designed and constructed to withstand the test pressures called for hereafter.

Heating Hot and Cold Water (Non- Plastic) Drinking and Fire Services

The complete installation shall be subjected to a hydraulic test of twice the normal working pressure or 4 bar (60 psi) whichever is the greater for a period of 30 minutes.

Oil Pipelines Installations

The test shall be made with air under a pressure sufficient to support a column of water to twice the maximum working pressure, for a period of not less than 15 minutes. After this test, the piping system shall be relieved of all air.

Gas Installation

The testing of all gas pipework shall be fully in accordance with "The Institution of Gas Engineers, IGE/UP/1 Soundness Testing and Purging of Industrial and Commercial Gas Installations".

The testing procedure shall consist of the following: -

- Estimation of the Installation Volume (see Sub-Section 5.1)
- Establishment of the Test Pressure (see Sub-Section 5.2)
- Selection of a Pressure Gauge (see Sub-Section 5.3)
- Determination of the Permitted Leak Rate (see Sub-Section 5.4)
- Determination of the Test Period (see Sub-Section 5.5)
- Carrying Out the Test (see Section 6)

The system shall be tested to the following test pressures: -

New Installations and Extensions

The test pressure should be the greater of:

- a) 1.5 x maximum operating pressure and,
- b) The fault pressure.

If a slam shut valve, a monitor regulator or an excess pressure relief regulator is fitted in the gas installation, the maximum operating pressure shall be taken as that which would be reached before such device operates. In all other cases, the maximum pressure should be taken as the normal inlet pressure to the last regulator on the inlet to the installation to be tested.

Existing Installations

The test pressure shall be at least the maximum operating pressure.

The medium of test, either Air or Nitrogen, shall be determined with due regard to size of installation and whether occupied or unoccupied premises, and the need to so purge the system before introduction of natural gas.

Venting and Filling

Allow for the proper filling of all the systems and the venting of same, before and after heat is applied.

Final Heat Tests and Commissioning

The heating and hot water services installations shall, after any acceptable hydraulic test, be subjected to a series of heat tests under the correct operation conditions. The duration period of each test shall be eight hours, during which time all the pipework, plant and pumps shall be subjected to test under actual operating conditions.

During the initial test isolating valves (which shall be in the fully open position), fittings, piping's and equipment must be inspected for any leaks or other defects, all of which must be made good before any subsequent test is applied.

For a satisfactory and acceptable test, no leaks should appear, and the service should be examined to ensure that the correct expansion and contraction takes place.

After the initial heat test, the systems shall be allowed to cool, and the heat test repeated a second time. Prior to this second heat test all balancing, and regulation shall be carried out.

Commissioning shall be carried out fully in accordance with CIBSE Commission Codes, series B for Boiler Plant, series W for Water Distribution Systems, series A for Air Distribution, series R for Refrigeration Systems and series C for Automatic Controls.

The Commissioning shall be undertaken by a Competent Specialist Commissioning Company and all initial and final inspection, testing and commissioning results recorded and a certified report issued.

Provide all skilled attention necessary during this period to ensure that all controls are operating correctly.

Allow for carrying out a full series of tests to ensure that all the required inspections, tests, regulations and balancing of the systems is carried out and to ensure that the entire contract is handed over in working order and properly regulated to the entire satisfaction of the Contract Administrator. Commissioning shall be carried out fully in accordance with the CIBSE codes, series B for boiler plant, series W for water distribution system, series A for air distribution and series C for automatic controls.

Make good any damage caused by defective equipment or workmanship during the carrying out of these tests.

S50 DUCTWORK

The duct installation shall be manufactured in full compliance with HVCA Specification DW 144. Ductwork air flow leakage testing shall be undertaken in full compliance with HVCA DW 143.

Performance Standards of Ductwork.

- Low Pressure - Class A
- Leakage Classification - Class A
- Positive & Negative Pressures Range - Class A
- Materials - zinc coated steel ductwork constructed from hot dip galvanised steel to BS EN 10142 Grade DX51D + Z coating type Z275.

All systems special requirements including access/cleaning access, regulating and fire damper, flexible ductwork, internal or external acoustic insulants and special supports shall be detailed in the Particular Specification and/or drawings. All primary and secondary ductwork supports shall be included.

All air terminal units with or without plenums shall be assumed to be supported and fixed from the ductwork.

S51 WATER AND GAS ACCESS

Water Access

The local Water Supply Company shall be given free access at all times for inspection of the works by their Authorised Representative.

Gas Access

Both the Third-Party Gas Supplier/Shipper and the Transporter of Gas (currently Transco) and the Emergency Gas Leak Isolation (currently Transco) shall all be given free access, at all times, for inspection of the works by their Authorised Representative.

S52 DRYING OUT OF THE BUILDING

The drying out of the building will be the responsibility of the Main Contractor, who will, subject to the approval of the Contract Administrator be allowed to use the Heating System at his own risk but only in collaboration with the skilled supervision of those responsible for the installation of the plant.

The whole of the charges in connection with the fuel, supervision and the replacement of any defective, worn or damaged parts together with any costs incurred in thoroughly cleaning down the plant immediately prior to acceptance by and to the entire satisfaction of the Contract Administrator, shall be borne by the Main Contractor.

The use of the heating installation by the Main Contractor for the purpose of drying out the building will in no way release the Main Contractor of any responsibility under the terms of the Contract.

S53 ELECTRICAL EQUIPMENT ASSOCIATED WITH MECHANICAL PLANT

Where electrical equipment is provided in conjunction with plant, e.g. thermostats, fan controllers etc., these shall be handed over to the electrical services installer for installation unless detailed otherwise in the Particular Specification.

S54 ASSOCIATED ELECTRICAL WORKS, HVCA CONTROL PANELS AND ASSOCIATED CONTROLS

The electrical installation shall be carried out by a specialist NICEIC approved electrical Contractor.

Boiler or Other Plant Assembly Interconnections

Install wiring as required to the boiler or other mechanical plant to interconnect burner, limit switches and any other integral controls.

Control Panels

Where detailed in the Particular Specification the works shall include the provision of control panels assembled as follows: -

Electricity Supply

The control panel(s) shall be suitable for operation on a three phase 400V 50 Hertz supply unless detailed in the Particular Specification. The maximum short circuit fault level at the point of installation will not exceed 6000A (M6).

Panel isolation will be by a remote device provided by others. No internal isolator is required.

Protection shall be provided to a segregated section of a terminal rail and terminals covered with a safety terminal shield stating the voltage present.

See following clauses for details of integral door switch and RCD protection.

Construction

Panel enclosures shall be rigidly constructed from suitably prepared and finished best quality folded mild steel sheet of a minimum thickness 1.5mm meeting the requirements of BS 5486 Part 1 and any other applicable BS specification.

Panels shall have **25% spare space** for future expansion of controls.

The final external finish of the panel shall be semi-gloss stoved or cellulose enamel finish to a grey colour or as approved by the Contract Administrator.

The final internal finish shall match the external finish except for the base which shall have a white or orange finish.

The panel shall be provided with a hinged and lockable door at the front of the panel. Locks shall be of the 8mm triangle type and 2 No. keys shall be provided. The door shall close onto a neoprene or polyurethane gasket to ensure effective sealing.

All panels shall be provided with external wall fixing brackets. Panels exceeding 75kg shall be provided with detachable lifting eyes.

Unless otherwise detailed, no internal illumination or anti-condensation heaters shall be fitted.

Where access to plant rooms is limited, the panel(s) shall be constructed so as to be delivered, off-loaded and erected on site to overcome these limitations.

Integral Residual Current Device

The internal circuit wiring and control equipment shall be controlled by a residual current device (RCD) so as to offer protection against electric shock when the panel door is open whilst the panel is energised.

The RCD shall have a maximum sensitivity of 30mA and be arranged to disconnect the electrical supply from within the panel in the event of an inadvertent direct contact with live parts by maintenance personnel.

Opening the door shall cause the RCD protection to isolate the panel. A deliberate manual operation shall be required to restore the power to controls whilst the door is open.

When the panel door is closed, the RCD protection shall be bypassed by a single pole changeover door activated safety switch to BS 5304, in such a way as to cause the RCD to trip upon door closure but leaving the control circuits alive.

Internal Components

Where possible all base mounted components shall be rail mounted using symmetric 35mm DIN rail. Where components require a proprietary DIN rail accessory bracket these shall be fitted.

Control relays shall be 3 pole changeover of the plug-in variety using bases with rising clamp fingerproof terminals. Every relay shall have a mechanical flag indicator to show contact operation and be energised from a 230V ac coil.

Miniature circuit breakers (MCB's) shall be of the DIN modular construction with positive contact status indication and type 'c' or type 'd' tripping characteristics. Space shall be allowed for 25% additional MCBs to be installed at a future date.

Motors shall each be provided with a suitably motor rated circuit breaker and a starter installed within the panel. Motors of 1kW and above shall be three phase. Every motor shall be protected by a hand resettable thermal overload and combined with single phasing protection where three phase motors are used. Motors under automatic control shall have starters arranged for automatic restart after power failure upon restoration of the mains supply. Duty and Standby manual or automatic selection of motors shall be detailed where necessary in the Particular Specification.

Terminals shall be flame resistant polyimide with a minimum cable capacity of 4mm². Earth terminals used for the connection of screened cables shall be green/yellow coloured. Sufficient terminals to allow a maximum of 2 outgoing cables per terminal shall be provided.

Grouped terminal blocks shall be installed and a minimum of 150mm allowed for wiring space. Install 20 No. spare terminals for future connections.

Door Mounted Components

Where possible all door mounted components shall be recessed into the panel door using correctly sized machined cut-outs.

Selector switches by UK Solenoid Ltd CA4 Range with escutcheon plates or equal. Switch rotation shall generally be at 60° intervals.

Wiring

The control circuitry within the panel shall be arranged so that functionally separate systems are protected by independent miniature circuit breakers. For example, heating (pumps and boilers), fan convectors, motorised valves, hot water service etc. shall each be protected by a separate suitable rated device.

In addition, power supplies to sensitive components (e.g. optimisers, electronic time switches, electronic thermostats etc.) shall be supplied from a separate miniature circuit breaker so as to provide a clean, noise-free supply. The neutral conductors to this equipment shall be separately taken to the terminals and not daisy-chained or used to supply relay coils.

Internal control wiring shall be in red 32/0.2mm (1.0mm²) minimum size conductors with all neutral wiring in black colour. Provide at each end a cable marker with wire number to correspond with the drawings. The markers shall be of the expandable gusset type (i.e. not stick-on or clip-on).

Panel wiring for sensors and detectors associated with electronic thermostats and other controllers shall be in twin twisted, screened flexible cable. This wiring and associated outgoing terminals shall be segregated and earthed at the terminal end only using a proprietary earthing terminal.

Wiring shall be run in proprietary slotted plastic cable trunking, screw fixed to the panel base.

Labels

All items of equipment within the panel shall be readily identified by means of clearly embossed labels of a permanent nature attached on or adjacent to them. Serviceable items (e.g. plug-in relays) shall be labelled by fixing the label adjacent to the component.

Provide each terminal with a pre-printed terminal marker to correspond with the numbering shown on drawings.

All items of door mounted equipment shall be labelled with laminated screw fixed engraved labels with clear indication of the function of the item. The minimum height of the characters shall be 2.5mm.

A warning label with black lettering on yellow background stating, "DANGER ISOLATE BEFORE OPENING DOOR".

Instruments and Indication

Panel alive and control circuit failure lamp indications shall be provided.

Each Plant selector switch shall be provided with run and trip status lamp indication.

Lamps shall be long-life low voltage LED types.

Electromagnetic Compatibility

The controls shall not emit or be affected by electromagnetic interference. Sensitive components shall be positioned within the panel remote from any sources of interference (e.g. relays) or be provided with effective screening.

Testing

The panel shall be fully equipped, wired, and tested before delivery to site. In addition to the tests required by BS 5486, a functional test simulating operating of the complete panel shall be performed before despatch.

Commissioning

The Contract Administrator shall be given advance notice of the commissioning of the controls and allow access to witness the commissioning.

The Specialist Controls Contractor shall commission the controls on completion. Any defects of workmanship, materials, performance, maladjustments, non-compliance with this Specification and other irregularities which become apparent during the tests or commissioning shall be rectified by the Contractor, at their own expense, until the controls are free from defects and in full working order to the complete satisfaction of the Contract Administrator. The Contractor shall allow two further return visits to site during the defects liability period to re-calibrate controls as necessary.

Demonstration

Demonstrate the operation of the control panel and associated plant.

Operation and Maintenance Manual

The original Equipment Manufacturer's Specification Notes, any test schedules, a description of the controls operation, and 'As Fitted' drawings shall be collated within an operation and maintenance manual.

Complete Electrical Installations within Boiler or Plant Rooms

Unless detailed otherwise in the Particular Specification the complete electrical installation within plant rooms associated with heating, ventilation and air conditioning systems shall be included. Controls installations shall be carried out by Specialist Controls Contractor.

These works do not include lighting, sockets or the main electrical service to the plant rooms.

Equipotential Bonding

Where metallic service pipework and/or ductwork have insulated sections i.e. PVC water pipe inserts, flexible connections etc., equipotential bonding conductors shall be installed to maintain a continuous metallic path between sections, unless the insert is intended for electrical isolation such as when pipes pass through external walls to outside.

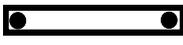
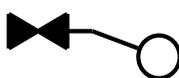
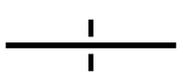
The responsibility for installing the main equipotential bonding conductors from the service pipes or ductwork to the main earthing terminal will be that of others.

General

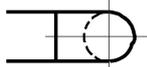
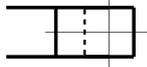
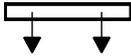
All electrical engineering works shall be carried out in accordance with any relevant statutory requirements, the current edition of BS 7671 (complete with amendments and applicable guidance notes) all relevant British standard Codes of Practice, the requirements of the Electricity Supply Authority and Kier Workplace Services Electrical Engineering Services Standard Material and Workmanship Clauses.

Wiring within the boiler and plant rooms shall be carried out using PVC insulated cables installed within heavy gauge galvanised screwed conduit or trunking complete with protective conductors. Wiring elsewhere shall generally be multicore PVC insulated and sheathed cables installed within the building cavities, conduit or trunking.

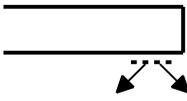
Final connections to each item of plant shall be via industrial metal plug and socket to allow ease of plant removal for maintenance.

PIPEWORK AND FITTINGS			
	3 Port Motorised Valve		Conventional Radiator
	2 Port Motorised Valve		Low Surface Temperature Radiator
	Isolating Valve		Natural Convecting Radiator
	Lockshield Valve		Fan Convecting Radiator
	Double Regulating Valve		Pipework at Low Level
	Double Regulating and Flow Measurement Valve		Pipework Under Floor
	Manual 3 Way Valve		Pipework at High Level
	Emergency Cut Off Valve (Manual)		Pipework in Roof Space
	Safety Valve		Vertical Pipework
	Ball Valve		Connected Pipework
	Non Return Valve		Crossing Unconnected Pipework
	Strainer		Pipework to be Removed
	Pressure Reducing Valve		Direction of Flow
	Existing Valve		Direction of Gradient Rise
	Shower Mixing Valve		Water Tap / Outlet
	Automatic Air Vent		Gas Tap / Outlet
	Pump		Hose Reel

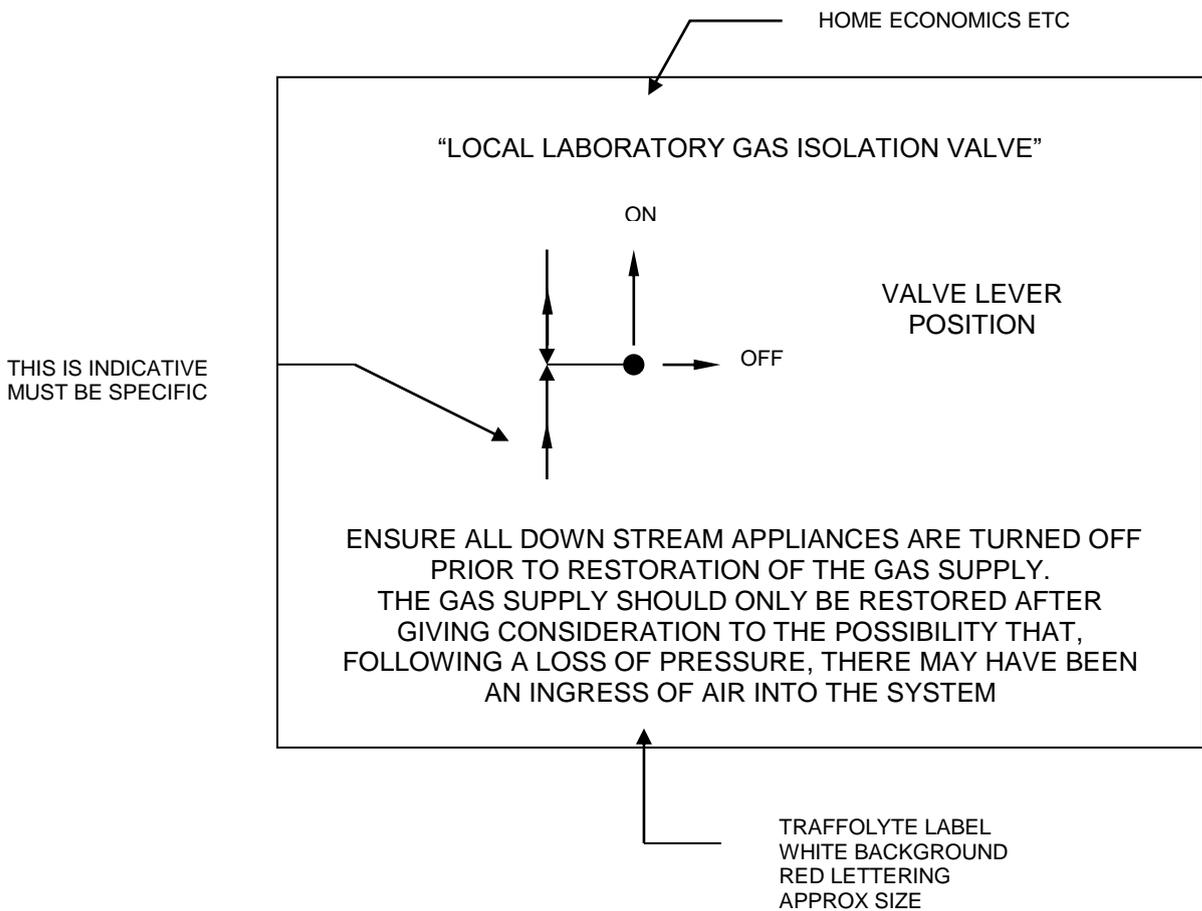
STANDARD SYMBOLS AND NOTATIONS FOR MECHANICAL ENGINEERING SERVICES DRAWINGS
 (Sheet No 2 of 3)

PIPEWORK AND FITTINGS (Cont)			
	Water Meter		Unions
	Gas Meter		Emergency knock Off Button
	Flanges		Fusible Link
DUCTWORK AND FITTINGS			
	Reducer		Propeller Fan
	Change Section Square to Round		Centrifugal Fan
	Bend with Turn Vanes		Flexible Connector
	Filter		Silencer
	Single Leaf Damper		Circular Duct Rise
	Multi Leaf Damper		Circular Duct Fall
	Opposed Blade Damper		Rectangular Duct Rise
	Fire Damper		Rectangular Duct Fall
	Heater Battery		Flexible Ductwork
	Cooling Battery		Linear Supply Grille
	Steam Humidifier		Rectangular Supply Grille

STANDARD SYMBOLS AND NOTATIONS FOR MECHANICAL ENGINEERING SERVICES DRAWINGS
 (Sheet No 3 of 3)

DUCTWORK AND FITTINGS (Cont)			
	Circular Supply Grille		Electric Actuator
	Facing Grille		Manual Actuator
	Remote Side Grille		Supply
	Edge Grille		Extract
NOTATIONS			
HTG	Heating	IV	Isolating Valve
HWS	Hot Water Service	LSV	Lockshield Valve
CWDS	Cold Water Down Service	NRV	Non- Return Valve
MWS	Mains Water Service	SV	Safety Valve
CHW	Chilled Water	PRV	Pressure Reducing Valve
LPHW	Low Pressure Hot Water	TRV	Thermostatic Radiator Valve
OV	Open Vent	DC	Drain Cock
CF	Cold Feed	BV	Ball Valve
LL	Low Level	GC	Gas Cock
HL	High Level	STR	Strainer
FB	From Below	FD	Fire Damper
TB	To Below	BD	Balancing Damper
FA	From Above	VCD	Volume Control Damper
TA	To Above	AD	Access Door
F&R	Flow and Return	TP	Test Point

STANDARD GAS LABEL (INDICATIVE)



MECHANICAL ENGINEERING SERVICES

PARTICULAR SPECIFICATIONS

ALTERATIONS/ADDITIONS TO STANDARD CLAUSES

S55 PARTICULAR SPECIFICATION - GENERAL

The Main Contractor must confirm in writing to the Contract Administrator before entering into a sub-contract agreement, when any of the following four items of works are carried out: -

1. The mechanical services sub-contractor, including sub-let contractors and self-employed person(s) carrying out any gas supply installation work for the Council is/are Gas Safe registered, and its operatives carrying out the work on its behalf is/are registered with Gas Safe, all in accordance with the requirements of the Gas Safety Regulations and the HSE.
2. The mechanical services operative(s) carrying out any hot and cold water supply installation works is/are suitably qualified and approved in accordance with the requirements of the Water Regulations 1999 and the Water Company.
3. The mechanical services sub-contractor's operative(s) carry out any unvented hot water system having a cylinder/water heater capacity of more than 15 litres, is/are suitably qualified and competent in accordance with the requirements of G3 of the Building Regulations.
4. The electrical services sub-contractor is registered with NICEIC or ECA.

It remains the responsibility of the Main Contractor to ensure that the mechanical services sub-contractor and its operative(s) are qualified and competent and comply with the legal requirements currently in force throughout the duration of the contract. The Council cannot give approval to any documentation relating to this requirement.

No mechanical or electrical services work can be carried out until such identification has been obtained by the Main Contractor and copies issued to the Contract Administrator as evidence.

A certificate to be issued to the Contract Administrator before any heating or hot and cold water pipework is carried out on site, showing the person's name, number, date of issue and qualification. A copy of the certificate showing all the details required shall be included in each operating and maintenance manual. On completion of the works, the sub-contractor shall issue a certificate, signed by the approved plumber, stating the installation of the hot and cold water supply systems comply with the Water Regulations.

All press system pipework where specified for heating shall be installed by the manufacturer's or specialist company's trained operative or the sub-contractor's suitably qualified person, who has received adequate training in accordance with their requirements. A certificate shall be issued to demonstrate this training has been carried out before work starts on site.

S56 INSULATION

The whole of the insulation work shall be in accordance with BS 5422:2001, BS 5970:2001 and executed by Specialist Contractors. Only first-class quality materials and workmanship will be accepted.

All materials shall be applied in accordance with manufacturer's recommendations.

Include for making good any sections cut out by the contract administrator after completion to see that the thickness of insulation specified has been adhered to.

Insulation on plant and pipework shall not be commenced, unless otherwise approved by the Contract Administrator, until the whole of the installation has been tested and all joints proved sound. The surface to be insulated shall be clean, dry and free from any foreign substances prior to installation of the insulation.

The insulation at all connections to and from the mountings on plant, tanks, valves and the like shall be neatly capped so that the fixing bolts can be removed without damaging the insulation.

Pipes shall be separately insulated and marrying together will not be allowed. Any mitred joints shall be cleanly cut out and neatly finished. Insulation shall be close fitting to all pipes with joints sealed.

The Contract Administrator will pay particular attention to the neatness of finish, general workmanship and appearance of this work and will require replacement in a more acceptable manner any section or sections of the work which in his opinion could be improved upon. All such replacement work shall be carried out at no additional cost to the contract.

S57 HOT WATER STORAGE CYLINDERS

Unless otherwise indicated in the Particular Specification, all cylinders shall be insulated by the manufacturer.

Cylinders which are not supplied as pre-insulated shall be insulated with 75mm thick Mineral Wool Lamella mat or 40mm thick pre-slotted Phenolic Foam Laminate and covered with Stucco aluminium sheeting.

Bolted ends and/or inspection covers shall be provided with removable aluminium boxes lined with identical insulation.

Where domestic type indirect copper cylinders to BS 1566 are specified, these shall be pre-insulated.

S58 HOT WATER PIPING IN MAIN BLOCK AND PLANT ROOM

The insulation is to be covered with Isogenopak PVC sheeting, white in colour and 0.35mm thick. On cold and chilled water installations, secure and seal joints with manufacturers matching PVC adhesive tape to ensure that the insulation vapour barrier is not punctured by plastic riveting.

S59 BOILERS

All boilers shall be supplied and fixed with the boiler manufacturer's standard approved insulated covers.

S60 CONCEALED PIPEWORK INCLUDING TANK ROOMS (HEATING, HOT WATER, COLD WATER, ALL FEEDS AND VENTS)

All concealed pipework as specified below shall be insulated with pre-formed sections having a factory applied reinforced aluminium foil facing. The insulation shall be carried over all fittings and valves. Minimum insulation thickness as detailed in BS 5422:2001 Tables 8, 12 or 13 for each particular service.

LPHW Heating Installations (up to 100°C), Hot Water Supply and Down Services including cold feeds and vents shall be insulated with preformed glasswool, rockwool or phenolic foam rigid sectional insulation. Insulation shall be carried over fittings and screwed valves.

MPHW, HPHW and Steam Installations (over 100°C) shall be insulated with preformed glasswool, rockwool rigid sectional insulation with factory applied reinforced aluminium foil facing. Minimum insulation thickness as detailed in BS 5422:2001. Insulation shall be carried over fittings and screwed valves.

Cold and Chilled Water installations shall be insulated with foil faced preformed phenolic foam rigid sectional insulation, minimum thickness as detailed in BS 5422:2001. Insulation shall be carried over fittings and screwed valves. The foil facing to be sealed at all joints, terminations and protrusions through the insulation to provide a continuous vapour barrier.

High-density phenolic foam load bearing inserts to be installed at pipe supports to facilitate sealing and continuity of the insulation and vapour barrier.

S61 VALVES

All flanged valves shall be insulated with proprietary aluminium valve boxes, lined with insulation and complete with quick release couplings.

S62 ALL EXTERNAL PIPEWORK

All external pipework shall be insulated as for concealed pipework and the whole then be covered in polyisobutylene 0.8mm thick, all joints well lapped and sealed and secured with 25mm mesh netting.

S63 HOT AND COLD WATER TANKS (INCLUDING FEED AND EXPANSION TANKS)

All cisterns and tanks shall be pre-insulated by the manufacturer.

Where an existing cistern is to be reinsulated, then this shall be carried out using either 50mm thick foil-faced glasswool or rockwool slabs secured by means of self-adhesive foil tape and further supported by means of 50mm, 22 gauge galvanised wire mesh netting ensuring that the foil facing is not damaged when applying the mesh, or 25mm thick slabs of foil faced phenolic foam laminate secured by means of adhesive and proprietary insulation pins and washers. All joints to be sealed with 75mm wide self-adhesive foil tape.

S64 DUCTWORK

All ductwork carrying fresh air supply and conditioned chilled or warm air shall be insulated. General extract ducts in ceiling voids shall be left un-insulated.

Rectangular ductwork shall be insulated with aluminium foil backed rock wool duct-slab or phenolic foam laminate and secured in accordance with the manufacturer's recommendations with adhesive and insulation pins or 22 gauge galvanised wire mesh netting ensuring that the foil facing is not damaged when applying the mesh. All joints, edges etc. fully sealed with 75mm wide, self-adhesive aluminium tape.

Circular supply and all general extract ductwork shall be insulated as above using aluminium foil backed flexible rockwool duct-wrap.

All ductwork carrying moisture laden air, e.g. kitchen extracts shall be insulated regardless of whether it is situated in a false ceiling or roof space.

The thickness of insulation to prevent condensation on chilled air and cold supply air ductwork shall be in accordance with BS 5422 Table 10. Thickness of insulation on heated air ductwork shall be in accordance with BS 5422 Table 11.

All external ductwork shall be fully insulated and protected using a suitable robust weatherproof covering, sealed to prevent ingress water and protection from insects, vermin and birds as well as being UV light resistant

S65 THICKNESS OF INSULATION IN ACCORDANCE WITH BS 5422:2001

(The minimum calculated thicknesses specified in BS 5422:2001 have been rounded up in the following tables to suit standard manufactured sizes).

S66 CHILLED AND COLD WATER

THICKNESS IN ACCORDANCE WITH BS 5422:2001 TABLE 8 CALCULATED TO PREVENT CONDENSATION IN AMBIENT AIR CONDITIONS OF 25°C AND 80%.

Steel pipe size (mm)		Temperature of water (°C)		
		+10	+5	0
		Thickness of insulation (mm)		
NB	OD	Phenolic foam	Phenolic foam	Phenolic foam

15	21	15	15	20
20	27	15	20	20
25	34	15	20	25
32	42	15	20	25
40	48	15	20	25
50	60	15	25	25
65	76	20	25	30
80	89	20	25	30
100	114	20	25	30
150	168	20	30	35
200	219	20	30	40
250	273	25	30	40
300	324	25	35	40
Vessels and flat surfaces		30	40	50

S67 HEATING INSTALLATIONS

ENVIRONMENTAL THICKNESS IN ACCORDANCE WITH BS 5422:2001 TABLE 12.

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

S68 HOT WATER SERVICES

Environmental thickness in accordance with BS 5422:2001 Table 13.

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	30	50
200	219	30	50
250	273	30	50
300	324	30	50
Vessels and flat		35	50

S69 WARM AIR DUCTING

ENVIRONMENTAL THICKNESS IN ACCORDANCE WITH BS 5422:2001 TABLE 11.

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

S70 COLD AIR DUCTING

THICKNESS OF INSULATION WITH TO PREVENT CONDENSATION IN AMBIENT AIR CONDITIONS OF 25°C AND 80% RH IN ACCORDANCE WITH BS 5422:2001 TABLE 10.

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

S71 PRESSURE VESSELS

The Contractor shall include for the provision of a written scheme of examination to be carried out in accordance with Regulation 8 of the "Pressure Systems and Transportable Gas Containers Regulations 2000" for all pressure vessels that fall within the scope of the regulations. The written scheme will form part of the Operating and Maintenance Manual".

S72 PAINTING

The sub-contractor shall include for making good all damaged sections of manufacturer's finish on boilers, pumps, control panels, burners, valves etc., and replace if necessary.

All cast-iron valve bodies and hand wheels on other ferrous metal parts adjoining insulation shall be painted with black gloss paint.

All steel pipework together with steel hangers, brackets, anchors for pipes and ductwork provided and erected under this contract, shall be painted with one coat of red oxide paint after erection and before insulation is applied. All steel pipework, brackets etc., in external ducts shall be painted with two coats of red oxide paints.

Where tubes are stored on site and have become rusty on the outside surface, the tubes shall be wire brushed and painted with red oxide paint prior to installation.

All welds on steel mains throughout shall be wire brushed and the weld given one coat of red oxide paint for 200mm either side of the weld, soon after welding and before any other painting. Steelwork exposed in the plant rooms shall be given two coats of black heat resisting paint after one coat of red oxide paint.

S73 CHEMICAL CLEANING

All heating and domestic hot and cold water pipework shall be chemically cleaned in accordance with S47 of this specification including de-sludging of existing connected systems.

S74 CHLORINATION

Domestic hot and cold water systems shall be sterilised in accordance with clause S47. Sampling and testing of existing and new hot and cold water supplies and the provision of satisfactory results to the CA for his acceptance shall be done prior to the connection between any new and existing system.

S75 DESCRIPTION OF WORKS

The works described herein and on the associated drawings table details as below comprise the following but not restricted to:

Kingswood Children's Centre

1. Removal of existing plant equipment gas fired boilers, pipework, flue, circulation pump, controls in Boiler Room 02, 04.
2. Provision and installation of new gas fired condensing boilers including new flue kit, shunt pumps, circulation pump, manufacturer controls on like for like sizing basis in Boiler room 02, 04.
3. Supply and installation of new DHWF&R, CWMS pipework connections to boilers including all necessary valves, sensors, gauges.
4. Supply and installation of new LTHW pipework to connect from the boiler to the existing HTG pipework and to the new fan convectors including all necessary valves, sensors, gauges.
5. Supply and installation of new thermal insulation including fire-rated collars to new pipework in the Boiler room 02, 04 and new fan convectors area.
6. Supply and installation of new Gas pipework connections to boilers including gas cocks, solenoid valves.
7. Supply and installation of new fan convectors with all necessary valves, controls.

8. Builder's Work including, cutting holes, making good floor, walls, ceiling, modification to suit a new flue kit, new fan convectors area etc.
9. Pressure tests of the gas, LTHW, DHWF&R and CWMS pipework's, chemical dosing of LTHW heating system, Commissioning and Balancing.
10. Chlorination of the existing Domestic water services.
11. Removal of existing controls, supply and installation of new manufacturer controller including electrical wiring in the Boiler Room 02, 04.
12. Removal of existing fan convectors thermostat controls, electrical wiring. Supply and installation of new controls including electrical wiring to the FC's.

Danesholme Communicare Centre

13. Removal of existing plant equipment gas fired redundant boiler, pipework, flue, circulation pump, controls in Boiler Room 01.
14. Provision and installation of new and existing gas fired condensing boilers including new frame kit, gas and heating header, flue kit, modulating controls kit, twin head pump on like for like sizing basis.
15. Supply and installation of new DHWF&R, CWMS pipework and connections to boilers including all necessary valves, sensors, gauges.
16. Supply and installation of new LTHW pipework to connect from the boiler to the existing HTG pipework and to the new fan convectors including all necessary valves, sensors, gauges.
17. Supply and installation of new thermal insulation including fire-rated collars to new pipework in the Boiler room 01 and new fan convectors area.
18. Supply and installation of new Gas pipework to boilers including gas cocks, solenoid valves linked to MCP.
19. Supply and installation of new fan convectors with all necessary valves, controls.
20. Builder's Work including, cutting holes, making good floor, walls, ceiling, modification to suit a new flue kit, new fan convectors area etc.
21. Pressure tests of the gas, LTHW, DHWF&R and CWMS pipework's, chemical dosing of LTHW heating system, Commissioning and Balancing.
22. Chlorination of the existing Domestic water services.
23. Removal of existing controls, supply and installation of new Mechanical Control Panel including electrical wiring in the Boiler Room 01 by contractor's appointed and approved controls specialist.
24. Removal of existing fan convectors thermostat controls, electrical wiring. Supply and installation of new controls including electrical wiring to the FC's.

The Autumn Centre

25. Removal of existing plant equipment gas fired boilers, pipework, flue, circulation pump, controls in Boiler Room 04, 02, 03.
 26. Provision and installation of new gas fired condensing boilers including new flue kit, shunt pumps, circulation pumps, manufacturer controls on like for like sizing basis in Boiler room 04, 02, 03.
 27. Supply and installation of new DHWF&R, CWMS pipework connections to boilers including all necessary valves, sensors, gauges.
 28. Supply and installation of new LTHW pipework to connect from the boiler to the existing HTG pipework and to the new fan convectors including all necessary valves, sensors, gauges.
 29. Supply and installation of new thermal insulation including fire-rated collars to new pipework in the Boiler room 04, 02, 03 and new fan convectors area.
 30. Supply and installation of new Gas pipework connections to boilers including gas cocks, solenoid valves.
 31. Supply and installation of new fan convectors with all necessary valves, controls.
 32. Builder's Work including, cutting holes, making good floor, walls, ceiling, modification to suit a new flue kit, new fan convectors area etc.
 33. Pressure tests of the gas, LTHW, DHWF&R and CWMS pipework's, chemical dosing of LTHW heating system, Commissioning and Balancing.
 34. Chlorination of the existing Domestic water services.
 35. Removal of existing controls, supply and installation of new manufacturer controller including electrical wiring in the Boiler Room 04, 02, 03.
 36. Removal of existing fan convectors thermostat controls, electrical wiring. Supply and installation of new controls including electrical wiring to the FC's.
37. Water systems specialists Laboratory testing and checking of centres DWS and updating of centres existing water risk assessments.

38. Provision of O&M Manuals for the whole project including H&S information, test and commissioning certificates, as built drawings in accordance with standard clauses.

39. Asbestos related works - refer to Asbestos R&D survey information and contracts preliminaries for details.

Below are the drawings to be read in conjunction with the specifications

23630-KBS-01-00-DR-M-6010	Proposed mechanical services layout Autumn Centre	D2 P02
23630-KBS-01-00-DR-M-6011	Proposed mechanical services layout Danesholme Centre	D2 P01
23630-KBS-01-00-DR-M-6012	Proposed mechanical services layout Kingswood Centre	D2 P01
23630-KBS-XX-XX-DR-M-6601	Proposed Plant Rooms Schematic Danesholme Centre	D2 P01

S76 BASIS OF DESIGN

The plant is sized to provide the following temperatures:
Winter at -1°C outside

Classrooms: 21°C
Toilets & corridors: 18°C
Hall: 20°C

Domestic hot water: 60 °C storage, 55 °C return
Heating boilers: 80 °C flow / 60 °C return

S77 NEW BOILERS WITH ASSOCIATED EQUIPMENT

Kingswood Children's Centre

Remove the existing plant equipment gas fired boilers, pipework, flue, circulation pump, controls in Boiler Room 02, 04.

Supply and install new gas fired condensing boilers including new flue kit, shunt pumps, circulation pump, manufacturer controls on like for like sizing basis in Boiler room 02, 04. The new boilers, controller and all pipework should be fixed into the wall to suit new boilers location and connected back with existing services.

Boiler Room 02

Existing 2No of Baxi Solo 24 HE boilers to be replaced with new 2No of LOGIC+Heat24 boilers completed with flue kit, valves, manufacturer controls to be connected to existing services pipework.

Boiler Room 04

Existing 1No of Alpha CD 35C combi boiler to be replaced with new 1No of Ideal Logic combi C35 boiler completed with flue kit, valves, manufacturer controls to be connected to existing services pipework.

Contact IDEAL COMMERCIAL on 08445 436060 or Martin Gray on 07714713445
www.idealcommercial.com | commercial@idealboilers.com
PO Box 103 National Avenue, Kingston Upon Hull, East Yorkshire, HU5 4JN

The boilers commissioning shall be carried out by the boiler manufacturer.

Danesholme Communicare Centre

Remove the existing plant equipment e.g. gas fired redundant floor standing boilers, pipework, flue, circulation pump, controls in Boiler Room 01. Retain existing wall hanged 1No of Ideal Evomax 60 boiler and should be coupled up with new 1No of Ideal Evomax 60 boiler.

Supply and install the wall-hung new and existing gas fired condensing boilers including new frame kit, gas and heating header, flue kit, modulating controls kit, twin head pump on like for like sizing basis.

The Evomax 60 boilers and all pipework should be fixed into the wall to suit new location and connected back with existing services.

Contact IDEAL COMMERCIAL on 08445 436060 or Martin Gray on 07714713445 giving quotation ref. 5817274 dated on 07/MAY/2019.

www.idealcommercial.com | commercial@idealboilers.com

PO Box 103 National Avenue, Kingston Upon Hull, East Yorkshire, HU5 4JN

The boiler commissioning shall be carried out by the boiler manufacturer.

The Autumn Centre

Remove the existing plant equipment gas fired boilers, pipework, flue, circulation pump, controls in Boiler Room 01, 02, 03.

Supply and install new gas fired condensing boilers including new flue kit, shunt pumps, circulation pumps, manufacturer controls on like for like sizing basis in Boiler room 01, 02, 03. The new boilers, controller and all pipework should be fixed into the wall to suit new boilers location and connected back with existing services.

Boiler Room 01

~~Existing 1No of Ideal RESPONSE 80 combi boiler to be replaced with new 1No of LOGIC+30 combi boiler completed with flue kit, valves, manufacturer controls to be connected to existing services pipework. New boiler shall come with circulating pump similar to existing and retain the existing expansion vessel to the system.~~

Boiler room 01 replacement works are excluded from the scope of works.

Boiler Room 02

Existing 2No of IDEAL CLASSIC NF80 combi boilers to be replaced with new 2No of LOGIC+Heat24 boilers completed with flue kit, valves, manufacturer controls to be connected to existing services pipework.

Boiler Room 03

Existing 2No of IDEAL CLASSIC NF60 combi boilers to be replaced with new 2No of LOGIC+Heat18 boilers completed with flue kit, valves, manufacturer controls to be connected to existing services pipework.

Contact IDEAL COMMERCIAL on 08445 436060 or Martin Gray on 07714713445

www.idealcommercial.com | commercial@idealboilers.com

PO Box 103 National Avenue, Kingston Upon Hull, East Yorkshire, HU5 4JN

The boilers commissioning shall be carried out by the boiler manufacturer.

S78 DOMESTIC WATER SERVICES PIPEWORK

Remove the existing plant equipment with associated existing DHW& Cold Water pipework connections to boilers in all centres.

Provide and install new mains service and domestic hot water flow & return pipework to the boilers and connect with a new plant equipment in the all centres. Allow to cut back to the floors and make good of the floor - ensure not to leave any pipework where it presents any trip hazard. Any capped pipework shall be boxed in to provide an aesthetically acceptable final finish. Ensure no dead legs are left within the service which would present hazard for legionella.

For all domestic hot and cold water provide and install Copper press in accordance with Standard Specifications that should be insulated and boxed in classrooms, circulation areas or be insulated with Isogenopak in all boiler rooms.

Allow for chlorination of the existing Domestic water services in all centres. Allow for water systems specialists Laboratory testing and checking of centres DWS and updating of centres existing water risk assessments in all centres.

Please provide the water conditioner 1No of ISB C20 ScaleBuster Compression Fitting CWS in Danesholme boiler room 01 - Line Size: 25 mm located in the Boiler room 01.

Contact Rodin Group Ltd. on +44 01795423400 or info@therodingroup.co.uk or other equal and Wras approved unit.

S79 NEW FLUE SYSTEM

The contractor shall remove or adjust existing flues as indicated on the drawings or within the specification. The main contractor shall supply, install and commission the flue systems as a part of boilers manufacturer quotation.

The main contractor shall carry out all the builders work including any access requirements to install the flue & carry out any tests in the boiler room areas as indicated on drawings. Allow for any builder's work including modification to suit new flue kits to make good all disturbed areas to the walls, ceiling etc.

S80 IDENTIFICATION OF SERVICES

Provide as per standard materials and workmanship clauses

S81 PRESSURISATION UNIT

Danesholme Communicare Centre

Existing unit shall be stripped out and replaced with new pressurisation unit. The main contractor shall supply and install new wall mounted Mikrofill3 unit completed with 200 litres expansion vessel.

Contact Mikrofill Systems Ltd on +44 (0)3452 606020 or email address info@mikrofill.com and provide a quote reference number Q104353 dated on 10/May/ 2019 or other equal and Wras approved unit

S82 NEW HEATING PIPEWORK

Contractor shall retain all existing heating pipework unless required for scope (replacement of FCU's and new boiler installations) - retain all existing radiators in the areas. Allow for complete draining of systems and following installation allow to fill, vent & balance, chemical dose & commission each systems.

The pipework shall be copper press installed by trained via manufacturer mechanical contractor employees. The modifications shall include cutting back of the existing pipework and running new pipework to connect with boilers or fan convectors. All new pipework shall be thermally insulated including valves insulation jackets with Isogenopak cover in the boiler rooms or boxed in in FC's areas.

The contractor shall allow for AAV's at high points and DRV's at low points even not indicated in drawings. The new and existing modified LPHW heating system should be pressure tested, balanced and commissioned.

Allow for pressure tests of the gas, LTHW, DHWF&R and CWMS pipework's, chemical dosing of LTHW heating system, Commissioning and Balancing.

The provision sum was allowed for investigative works of the heating system served by Boiler Room 01 to resolve the unheated areas issue e.g. staff room radiators not giving any heat on Kingswood Centre site. It was allowed for balancing the system, boiler, radiators check and TRV's valves replacement if required. The contractor shall allow to report back in the report to the Contract Administrator of all findings on site and awaiting for further instruction from CA.

S83 NEW FAN CONVECTOR

The Contractor shall be responsible to confirm the size and the number of fan convectors, following thorough survey of the site after measuring available positions for fan convectors. It is contractor responsibility to ensure proposed fan convectors will fit to the positions indicated including recessed grills, remote on/off thermostat controls and necessary installation space requirements including electrical wiring to FC's and controls.

All existing radiators and heating system shall be retained, and new Fan convectors shall be connected back to the system with new isolation valves etc. Provide and install fan convector as scheduled on the drawings. Allow for replacement /

adaptation of grilles within walls / cupboards to suit new fan convectors size - liaise with the FCU manufacturer for details of the builders work required. Make good of disturbed areas.

Contact Dunham Bush with Ami Ubhi at Ami@mba-ltd.co.uk on the phone number 07970 770596 giving the fan convectors quotation number:

Project reference: Autumn Centre Quote reference: 29220MS00 dated on 03/MAY/2019

Project reference: Danesholme Centre Quote reference: 29218MS00 dated on 03/MAY/2019

Project reference: Kingswood centre Quote reference: 29219MS00 dated on 03/MAY/2019

or other equal and approved.

The mechanical contractor shall free issue the FC's thermostat controls to control specialist for electrical wiring.

S84 NEW GAS PIPEWORK & PIPEWORK MODIFICATIONS

Danesholme Communicare Centre

Allow to modify the existing gas pipework with new within plant rooms, as indicated in the drawings. Use mild steel pipework and jointing methods suitable to gas applications as per standard specifications and connect with the existing gas pipework.

Provide and install new 25mm gas solenoid valve in Boiler room 01. Free issue the valve to the controls specialist for wiring and control of the gas emergency shut off button.

The new and existing modified gas pipework system should be pressure tested, purged and commission with a new and existing gas fired appliances in accordance with gas & safety regulations.

The Autumn Centre and Kingswood Centre

Contractor shall allow for testing and identification of the existing gas pipework.

Allow to modify the existing internal gas pipework with new to connect with new boilers as indicated in the drawings. Use mild steel pipework and jointing methods suitable to gas applications as per standard specifications and connect with the existing gas pipework.

The new and existing modified gas pipework system should be pressure tested, purged and commission with a new and existing gas fired appliances in accordance with gas & safety regulations.

S85 THERMAL INSULATION OF PIPEWORK

Employ specialist insulation company and install thermal insulation to all new LPHW heating, DHW & Cold Water pipework including valve insulation jackets within modified boiler rooms and fan convectors modified areas. Thermal insulation for low temperature heating pipework and domestic hot and cold water pipework shall be Kooltherm FM Pipe Insulation as manufactured and supplied by Kingspan Industrial Insulation Ltd. with a white Isogenopak cover or other approved equal. The thickness of insulation shall be in accordance with Appendix 1 to 2.

The areas with LTHW heating, DHW & Cold water pipework in boiler rooms areas shall be insulated with Isogenopak cover.

Allow within your costs to provide thermal insulation to all existing LPHW and domestic H&C water pipework within the modified boiler rooms as indicated in the drawings to the specifications provided within this section.

The Kooltherm FM insulation shall be suitable for the application depending on the operational and environmental temperatures.

All insulation shall be CFC and HCFC free, non-fibrous, with zero Ozone Depleting Potential (ODP) and Global Warming Potential (GWP) less than 5. Under the terms of the Montreal Protocol as enforced under EC Reg 1005/2009 [X], neither chlorofluorocarbons (CFCs) nor hydrochlorofluorocarbons (HCFCs) are permitted in the production of thermal insulation in the EU.

Insulation shall be manufactured to BS EN ISO 9001:2008, BS OHSAS 18001:2007 and BS EN ISO 14001:2004 with a factory applied vapour barrier.

Phenolic Pipe Insulation shall include passivated, impregnated, liner technology with a passivating foam additive, creating a fully bore coated product.

All thermal insulation work shall be carried out by a member of the Thermal Insulation Contractors Association (TICA). Insulation shall not be applied until pipes, plant, equipment and ductwork have been tested.

Phenolic pipe insulation shall be CE Marked in accordance BS EN 14314:2009+A1:2013 as required by the Construction Products Regulation (EU) No 305/2011 (CPR)

Phenolic pipe insulation shall have a European fire classification of BL-s1,d0 to BS EN 13501-1:2007+A1:2009 and achieve BS 476-6 and BS 476-7 results to enable a Class O classification to the Building Regulation in England & Wales, and a Low Risk classification to the Building Standards in Scotland.

Pipe Insulation shall be FM Approved to Approval Class 4924 and achieve ASTM E84 Class 1/A and UL 723 25/50

Pipe Insulation shall have a BREEAM Green Guide rating of A/A+ in accordance with the 2016 Pipe Insulation Environmental Profile Methodology as shown on the BRE Green Book Live website www.greenbooklive.com

Pipe Insulation shall achieve Eurofins Indoor Air Comfort Gold certification in accordance with the legal regulations on VOCs and low emitting products in BREEAM, Belgium, France (class A+), Germany (AgBB) and LEED v4 (outside US).

Pipe Insulation shall have a declared thermal conductivity of 0.025 W/mK at 10oC mean temperature in accordance with BS EN 14314 and based on the time averaged value over 25 years, plus a safety increment.

The insulation system shall comprise Kooltherm FM Pipe Insulation, Kooltherm Fire Sleeves and Kooltherm Insulated Pipe Support Inserts and be in accordance with BS 5422 and BS 5970. Before applying insulation, all pipework should be clean and dry and free of corrosive substances such as excess soldering flux, building materials debris and moisture. On cold pipework the vapour barrier jacket should be fully sealed at longitudinal and circumferential joints with self-adhesive aluminium foil tape. All insulation terminations shall be sealed to provide a permanent and continuous vapour barrier over the insulation.

Pipework supports shall be insulated from the pipework on all HVAC services. On cold and chilled applications Kooltherm FM 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 FM Insulated Pipe Support Inserts shall be used to limit overall system heat loss, and to minimise the risk of heat transfer through supporting structures.

Kooltherm Fire Sleeves shall be used as in accordance within the manufacturer's instructions where the insulation system passes through fire rated walls.

The pipe insulation system shall have third party verification of the performance claims such as LABC Registered Detail status and LABC Warranty or KIWA BDA Agreement Certification.

The Kooltherm FM Pipe Insulation system is an LABC Registered Detail, Certificate Number EWW382. The system conforms to the Functional Requirements of LABC Warranty Technical Manual.

Kooltherm FM Pipe Insulation system holds KIWA BDA Agreement Certification BAP15-036-01-C Thermal Insulation of Pipework, HVAC & Building Services Pipe Insulation.

S86 NEW PUMPS WITH ASSOCIATED VALVES

The Autumn Centre

Boiler Room No 02

Existing heating 1No of Grundfos UPS 40-50F-250P/N pump shall be removed and replaced with new Grundfos Magna 1 D 32-60 twin head pump with all associated isolation, non-return valves, sensors etc. as detailed in the drawings or other equal and approved.

Boiler Room No 03

Existing heating 1No of Grundfos UPSD 40-50-250P/N single head pump shall be removed and replaced with new twin head Grundfos Magna 1 D 32-60 pump completed with all associated isolation, non-return valves, sensors etc. as detailed in the drawings or other equal and approved.

Contact Grundfos Ltd. on phone number (+44) 1525 850000 or other equal and approved.

GRUNDFOS Pumps Ltd.
Grovebury Road
Leighton Buzzard
Bedfordshire
LU7 4TL
Phone: (+44) 1525 850000
grundfos-uk@sales.grundfos.com
<http://www.grundfos.com/>

Commissioning of the pumps shall be carried out by the manufacturers.

The Danesholme Communicare Centre

Boiler Room No 01

Existing heating 2No of Grundfos single head pumps shall be removed and replaced with new single head Grundfos Magna 1 D 32-80 twin head pump completed with all associated isolation, non-return valves, sensors etc. as detailed in the drawings or other equal and approved.

Contact Grundfos Ltd. on phone number (+44) 1525 850000 or other equal and approved.

GRUNDFOS Pumps Ltd.
Grovebury Road
Leighton Buzzard
Bedfordshire
LU7 4TL
Phone: (+44) 1525 850000
grundfos-uk@sales.grundfos.com
<http://www.grundfos.com/>

Commissioning of the pumps shall be carried out by the manufacturers.

The Kingswood Centre

Boiler Room No 02

Existing heating Grundfos UPSD 40-50F-250P/N pumps shall be removed and replaced with new twin head Grundfos Magna 1 D 32-60 pump completed with all associated isolation, non-return valves, sensors etc. as detailed in the drawings or other equal and approved.

Contact Grundfos Ltd. on phone number (+44) 1525 850000 or other equal and approved.

GRUNDFOS Pumps Ltd.
Grovebury Road
Leighton Buzzard
Bedfordshire
LU7 4TL
Phone: (+44) 1525 850000
grundfos-uk@sales.grundfos.com
<http://www.grundfos.com/>

Commissioning of the pumps shall be carried out by the manufacturers.

S87 CONTROLS

Employ a controls specialist to design, install and commission controls to new and existing plant equipment from an

existing mechanical controls in the Danesholme Communicare Centre Boiler Room No 01. The scope of works should include design, manufacture and installation of new or existing control panels to control the new and existing plant equipment including electrical wiring. Employ specialist in time to produce wiring diagrams for approval by CA.

Contact: C.J. RINGWOOD CONTROLS LTD
WENDOVER ROAD
RACKHEATH IND ESTATE
NORWICH
NR13 6SX. TEL: 01603 722558

Ask for quotation ref. number JiR/195417 dated on 9/May/2019 for the Boiler Room No 01 in Danesholme Communicare Centre or other approved equal.

Allow for removal of existing controls and wiring and supply, installation of electrical wiring to new boilers, manufacturer controls and new fan convectors units in the areas as indicated on the drawings.

Ask for quotation ref. number JiR/195421 dated on 13/May/2019 for the electrical installation in the Danesholme Communicare Centre or other approved equal.

Ask for quotation ref. number JiR/195420 dated on 13/May/2019 for the electrical installation in the Kingswood Centre or other approved equal.

Ask for quotation ref. number JiR/195419 dated on 13/May/2019 for the electrical installation in the Autumn Centre or other approved equal.

Danesholme Communicare Centre Boiler Room 01 CONTROL PANEL:

To supplying 1 No wall mounted standard enclosure. Colour to be standard grey. Constructed of sheet steel measuring approximately 800mm high x 600mm wide x 210mm deep, containing the following :

1 No . 20 Amp SP&N Main door interlocked isolator

1 No . Neutral block

1 No . Earth block

1 No . Common MCB control circuit

1 No . Set of control and interlock relays

1 No . Mains on indicator

1 No . Set of terminals

1 No . Pressure Fault Indicator

1 No . Emergency Circuit Activated Indicator

1 No . 0-6 Hour Extension Timer

1 No . Summer/Winter/Holiday switch

OUTGOING SUPPLIES

2 No . UP TO 4 Kw SP&N/TP&N MCB protected supplies inclusive of Run/Trip indicators, Hand/Off/Auto and No 1 / No 2 selector switches.

2 No . HEATING CIRCULATION PUMPS

2 No . SP&N MCB protected supplies to HEATING BOILER inclusive of Run/Trip indicators, and Hand/Off/Auto selector switch.

1 No . SP&N supplies to PRESSURE UNIT inclusive of fault indication.

The control panel is to be situated in the boiler room. It shall house the motor starters and switchgear for boiler pumps and boilers control equipment.

All plant being controlled by the control panel shall have indication of Run & Trip or fault condition with Hand/Off/Auto selector switches mounted on the door of the panel.

A door interlocked isolator is to be fitted to the front of the control panel to isolate the supply when doors are opened. A voltage warning sign shall be provided adjacent to the door interlocked isolator.

The control panel shall be a single compartment type with the Cylon controls & low voltage items mounted within the same section as the high voltage switchgear. Openable only by the door interlocking isolator.

Plant being controlled by the control panel shall have indication of Run & Trip or fault condition with Hand/Off/Auto selector switches mounted on the door of the panel.

Panel indicators are to be multiple LED type and 24vAC wherever possible.

The main control circuits are to be transformed down to 24V AC.

All power supplies are to be backed up by miniature circuit breakers and clearly marked within the control panel by means of engraving on the panel trunking lid.

GAS SOLENOID VALVE & EMERGENCY CIRCUIT:

A Gas/CO detector is to be provided in the boiler room to shut down the gas solenoid valve & boiler plant if Co or gas is detected.

There are to be thermal links installed over each of the boilers and the HWS heater. In the case of a fire, the link will melt and break the control panel's safety circuit therefore stopping the plant fed from the control panels control circuit and shut the gas solenoid valve. A panic button is also provided adjacent to the door to also break the control panel's safety circuit, therefore stopping the plant fed from the control panels control circuit and shut the gas solenoid valve.

CYLON CONTROLS:

The heating system is controlled by a Cylon control system of which is mounted within the control panel with a touchscreen display on the front of the panel. The Cylon controls shall be programmed to enable easy interrogation of the heating systems times, temperatures and set points by the end client.

A touchscreen display (site guide V2.2) shall be provided on the front of the panel. The Cylon controls shall be programmed to enable easy interrogation on the display of the heating systems & hot water times, temperatures, plant status and set points by the end client.

Optimum start control (latest start time) shall be provided for each of the 2 zones and switch the heating plant to ensure that upon occupancy time the building is at occupancy temperature by monitoring the room and outside air temperatures and the optimum off time.

S88 BUILDER'S WORK

Allow for all builder's work including provision of making good of the areas including cutting wholes to the walls and floors, providing sleeves for protection of pipework, provision of fire barriers between floor/walls, filing and painting to disturbed areas to match existing colours, modification of existing concrete bases to suit a new installation.

S89 WATER TREATMENT

Following installation completely flush the heating system and dose the system in accordance with the S47 of the specifications. Test certificates shall be provided within the O&M Manuals.

S90 O&M MANUALS

Provide Class B Manual as per standard specifications. Allow for provision of O&M Manuals for the whole project including H&S information, test and commissioning certificates, as built drawings in accordance with standard clauses.

S91 RECORD DRAWINGS

Provide within O&M Manuals in AutoCAD dwg and pdf format.

S92 WORKING/ INSTALLATION DRAWINGS

Provide Working Drawings for all installation work, fully in accordance with Clause S5. Retain copies on site that consider all comments received from the CA or his representative. Keep the drawings up-to-date on a weekly basis to show the installations 'as-installed' and readily available for the CA or his representative when attending site.

S93 VALVE CHARTS

Provide and fit Valve Charts to A2 size within the plant room.

S94 ZONE CHART

The Contractor shall provide copies of a coloured or otherwise, clearly identified zone chart for the heating installation. The chart shall comprise a floor plan of the building identifying the distinct heating zones and shall be A3 in size in a glazed frame.

One copy of the chart shall be fixed securely to each plant room wall able to be agreed with the CA, generally in the same manner as detailed for valve charts. The other copy of the chart shall be included within the control section of the O&M manual.

S95 WATER SYSTEM SCHEMATIC DIAGRAM

Provide and fit a schematic diagram of the water systems to meet HSE recommendations.

S96 CERTIFICATES OF TESTING

Provide, as indicated within the Standard Materials and Workmanship Clauses, all necessary original certifications at Practical Completion Stage.

S97 COMMISSIONING REPORTS

Provide fully, as indicated within the Standard Material and Workmanship Clauses, all necessary Commissioning Reports to include controls and plant.

The contractor shall ensure that any shortfall in design values is established and the CA advised as soon as possible providing sufficient time for any remedial work to be carried out and any unnecessary disruption to the normal use of the school and its facilities avoided.

Copies of all satisfactory commissioning reports shall be submitted in the O&M Manual.

S98 VALVE SPECIFICATION:

S99 VALVE <50mm

SERVICE	
Heating Isolation	Oventrop 107 90
Heating Lockshield	Oventrop 107 92
Heating Check	Oventrop 107 50
Heating Double Regulating	Oventrop 106 01
Heating Flow Measurement	Oventrop 106 08
Stopcocks	BS1010
Water Services Isolation	Oventrop 107 95
Water Services Lockshield	Oventrop 107 99
Water Services Check	Oventrop 107 50
Drain Cocks (Plantrooms)	Oventrop 103 33
Drain Cocks	Oventrop 103 35
Service	Oventrop 107 93
Strainers	Oventrop 112 00
Safety Valves	Nabic Fig. 542
Gas Cocks	Oventrop 301 64

Manufacturer to be consulted with respect to heating system primary, secondary stage regulating valve selection and locations and remote circuit devices to ensure new and existing systems have full balancing capability. Manufacturer to be consulted in respect to HWS secondary circulation regulating valve, location and selection to ensure new and existing systems have full balancing capability.

S100 VALVE >50mm

SERVICE	
Heating Isolation	Oventrop 104 82
Heating Lockshield	Oventrop 104 82 - complete with locking device
Heating Check	Oventrop 107 30
Heating Double Regulating	Oventrop 106 26
Heating Flow Measurement	Oventrop 106 28
Water Services Isolation	Oventrop 104 84
Water Services Lockshield	Oventrop 104 84- complete with locking device
Water Services Check	Oventrop 107 50
Gas Cocks	Oventrop 104 83

Manufacturer to be consulted with respect to heating system primary, secondary stage regulating valve selection and locations and remote circuit devices to ensure new and existing systems have full balancing capability. Manufacturer to be consulted in respect to HWS secondary circulation regulating valve, location and selection to ensure new and existing systems have full balancing capability.

S101 APPENDIX 1

Indicative thickness to comply with:

- Building Regulations Approved Document Part L2A 2013;
- Non-domestic Building Services Compliance Guide: 2013 Edition, Section 11,
- TIMSA HVAC Guide Section 6.2.1, 6.2.2
- BS 5422:2009, Tables 15 to 18
- Enhanced Capital Allowance 2013 Energy Technology List, and NES Y50 Enhanced thickness tables

Indicative thickness – Control Heat Loss

Pipe Size					Hot Water up to +60°C						Low Temperature Heating Water ≤+95°C					
					ε=0.05	ε=0.9	Heat Loss	ε=0.05	ε=0.9	Heat Loss	ε=0.05	ε=0.9	Heat Loss	ε=0.05	ε=0.9	Heat Loss
Steel		Copper Plastic			silver	black	(W/m)	silver	black	(W/m)	silver	black	(W/m)	silver	black	(W/m)
NB	NB	OD	OD	OD	Minimum Kooltherm FM thickness (mm) to comply with											
(inch)	(mm)	(mm)	(mm)	(mm)	BS5422:2009			Enhanced Capital Allowance			BS5422:2009			Enhanced Capital Allowance		
-	-	-	15	-	15	15	6.60	15	20	6.04	15	15	8.90	20	20	7.78
-	-	-	-	16	15	15	6.60	15	20	6.04	15	15	8.90	20	20	7.78
¾	10	17.2	-	-	15	15	6.60	15	20	6.04	15	15	8.90	20	20	7.78
-	-	-	-	20	15	15	7.13	15	20	6.45	15	15	9.28	20	20	8.42
½	15	21.3	-	-	15	20	7.13	20	20	6.45	15	20	9.28	20	20	8.42
-	-	-	22	-	15	20	7.13	20	20	6.45	15	20	9.28	20	20	8.42
-	-	-	-	25	15	20	7.83	20	20	7.00	15	20	10.06	20	20	9.05
¾	20	26.9	-	-	15	20	7.83	20	25	7.00	20	20	10.06	20	25	9.05
-	-	-	28	-	20	20	7.83	20	25	7.00	20	20	10.06	20	25	9.05
-	-	-	-	32	20	20	8.62	20	25	7.71	20	20	11.07	20	25	9.86
1	25	33.7	-	-	20	20	8.62	20	25	7.71	20	20	11.07	25	25	9.86
-	-	-	35	-	20	20	8.62	20	25	7.71	20	25	11.07	25	25	9.86
-	-	-	-	40	20	20	9.72	20	25	8.46	20	25	12.30	25	25	10.83
-	-	-	42	-	20	20	9.72	25	25	8.46	20	25	12.30	25	30	10.83
1¼	32	42.4	-	-	20	20	9.72	25	25	8.46	20	25	12.30	25	30	10.83
1½	40	48.3	-	-	20	25	10.21	25	30	9.01	25	25	12.94	30	30	11.42
-	-	-	-	50	20	25	10.21	25	30	9.01	25	25	12.94	30	30	11.42
-	-	-	54	-	20	25	11.57	25	30	9.94	25	25	12.94	30	30	11.42
2	50	60.3	-	-	20	25	11.57	30	30	9.94	25	25	14.45	30	35	12.61
-	-	-	-	63	20	25	11.57	30	30	9.94	25	30	14.45	30	35	12.61
-	-	-	67	-	25	25	11.57	30	30	9.94	25	30	14.45	30	35	12.61
-	-	-	-	75	25	25	13.09	30	30	11.25	25	30	14.45	30	35	12.61
-	-	-	76	-	25	25	13.09	30	30	11.25	25	30	14.45	30	35	12.61
2½	65	76.1	-	-	25	25	13.09	30	30	11.25	25	30	16.35	35	35	14.12
3	80	88.9	-	-	25	25	14.58	30	35	12.17	25	30	17.91	35	35	15.28
-	-	-	-	90	25	25	14.58	30	35	12.17	25	30	17.91	35	35	15.28
-	-	-	108	-	25	25	17.20	35	35	14.29	25	30	20.77	35	40	17.51
-	-	-	-	110	25	25	17.20	35	35	14.29	25	30	20.77	35	40	17.51
4	100	114.3	-	-	25	30	17.20	35	35	14.29	30	30	20.77	35	40	17.51
-	-	-	-	125	25	30	19.65	35	35	16.09	30	30	23.71	35	40	19.71
-	-	-	133	-	25	30	19.65	35	40	16.09	30	30	23.71	40	40	19.72
5	125	139.7	-	-	25	30	19.65	35	40	16.09	30	35	23.71	40	40	19.72
-	-	-	159	-	25	30	22.31	35	40	18.24	30	35	26.89	40	45	22.34
-	-	-	-	160	25	30	22.31	35	40	18.24	30	35	26.89	40	45	22.34
6	150	168.3	-	-	25	30	22.31	35	40	18.24	30	35	26.89	40	45	22.34
-	-	-	-	200	25	30	27.52	35	40	22.06	30	35	32.54	40	45	26.61
8	200	219.1	-	-	30	30	27.52	35	40	22.06	30	35	32.54	40	45	26.61
-	-	-	-	250	30	30	32.40	35	40	25.95	30	35	38.83	40	45	30.91
10	250	273	-	-	30	30	32.40	40	40	25.95	35	35	38.83	45	50	30.91

Estimated Mean Temperature of Insulation: +50°C

Ambient Air Temperature: +15°C

Surface Emissivity ε (Outer Surface): 0.05 / 0.9

Assumed Thermal Conductivity (k-value) of Kooltherm FM Pipe Insulation: 0.025 W/mK

S102 APPENDIX 2

Indicative thickness to comply with:

- Building Regulations Approved Document Part L2A 2013;
- Non-domestic Building Services Compliance Guide: 2013 Edition, Section 11,
- TIMSA HVAC Guide Section 7.1

Note: The thicknesses quoted for condensation control may exceed the thicknesses required by the Building Regulations 2013 to control heat gain.

Indicative thickness – Control Heat Gain & Condensation

Pipe Size					Water 0°C to <4.9°C			Water +5°C to <10°C			Water ≥ 10°C			
					ε=0.05	ε=0.9	Heat Gain	ε=0.05	ε=0.9	Heat Gain	ε=0.05	ε=0.9	Heat Gain	
					silver black	(W/m)	silver	black	(W/m)	silver	black	(W/m)		
NB (inch)	NB (mm)	OD (mm)	OD (mm)	OD (mm)	Minimum Kooltherm FM thickness (mm) to comply with BS 5422:2009									
-	-	-	-	-	16	25	20	3.47	20	15	2.97	15	15	2.48
¼	10	17.2	-	-	25	20	3.47	20	15	2.97	15	15	2.48	
-	-	-	-	20	25	20	3.81	20	15	3.27	15	15	2.72	
½	15	21.3	-	-	25	20	3.81	20	15	3.27	15	15	2.72	
-	-	-	22	-	25	20	3.81	20	15	3.27	15	15	2.72	
-	-	-	-	25	25	20	4.18	20	15	3.58	15	15	3.05	
¾	20	26.9	-	-	25	20	4.18	20	20	3.58	15	15	3.05	
-	-	-	28	-	30	20	4.18	20	20	3.58	15	15	3.05	
-	-	-	-	32	30	20	4.60	20	20	4.01	15	15	3.41	
1	25	33.7	-	-	30	20	4.60	25	20	4.01	20	15	3.41	
-	-	-	35	-	30	25	4.60	25	20	4.01	20	15	3.41	
-	-	-	-	40	30	25	5.11	25	20	4.53	20	15	3.86	
-	-	-	42	-	30	25	5.11	25	20	4.53	20	15	3.86	
1¼	32	42.4	-	-	30	25	5.11	25	20	4.53	20	15	3.86	
1½	40	48.3	-	-	30	25	5.45	25	20	4.82	20	20	4.11	
-	-	-	-	50	35	25	5.45	25	20	4.82	20	20	4.11	
-	-	-	54	-	35	25	6.17	25	20	5.48	20	20	4.78	
2	50	60.3	-	-	35	25	6.17	25	25	5.48	20	20	4.78	
-	-	-	-	63	35	25	6.17	25	25	5.48	20	20	4.78	
-	-	-	67	-	35	30	6.17	30	25	5.48	20	20	4.78	
-	-	-	-	75	35	30	6.70	30	25	6.30	20	20	5.51	
-	-	-	76	-	35	30	6.70	30	25	6.30	20	20	5.51	
2½	65	76.1	-	-	35	30	6.70	30	25	6.30	20	20	5.51	
3	80	88.9	-	-	40	30	7.77	30	25	6.90	20	20	6.17	
-	-	-	-	90	40	30	9.15	30	25	8.31	25	20	7.28	
-	-	-	108	-	40	30	9.15	30	25	8.31	25	20	7.28	
-	-	-	-	110	40	30	9.15	30	25	8.31	25	20	7.28	
4	100	114.3	-	-	40	30	9.15	35	25	8.31	25	20	7.28	
-	-	-	-	125	40	30	10.45	35	25	9.49	25	20	8.52	
-	-	-	133	-	45	30	10.45	35	25	9.49	25	20	8.52	
5	125	139.7	-	-	45	30	10.45	35	25	9.49	25	20	8.52	
-	-	-	-	140	45	30	10.45	35	25	9.49	25	20	8.52	
-	-	-	159	-	45	30	11.86	35	25	10.97	25	20	9.89	
-	-	-	-	160	45	30	11.86	35	25	10.97	25	20	9.89	
6	150	168.3	-	-	45	30	11.86	35	25	10.97	25	20	9.89	
-	-	-	-	200	50	30	14.61	40	25	13.57	30	20	12.27	
8	200	219.1	-	-	50	35	14.61	40	30	13.57	30	20	12.27	
-	-	-	-	250	50	35	17.48	40	30	16.28	30	20	14.74	
10	250	273	-	-	50	35	17.48	40	30	16.28	30	25	14.74	
-	-	-	-	315	55	35	17.48*	40	30	16.28*	30	25	14.74*	
12	300	323.9	-	-	55	35	17.48*	40	30	16.28*	30	25	14.74*	
-	-	-	-	355	55	35	17.48*	45	30	16.28*	30	25	14.74*	
14	350	355.6	-	-	55	35	17.48*	45	30	16.28*	30	25	14.74*	
-	-	-	-	400	55	35	17.48*	45	30	16.28*	30	25	14.74*	
16	400	406.4	-	-	55	35	17.48*	45	30	16.28*	30	25	14.74*	
-	-	-	-	450	55	35	17.48*	45	30	16.28*	35	25	14.74*	
18	450	457	-	-	60	35	17.48*	45	30	16.28*	35	25	14.74*	
-	-	-	-	500	60	35	17.48*	45	30	16.28*	35	25	14.74*	
20	500	508	-	-	60	35	17.48*	45	30	16.28*	35	25	14.74*	
-	-	-	-	560	60	35	17.48*	50	30	16.28*	35	25	14.74*	
24	600	610	-	-	65	35	17.48*	50	30	16.28*	35	25	14.74*	
-	-	-	-	630	65	35	17.48*	50	30	16.28*	35	25	14.74*	

Ambient Air Temperature:

Relative Humidity:

Surface Emissivity ε (Outer Surface):

Assumed Thermal Conductivity (k-value) of Kooltherm FM Pipe Insulation:

+25°C

80%

0.05 / 0.9

0.025 W/mK

*For pipes and vessels of diameter greater than 273mm, the items shall be assumed to be 273mm for calculation purposes