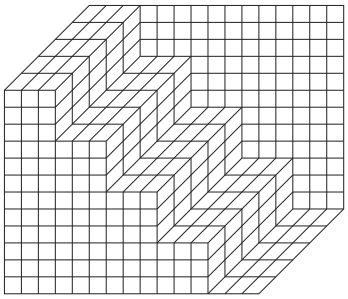

Buro Happold

025901 South Camden Community School

SCCS_SP_0001 - Solar Thermal Performance Specification

Section B: Performance Specification

Section C: Materials and Workmanship

Preliminary
November 2010

Revision 0

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1 Executive Summary

This performance specification sets out Employer's Requirements for the design and build of complete solar thermal hot water installations. The performance specification covers two distinct and separate systems;

1. Solar thermal hot water system serving the Sports Hall area,
2. Solar thermal hot water system serving the Kitchen and Drama changing/showers area.

See SCCS_P_5701 to 5704 for distribution circuits. See SCCS_P_5704_1 and SCCS_P_5704_2 for schematics of the solar thermal system.

Each system will be designed, supplied, installed, tested and fully commissioned as separate systems.

For the purpose of this document, the works is assumed to be undertaken by M&E sub contractor, who will be henceforth referred to as the 'mechanical sub contractor'. BAM will henceforth be referred to as the 'main contractor'.

The Mechanical sub contractor shall design, supply, install, test and fully commission the solar thermal hot water systems as a turnkey package in line with the requirements of this Performance Specification.

The Mechanical sub contractor will provide all elements of the solar thermal hot water installations including:

- Flat plate solar thermal Modules
- Flat roof A-frame supports
- Storage Cylinders
- Circulation Modules/ pump stations
- Electric power, including connections to the site power
- Controls
- Pipework, valves and ancillaries
- Expansion vessels
- Testing and commissioning
- Heat rejection equipment as required

2 Project Particulars

Refer to the Main Contract Preliminaries for details of Project, Employer, Design Team, Contract Administrator.

The Solar Thermal Hot Water Systems specification is split as follows:

Section A: Technical Preliminaries

Section B: Performance Specification

This Performance Specification shall be read in conjunction with Section A of the Specification as well as the Main Contract Preliminaries and all work shall comply with the Main Contract Preliminaries. The Main Contract shall take precedence in the event of any conflict between this Performance Specification and the Main Contract.

3 Scope of Works

3.1 Introduction

The scope of works for the solar thermal hot water systems is to design, supply, install, test and fully commission solar thermal hot water systems, including, but not limited to; evacuated tube solar thermal modules, buffer cylinders, storage cylinder circulation, heat rejection equipment, module electric power, including connections to the site power, controls and pipework. The Mechanical sub contractor shall be responsible for the design, supply, installation testing and full commissioning of complete 'turnkey' solutions.

The solar thermal hot water systems shall be designed, installed and commissioned by the solar thermal system specialist supplier. All components shall be selected and provided to form a complete system installation. Below are some of the major components of the system. Further details of components, such as valves, pipe fittings and system accessories, electrical installation, controls and connections shall be confirmed by the specialist and shown on the specialist schematics and drawings as part of the technical submittal.

All design information, production drawings and buildersworks details shall be provided in good time to enable co-ordination and final detailing to comply with the requirements of the construction works programme.

This specification should be read in conjunction with the Architect's site plan drawings, Planning Permission drawings and general arrangement drawings. The specification shall be subject to the terms and conditions as specified by the Contract Administrator.

The Mechanical sub contractor must survey the existing site prior to commencing the production of working installation and builderswork drawings. The mechanical sub contractor must assess any shading on-site affecting the installation output and qualification for grant awards. The effect of any changes to the design post tender on the solar thermal system performance shall be considered.

The mechanical sub contractor shall ensure that the proposed installation complies with all current CDM regulations, particularly where working at height and in relation to pressurised LTHW systems. The systems shall be installed to require minimum cleaning and maintenance where the panels are located on roof areas which are not flat.

The Mechanical sub contractor shall interface with all trade packages to ensure the satisfactory integration of the works with the architectural scheme and all other trade packages. These interfaces shall be detailed on all installation drawings and submitted to the Contract Administrator (hereafter referred to as the CA) and the Architect for approval.

The Mechanical sub contractor shall be responsible for all liaisons and submitting all drawings and documentations as required to the Building Control/District Surveyor for their approval/sign off. This process shall be co-ordinated with other approvals required by the Architect and Structural Engineer.

The Mechanical sub contractor shall be responsible for the coordination of access requirements and shall liaise with all trade mechanical sub contractors to ensure adequate access provisions to all components and ensure compliance with all CDM regulations.

The mechanical sub contractor shall advise the client on opportunities to make best value of the generated heat and determine a strategy for obtaining tariffs in relation to the proposed Renewable Heat Incentive (RHi) scheme.

The Mechanical sub contractor shall be responsible for programming the works within the main construction works and fit out.

The Mechanical sub contractor shall provide a sample of every item of equipment that shall be visible to the building users, for review by the Contract Administrator for approval.

The Mechanical sub contractor shall identify any opportunities for value engineering in writing to the Contract Administrator including any impact these might have on the level of service provided by the installation.

3.2 Scope of Work

The Main contractor will ultimately be responsible for the delivery of the building services systems for this Contract via a suitably qualified Mechanical and Electrical contractor (hereafter referred to as the M&E Sub-contractor) and specialist Sub- contractors (including the Solar Thermal mechanical sub contractor).

Design warranties shall also be required from the relevant mechanical sub contractors as outlined in the Main Contract preliminaries.

To design, supply, install, test and fully commission solar thermal hot water systems – to provide domestic hot water heating to the South Camden Community School.

To provide an outline description of any anticipated civil and building works, and liaise with the mechanical sub contractor for the provision of these requirements.

The STM heating system described within this section shall be on a performance basis and the works shall be carried out under the contractor Design Portion of the project.

The Mechanical sub contractor shall be fully responsible for the design, supply, delivery to site, installation, detailed co-ordination, cleaning, testing, commissioning and setting to work of the entire solar thermal hot water heating system to suit the specific requirement of the site. The entire solar thermal hot water heating system includes the following:

- Evacuated tube solar Modules
- Flat roof A-frame supports
- Storage Cylinders
- Circulation Modules
- Controls, including integration with the site Building Management System (BMS), monitoring and graphic information for occupant use
- Pumps
- Electric power, including connections to the site power

- Pipework, valves, supports and all ancillaries to complete the system installation
- Integration with the site Gas Fired Water Heating systems
- Testing and commissioning

It shall also include the supply of 'As Installed' record drawings and an operating and maintenance (O&M) manual.

The Mechanical sub contractor shall be responsible for the full design co-ordination of the solar thermal hot water heating system and ensuring that its associated services, storage, controls and its ancillaries are fully co-ordinated and integrated with the latest architectural, structural engineering layout drawings and mechanical and electrical services design.

The Mechanical sub contractor shall interface with all trade packages to ensure the satisfactory integration of the works with the architectural scheme and all other trade packages. These interfaces shall be detailed on all installation drawings and submitted for approval.

The Mechanical sub contractor shall be responsible for ensuring that the design is spatially consistent with the works of the architect and/or the consulting engineer. The Mechanical sub contractor shall also be responsible for the detailed co-ordination with the main contractor and all other trade contractors to ensure adequate access provisions to all components for repairs and maintenance.

The mechanical sub contractor shall be responsible for all liaisons and for submitting all drawings and documents as required to the Building Control/District Surveyor for their approval and sign off.

The Mechanical Sub contractor shall be responsible for surveying the existing site and routes prior to commencing the working installation and builders' work drawings.

The solar thermal hot water systems shall be installed by a certified installer of the Microgeneration Certification Scheme (MCS) covering microgeneration products and services.

3.3 Location

The solar thermal hot water systems shall be located in the following areas;

System 1

Solar thermal hot water system 1 will serve the Sports Hall area and local bathrooms as outlined in SCCS_P_5101-5104. The STM will be located on the roof of the Sports Hall, serving pre-heat cylinders on the floor below. The pre-heated water will be finally heated vie the gas-fired calorifer to achieve the design temperature. See drawings SCCS_P_5704_1-2.

System 2

Solar thermal hot water system 1 will serve the Kitchen and Drama changing/ showers area and local bathrooms as outlined in SCCS_P_5101-5104. The STM will be located on the roof of the block, the storage cylinders will be located within a rooftop plantroom adjacent to the panels.

To achieve optimum energy absorption, the modules must be oriented as close to due south as possible, layout outlined in SCCS_M_4000_1 and SCCS_M_4000_2, and the angle of inclination shall be 35 deg from the horizontal. Further coordination will be required with the architect to explore the maximum allowable inclination, final location and fixing details of the collectors.

3.3.1 Applicable Drawings

The following drawings shall be read in conjunction with this specification and the associated preliminaries;

- SCCS_P_5704_1 – Sports centre DHW schematic
- SCCS_P_5704_2 – Medburn schematic
- SCCS_P_5701_1-2 – Domestic hot water schematics
- SCCS_P_5101-5104 – Domestic water services

3.4 Design Parameters

3.4.1 Solar thermal collectors

Solar thermal hot water System 1 shall comprise 8no. roof mounted evacuated tube collectors (16 sqm absorber area). Based on the Vitasol 300 T panels or equivalent.

Solar thermal hot water System 2 shall comprise 10no. roof mounted evacuated tube collectors (20 sqm absorber area). Based on the Vitasol 300 T panels or equivalent.

The collectors for each system shall be arranged in line with the manufacturers recommendations to provide complete solar arrays. The collector array shall also be frost protected by an automatic drain down of the collector panels when the external temperature drops below 5 degC (or the manufacturers' minimum working temperature recommendation).

For hydraulic equalisation, rows of panels shall be equal in number and no less than 4 panels shall be adjoined in any row.

The mechanical sub contractor shall be responsible for ensuring safe operation of the overall system when the demand for hot water is at its minimum. This shall include sizing of all system components based on the minimum hot water demand and maximum peak solar irradiation for Camden.

3.4.2 Solar thermal collectors support

The mechanical sub contractor shall be responsible for the design of the supporting structure for the collectors. The supports shall be suitable for mounting externally on the flat roof taking into account snow load, wind load etc. The mechanical sub contractor shall confirm the fixing and mounting method and interface with roof finishes and shall coordinate with the Architect and the Structural Engineer.

3.4.3 Solar circuit (heat transfer) fluid

The mechanical sub contractor shall confirm the mixture of water and a non-toxic anti-freeze agent (Glycol or equivalent). It shall provide anti-freeze protection to the system.

3.4.4 Solar circuit circulation pump

The mechanical sub contractor shall be responsible for the final selection of the circulating pump based on the final layout of the solar collector and total pressure drop of the solar circuit, which consists of the resistance of the collectors, pipe, valves, fittings and heat exchanger in the cylinder(s).

3.4.5 Pipework of the solar circuit

Pipework shall be selected and confirmed by the mechanical sub contractor taking into account the following:

- Heat resistance up to the maximum temperature (i.e. 100 degC, to be confirmed by the specialist) anywhere in the collector loop and up to stagnancy temperature (to be confirmed by the specialist) near the collector.
- Compatibility with the heat transfer fluid. This means no chemical interactions are allowed between the pipework material and the anti-freeze agent.
- Thermal expansions within the temperature range (i.e. -4 degC to 100 degC).
- Solar circuit pipework shall be provided in accordance with the Buro Happold specification regarding pipeline insulation for the heating system.
- Solar circuit pipework shall be provided with a reverse return connection to balance the flow through the collector arrays.
- Where pipework is routed externally the insulation shall be weather protected by the application of Fibaroll insulation cladding or equivalent system. Equivalent system to be submitted for approval.

3.4.6 Solar 'Buffer'/ Storage Cylinder

Each solar thermal hot water system will serve 2 x solar buffer storage tanks, from which the hot water supply will feed gas fired water heaters. Each solar buffer storage tank will be approximately 500 litres storage volume.

The solar buffer tank will be served with a boosted cold water service (BCWS) connection. The internal indirect coils within the cylinders are effectively the heat exchanger, transferring energy from the solar thermal collectors' circuit to the incoming BCWS and thus raising the temperature of the stored water before it is drawn into the gas fired water heaters.

External insulation shall be provided to the buffer cylinders, achieving a heat loss of less than 2.7kWh/day calculated using DIN 4701-10. This is to prevent heat loss from the cylinders to the plantroom which may be subject to overheating in the summer. Similarly, all solar collector circuit pipework shall be insulated within the plantroom in line with BS 5970 and BS 5422 environmental thicknesses. All pipework and vessel insulation in plantrooms shall be protected by the application of metal cladding to ensure mechanical protection.

3.4.7 Legionella Protection Loop

A Legionella protection loop with circulating pump shall be allowed to prevent Legionella growth within the solar buffer cylinder. The controls system associated shall ensure the water within the solar preheat cylinder will be heated to at least 65 degC once a day out with normal working hours for thermal disinfection. Final arrangement shall be confirmed by the Specialist and be designed to comply with all relevant regulations.

3.4.8 Safety Equipment

A high limit safety cut out facility shall be provided (Electronic Temperature Limiter). The collector circuit must be protected in such a way that at the highest possible collector temperature (shut down temperature) no heat transfer medium can escape from the safety valve. The specialist shall size the expansion vessel based on the worst case scenario.

Where buildings are unlikely to be used through the summer holidays, a heat rejection loop will be required to minimise the damage to the glycol fluid through frequent boiling of the fluid. This will be in the form of a heat rejection radiator coupled to the solar themal pre-heat cylinders. The circuit will commence working when the water within the pre-heat tank exceeds a pre-determined set-point temperature, to be established by the specialist mechanical sub contractor. The specialist mechanical sub contractor shall provide the heat rejection radiator as part of the solar thermal package.

3.4.9 Temperature Sensors

There shall be a number of temperature sensors required for the control of the solar thermal system and the hot water heaters. They are as follows:

- Collector temperature sensor(s)
- Solar ‘Preheat’/ Storage Cylinder(s) temperature sensor(s)
- Temperature sensor in Boosted Cold Water pipe prior to entering the Solar ‘Buffer’ Cylinder
- Temperature sensor at the outlet pipe from the Solar ‘Preheat’ Cylinder

3.4.10 Measurement of Relevant Energy Consumption

A heat meter shall be provided to measure volume flow through the water heater and water temperatures. This shall enable the BMS to calculate how much energy is saved due to the solar hot water installation.

Other components shall be included as part of the system but these will be confirmed by the specialist, subject to the final arrangements for the integration of the solar thermal system. These will include:

- Solar manual filling pump
- Filling valve
- Expansion vessel
- Collector tank
- Air separator
- Solar control unit
- Flexible connection pipe
- Air vent valves
- Control valves
- Anti scale valves

3.4.11 Control System

The control system of the solar thermal array shall be linked to the overall BMS which shall have the capability to monitor the amount of energy saved by the solar hot water installation. This data shall be readily available or extracted from the BMS for the schools use.

The solar controller as part of the solar thermal system package shall be able to provide safe operation of the whole solar circuit and the interface with the control system of the hot water circuit.

Safety interlocks shall be linked to the BMS to allow a general alarm to be raised should any faults develop in the solar thermal system.

3.4.12 Testing and Commissioning

Sufficient time shall be allowed in the construction schedule for testing and commissioning to be adequately carried out and to ensure that any faults and equipment defects are identified and rectified.

Testing and commissioning shall include the following elements of the system, in line with all statutory requirements and good practise guidance:

- Solar collectors
- Solar primary circuit
- Solar thermal buffer cylinder
- Heat rejection circuit

3.5 Manufacturers

All manufacturers or suppliers listed below are on an EQUAL OR APPROVED basis, the mechanical sub contractor will include the costs associated with these specified manufacturers within their tender return.

Solar Thermal Hot Water system:	**Viessmann Limited** Hortonwood 30 Telford TF1 7YP
Gas Fired Water Heaters:	**A.O. Smith Water Heaters** Unit B8 Armstrong Mall Southwood Business Park Farnborough Hampshire GU14 ONR

4 Summary of Design Brief Documents

The mechanical sub contractor shall install the solar thermal hot water systems in line with all relevant standards and legislation. A number of British Standards have been listed below for information.

It should be noted that the British Standards listed below are not an exhaustive or all-inclusive list and does not relieve the mechanical sub contractor of his duties to comply with all relevant standards and legislation under the contract.

The principle design parameters shall be in line with the following standards, regulations, guidelines and codes of practice:

Statutory Legislation
BS – EN 12975-1
BS – EN 12975-2
Electricity at Work Regulations
Construction Design and Management Regulations 2007
Health and Safety at Work Act 1974
The Control of Substances Hazardous to Health Regulations
Disabilities Discrimination Act 1995
Electromagnetic Compatibility regulations 1992

Main Solar Thermal Hot Water Related Documents	
Standard	Description
CIBSE TM 13	Minimising risk of Legionnaires Disease
CIBSE TM 38	Renewable Energy Sources for Buildings
CIBSE Guide A	Design data
CIBSE Guide B	Installation and equipment data
CIBSE Guide C	Reference data
CIBSE Guide G	Public Health Engineering
CIBSE Guide J	Weather, Solar and Illuminance Data
CIBSE	Solar Heating Design and Installation Guide
CIBSE	Knowledge Series: Capturing Solar Energy (KS15)
SI 1999 No.1148	The water supply (water fittings) regulations
SI 1999 No. 1506	Amendment to – The water supply (water fittings) regulations
The Institute of Plumbing	Engineering services design guide

5 Summary of Tender Return Documents

The technical details within this specification represent the minimum standards, quality and performance which are acceptable. However, it is not intended for this document to limit competition, prevent product improvement or exclude manufacturers from supplying above standard products. Where standard products are offered the manufacturer shall demonstrate them to be equal or better than the performance requirements contained within this specification.

Bids shall list all the equipment necessary to complete system installations. In addition, documentation on the design, configuration, installation, operation and maintenance of the complete system shall be included.

The tender shall include the total bid price.

The tender shall include the required lead-time in delivery of equipment.

The tender shall include following performance information:

5.1 Tender Return Break Down

The tenders shall be evaluated on a number of criteria including whole life cycle costs and simplicity. Tenderers shall fill in the summary sheet attached in the appendix and providing additional detail as necessary. Tenderers shall provide the following tender break down:

1. Price and detailed breakdown of complete Solar Thermal System installations
2. Price to carry out installations
3. Price to carry out all commissioning
4. Price and details of operation and maintenance contract

5.2 Solar Thermal system

5.2.1 Power Supply

240v Single Phase and 400v 3 phase are available on site. The tenderer shall make it known if the proposed solar thermal system requires power of a different type.

5.2.2 Power Consumption

The peak electrical power draw of the pumps must be quoted by the supplier. Where possible all electric circuits shall draw zero power in a quiescent state.

5.2.3 Water Supply

The tenderer shall state the limitations of the solar thermal system in terms of water pressure, pH, colour, hardness and alkalinity. The tenderer shall also state any other water supply factors that are important to the efficient and smooth running of the solar thermal system specified.

5.3 Flat Plate Collectors

5.3.1 Annual Output (kWh)

The tenderer shall confirm the exact expected annual output of the system.

5.3.2 System Efficiency

The tenderer shall quote efficiencies when working at full load and part load. Independent verification of efficiency to a recognised standard such as BS EN 12975-1 is required.

5.3.3 Solar Thermal System Operation

The following details regarding boiler operation shall be provided:

1. The Maximum and Minimum Operating Pressure (bar)
2. Maximum and Minimum Operating Temperature (ºC)
3. Expected Return Temperature (ºC)
4. System water volume (litres)
5. System operational weight (kg)
6. Pressure drop across Collector(s) (kPa)
7. Maximum and minimum flow rates through Collectors (kg/s)
8. Design flow rate (kg/s)

5.4 Other Requirements

5.4.1 Warranty

The tenderer shall provide details of warranty cover and first year maintenance schedule.

5.4.2 First Year Maintenance Schedule

The tenderer shall provide details of first year maintenance schedule and details of attendance required by Client personnel for operation of the solar thermal system, with particular reference to attendance required under any operation and maintenance contract.

5.4.3 Drawings Required

The tenderer shall provide a plan view showing proposed location of the solar thermal collectors and thermal storage.

5.4.4 Sketch Details and Anticipated Civil and Builders Works

The tenderer shall provide sketch details and outline description of any anticipated civil or building works including, but not limited to:

- plinths
- dimensions of apertures required for boiler installation

5.4.5 Installation and Commissioning

The tenderer shall provide details of lead-time and proposed installation programme.

5.4.6 Solar Thermal Installation

The tenderer shall provide a method statement – including details of any services (electricity, water etc) and/or client personnel required during the installation.

5.4.7 Commissioning Protocol and Handover Documentation

Final handover shall not occur until such time as full load performance has been verified by the Client or Client's representative.

5.4.8 Guarantees

Manufacturer's guarantees shall be provided for all equipment and warranties transferred as required to the Client.

5.4.9 Servicing and Operator Control

The tenderer shall confirm that the following requirements are met.

5.4.9.1 Service Schedule

Recommended service schedule with terms and conditions for service supply shall be included.

5.4.9.2 Spare Parts

Spare parts necessary for 1 year's operation shall be included (clearly marked) with written recommendations for future stock levels.

5.4.9.3 Operator Training

Operator training for 2 individuals and routine troubleshooting and maintenance instruction for 2 individuals (including 1 from local heating mechanical sub contractor) must be included as a minimum.

The tenderer shall provide details of training provision.

5.4.9.4 Operation and Maintenance Manuals

The supplier shall provide at least 4x copies of all manuals to ensure the safe and reliable operation of the solar thermal collectors, storage cylinders and all ancillary equipment.

5.4.9.5 As Installed Drawings

The supplier shall provide at least 4x copies of all drawings to ensure the safe and reliable operation of the solar thermal collectors, storage cylinders and all ancillary equipment.

5.4.10 References

The tenderer shall provide a list of reference projects and units of similar equipment with year of installation, Installed capacity and names and addresses of customer contacts (3 references recommended).

6 Section C. Equipment, Materials and Workmanship

Contents

S10 Cold Water

S11 Hot Water

T30 Low and Medium Temperature Hot Water

S10.1 General

A Supply, install, clean, test and commission the complete cold water system.

B All equipment shall meet the performance criteria as detailed in the schedules and drawings.

C Consideration to water conservation issues should extend to current industry good practice.

S10.2 Quality Assurance

A Ensure that the design, construction, materials and finishes of all equipment are suitable for the location, climatic and operating conditions to which the installation will be exposed.

B Ensure that the whole installation complies with the relevant standards, including the following:

- BS 21:1985 - Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions). (Partially superseded by BS EN 10226-1:2004)
- BS 65:1991 - Specification for vitrified clay pipes, fittings and ducts, also flexible mechanical joints for use solely with surface water pipes and fittings
- BS 381C:1996 - Specification for colours for identification, coding and special purposes
- BS 416-1:1990 - Discharge and ventilating pipes and fittings, sand-cast or spun in cast iron. Specification for spigot and socket systems
- BS 417-2:1987 - Specification for galvanized low carbon steel cisterns, cistern lids, tanks and cylinders. Metric units
- BS 437:1978 - Specification for cast iron spigot and socket drain pipes and fittings
- BS 534:1990 - Specification for steel pipes, joints and specials for water and sewerage. (Replaced by BS EN 10224:2002 and BS EN 10311:2005 but remains current)
- BS 1010-2:1973 - Specification for draw-off taps and stopvalves for water services (screw-down pattern). Draw-off taps and above-ground stopvalves.
- BS 1196:1989 - Specification for clayware field drain pipes and junctions
- BS 1212-1:1990 - Float operated valves. Specification for piston type float valves (copper alloy body) (excluding floats)
- BS 1212-2:1990 - Float operated valves. Specification for diaphragm type float operated valves (copper alloy body) (excluding floats)
- BS 1212-3:1990 - Float operated valves. Specification for diaphragm type float operated valves (plastics bodied) for cold water services only (excluding floats)
- BS 1306:1975 - Specification for copper and copper alloy pressure piping systems
- BS 1564:1975 - Specification for pressed steel sectional rectangular tanks
- BS 1640-3:1968 - Specification for steel butt-welding pipe fittings for the petroleum industry. Wrought carbon and ferritic alloy steel fittings. Metric units
- BS 1710:1984 - Specification for identification of pipelines and services
- BS 1965-1:1963 - Specification for butt-welding pipe fittings for pressure purposes. Carbon steel. (Replaced by BS EN 10253-1:1999 but remains current)
- BS 2767:1991 - Specification for manually operated copper alloy valves for radiators
- BS 2879:1980 - Specification for draining taps (screw-down pattern)

- BS 3169:1986 - Specification for first aid reel hoses for fire-fighting purposes. (Current, but partially replaced by BS EN 694:2001 and BS EN 1947:2002 and has been proposed for withdrawal)
- BS 3505:1986 - Specification for unplasticised polyvinylchloride (PVC-U) pressure pipes for cold potable water. (Replaced by BS EN 1452-1:200, BS EN 1452-2:2000, BS EN 1452-3:2000, BS EN 1452-4:2000 and BS EN 1452-5:2000 but remains current)
- BS 3506:1969 - Specification for unplasticised PVC pipe for industrial uses
- BS 3799:1974 - Specification for steel pipe fittings, screwed and socket-welding for the petroleum industry
- BS 4211:2005 - Specification for permanently fixed ladders
- BS 4213:2004 - Cisterns for domestic use. Cold water storage and combined feed and expansion (thermoplastic) cisterns up to 500 l. specification
- BS 4346-1:1969 - Joints and fittings for use with unplasticised PVC pressure pipes. Injection moulded unplasticised PVC fittings for solvent welding for use with pressure pipes, including potable water supply. (Current, but replaced by parts 1 to 5 of BS EN 1452)
- BS 4346-2:1970 - Joints and fittings for use with unplasticised PVC pressure pipes. Mechanical joints and fittings, principally of unplasticised PVC. (Current, replaced by parts 1 to 5 of BS EN 1452)
- BS 4368-1:1998 - Metallic tube connectors for fluid power and general use. Split collet compression fittings
- BS 4508-1:1986 - Thermally insulated underground pipelines. Specification for steel cased systems with air gap
- BS 4514:2001 - Unplasticised PVC soil and ventilating pipes of 82.4mm minimum mean outside diameter, and fittings and accessories of 82.4mm and of other sizes. Specification
- BS 4549-1:1997 - Guide to quality control requirements for reinforced plastics mouldings. Guide to the preparation of a scheme to control the quality of glass reinforced polyester mouldings
- BS 4800:1989 - Schedule of paint colours for building purposes
- BS 4994:1987 - Specification for design and construction of vessels and tanks in reinforced plastics
- BS 4660:2000 - Thermoplastics ancillary fittings of nominal sizes 110 and 160 for below ground gravity drainage and sewerage. (Partially replaced by BS EN 13598-1:2003)
- BS 476-7:1997 - Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products
- BS 4825-1:1991 - Stainless steel tubes and fittings for the food and other hygiene applications. Specification for tubes
- BS 4825-2:1991 - Stainless steel tubes and fittings for the food and other hygiene applications. Specification for bends and tees
- BS 4825-3:1991 - Stainless steel tubes and fittings for the food and other hygiene applications. Specification for clamp type couplings
- BS 4825-4:1991 - Stainless steel tubes and fittings for the food and other hygiene applications. Specification for threaded (IDF type) coupling
- BS 4825-5:1991 - Stainless steel tubes and fittings for the food and other hygiene applications. Specification for recessed ring joint type couplings
- BS 4962:1989 - Specification for plastics pipes and fittings for use as subsoil field drains
- BS 4991:1974 - Specification for propylene copolymer pressure pipe

- BS 5154:1991 - Specification for copper alloy globe, globe stop and check, check and gate valves. (Partially replaced by BS EN 12288:2003)
- BS 5158:1989 - Specification for cast iron plug valves
- BS 5159:1974 - Specification for cast iron and carbon steel ball valves for general purposes
- BS 5163-1:2004 - Valves for waterworks purposes. Predominantly key-operated cast iron gate valves. Code of practice
- BS 5254:1976 - Specification for polypropylene waste pipe and fittings (external diameter 34.6 mm, 41.0 mm and 54.1 mm). (Replaced by BS EN 1451-1:2000 but remains current)
- BS 5255:1989 - Specification for thermoplastics waste pipe and fittings. (Partially replaced by BS EN 1329-1:2000, BS EN 1451-1:2000, BS EN 1455-1:2000, BS EN 1519-1:2000, BS EN 1565-1:2000, BS EN 1566-1:2000 but remains current)
- BS 5353:1989 - Specification for steel plug valves
- BS 5391-1:1976 - Specification for acrylonitrile-butadiene-styrene (ABS) pressure pipe. Pipe for industrial uses
- BS 5392-1:1976 - Specification for acrylonitrile-butadiene-styrene (ABS) pressure pipe. Fittings for use with pipe for industrial uses
- BS 5409-1:1976 - Specification for nylon tubing. Fully plasticised nylon tubing types 11 and 12 for use primarily in pneumatic installations
- BS 5422:2001 - Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C
- BS 5433:1976 - Specification for underground stopvalves for water services
- BS 5480:1990 - Specification for glass reinforced plastics (GRP) pipes, joints and fittings for use for water supply or sewerage
- BS 5481:1977 - Specification for unplasticised PVC pipe and fittings for gravity sewers. (Replaced by BS EN 1401-1:1998 but remains current)
- BS 5911-1:2002 - Precast concrete pipes, fittings and ancillary products. Specification for unreinforced and reinforced concrete pipes (including jacking pipes) and fittings with flexible joints (complementary to BS EN 1916:2002)
- BS 5911-5:2004 - Precast concrete pipes, fittings and ancillary products. Specification for prestressed non-pressure pipes and fittings with flexible joints
- BS 6282-1:982 - Devices with moving parts for the prevention of contamination of water by backflow. Specification for check valves of nominal size up to and including DN 54
- BS 6282-2:1982 - Devices with moving parts for the prevention of contamination of water by backflow. Specification for terminal anti-vacuum valves of nominal size up to and including DN 54
- BS 6282-4:1982 - Devices with moving parts for the prevention of contamination of water by backflow. Specification for combined check and anti-vacuum valves of nominal size up to and including DN 42
- BS 6399-3:1988 - Loading for buildings. Code of practice for imposed roof loads
- BS 6572:1985 - Specification for blue polyethylene pipes up to nominal size 63 for below ground use for potable water. (Obsolete. Superseded by BS EN 12201-1:2003, BS EN 12201-2:2003 and BS EN 12201-5:2003 but remains current)
- BS 6700:2006 - Design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. Specification (Partially superseded by BS EN 806-2:2005 and BS EN 806-3:2006)
- BS 7291-1:2006 - Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings. General requirements

- BS 7291-2:2006 - Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings. Specification for polybutylene (PB) pipes and associated fittings
- BS 7291-3:2006 - Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings. Specification for cross-linked polyethylene (PE-X) pipes and associated fittings
- BS 7291-4:1990 - Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings. Specification for chlorinated polyvinylchloride (PVC-C) pipes and associated fittings and solvent cement
- BS 7350:1990 - Specification for double regulating globe valves and flow measurement devices for heating and chilled water systems
- BS 7671 - Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition
- BS 7697:1993 - Nominal voltages for low voltage public electricity supply systems
- BS EN 215:2004 - Thermostatic radiator valves. Requirements and test methods
- BS EN 253:2003 - District heating pipes. Preinsulated bonded pipe systems for directly buried hot water networks. Pipe assembly of steel service pipe, polyurethane thermal insulation and outer casing of polyethylene
- BS EN 295-1:1991 - Vitrified clay pipes and fittings and pipe joints for drains and sewers. Requirements
- BS EN 545:2002 - Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods
- BS EN 593:2004 - Industrial valves. Metallic butterfly valves
- BS EN 598:1995 - Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods
- BS EN 639:1995 - Common requirements for concrete pressure pipes including joints and fittings
- BS EN 642:1995 – Pre-stressed concrete pressure pipes, cylinder and non-cylinder, including joints, fittings and specific requirement for pre-stressing steel for pipes
- BS EN 671-1:2001 - Fixed fire fighting systems. Hose systems. Hose reels with semi-rigid hose
- BS EN 671-2:2001 - Fixed fire fighting systems. Hose systems. Hose systems with lay-flat hose
- BS EN 694:2001 - Fire-fighting hoses. Semi-rigid hoses for fixed systems
- BS EN 1057:2006 - Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications
- BS EN 1092-1:2002 - Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges
- BS EN 1092-2:1997 - Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Cast iron flanges
- BS EN 1092-3:2003 - Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Copper alloy flanges
- BS EN 1092-4:2002 - Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Aluminium alloy flanges
- BS EN 1124-1:1999 - Pipes and fittings of longitudinally welded stainless steel pipes with spigot and socket for waste water systems. Requirements, testing, quality control
- BS EN 1124-2:1999 - Pipes and fittings of longitudinally welded stainless steel pipes with spigot and socket for waste water systems. System S. Dimensions

- BS EN 1124-3:1999 - Pipes and fittings of longitudinally welded stainless steel pipes with spigot and socket for waste water systems. System X; dimensions
- BS EN 1171:2002 - Industrial valves. Cast iron gate valves
- BS EN 1213:2000 - Building valves. Copper alloy stopvalves for potable water supply in buildings. Tests and requirements
- BS EN 1254-1:1998 - Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes. (Replaces BS 864-2:1983 which remains current)
- BS EN 1254-2:1998 - Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes
- BS EN 1254-3:1998 - Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with plastics pipes
- BS EN 1329-1:2000 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Unplasticised polyvinylchloride) (PVC-U). Specifications for pipes, fittings and the system
- BS EN 1401-1:1998 - Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticised polyvinylchloride (PVC-U). Part 1 Specifications for pipes, fittings and the system
- BS EN 1451-1:2000 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Polypropylene (PP). Specifications for pipes, fittings and the system
- BS EN 1452-1:2000 - Plastics piping systems for water supply. Unplasticised polyvinylchloride (PVC-U). General
- BS EN 1452-2:2000 Plastics piping systems for water supply. Unplasticised polyvinylchloride (PVC-U). Pipes
- BS EN 1452-3:2000 - Plastics piping systems for water supply. Unplasticised polyvinylchloride (PVC-U). Fittings
- BS EN 1452-4:2000 - Plastics piping systems for water supply. Unplasticised polyvinylchloride (PVC-U). Valves and ancillary equipment
- BS EN 1452-5:2000 - Plastics piping systems for water supply. Unplasticised polyvinylchloride (PVC-U). Fitness for purpose of the system
- BS EN 1453-1:2000 - Plastics piping systems with structured-wall pipes for soil and waste discharge (low and high temperature) inside buildings. Unplasticised polyvinylchloride (PVC-U). Specifications for pipes and the system
- BS EN 1455-1:2000 - Plastics piping systems for soil and waste (low and high temperature) within the building structure. Acrylonitrile-butadiene-styrene (ABS). Specifications for pipes, fittings and the system
- BS EN 1519-1:2000 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Polyethylene (PE). Specifications for pipes, fittings and the system
- BS EN 1565-1:2000 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Styrene copolymer blends (SAN + PVC). Specifications for pipes, fittings and the system
- BS EN 1566-1:2000 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Chlorinated polyvinylchloride (PVC-C). Specification for pipes, fittings and the system
- BS EN 1595:1997 - Pressure equipment made from borosilicate glass 3.3. General rules for design, manufacture and testing
- BS EN 1984:2000 - Industrial valves. Steel gate valves

- BS EN 10083-1:2006 - Steels for quenching and tempering. General technical delivery conditions
- BS EN 10083-2:2006 - Steels for quenching and tempering. Technical delivery conditions for non alloy steels
- BS EN 10083-3:2006 -Steels for quenching and tempering. Technical delivery conditions for alloy steels
- BS EN 10084:1998 - Case hardening steels. Technical delivery conditions
- BS EN 10085:2001 - Nitriding steel. Technical delivery conditions
- BS EN 10087:1999 - Free cutting steels. Technical delivery conditions for semi-finished products, hot rolled bars and rods
- BS EN 10088-1:2005 - Stainless steels. List of stainless steels
- BS EN 10088-2:2005 - Stainless steels. Technical delivery conditions for sheet/plate and strip of corrosion resisting steels for general purposes
- BS EN 10088-3:2005 - Stainless steels. Technical delivery conditions for semi-finished products, bars, rods, wire, sections and bright products of corrosion resisting steels for general purposes
- BS EN 10095:1999 - Heat resisting steels and nickel alloys
- BS EN 10216-1:2002 - Seamless steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties
- BS EN 10216-2:2002 - Seamless steel tubes for pressure purposes. Technical delivery conditions. Non-alloy and alloy steel tubes with specified elevated temperature properties
- BS EN 10216-3:2002 - Seamless steel tubes for pressure purposes. Technical delivery conditions. Alloy fine grain steel tubes
- BS EN 10216-4:2002 - Seamless steel tubes for pressure purposes. Technical delivery conditions. Non-alloy and alloy steel tubes with specified low temperature properties
- BS EN 10217-1:2002 - Welded steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties
- BS EN 10217-2:2002 - Welded steel tubes for pressure purposes. Technical delivery conditions. Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties
- BS EN 10217-3:2002 - Welded steel tubes for pressure purposes. Technical delivery conditions. Alloy fine grain steel tubes
- BS EN 10217-4:2002 - Welded steel tubes for pressure purposes. Technical delivery conditions. Electric welded non-alloy steel tubes with specified low temperature properties
- BS EN 10217-5:2002 - Welded steel tubes for pressure purposes. Technical delivery conditions. Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties
- BS EN 10217-6:2002 - Welded steel tubes for pressure purposes. Technical delivery conditions. Submerged arc welded non-alloy steel tubes with specified low temperature properties
- BS EN 10224:2002 - Non-alloy steel tubes and fittings for the conveyance of aqueous liquids including water for human consumption. Technical delivery conditions
- BS EN 10226-1:2004 - Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
- BS EN 10241:2000 - Steel threaded pipe fittings

- BS EN 10250-4:2000 - Open steel die forgings for general engineering purposes. Stainless steels
- BS EN 10255:2004 - Non-alloy steel tubes suitable for welding or threading. Technical delivery conditions
- BS EN 10312:2002 - Welded stainless steel tubes for the conveyance of aqueous liquids including water for human consumption. Technical delivery conditions
- BS EN 12201-1:2003 - Plastic piping systems for water supply. Polyethylene (PE). General
- BS EN 12201-2:2003 - Plastic piping systems for water supply. Polyethylene (PE). Pipes
- BS EN 12201-3:2003 - Plastic piping systems for water supply. Polyethylene (PE). Fittings
- BS EN 12201-5:2003 - Plastic piping systems for water supply. Polyethylene (PE). Fitness for purpose of the system
- BS EN 12334:2001 - Industrial valves. Cast iron check valves
- BS EN 12449:1999 - Copper and copper alloys. Seamless, round tubes for general purposes
- BS EN 12450:1999 - Copper and copper alloys. Seamless, round copper capillary tubes
- BS EN 13244-3:2002 - Plastics piping systems for buried and above-ground pressure systems for water for general purposes, drainage and sewerage. Polyethylene (PE). Fittings
- BS EN 13244-5:2002 - Plastics piping systems for buried and above-ground pressure systems for water for general purposes, drainage and sewerage. Polyethylene (PE). Fitness for purpose of the system
- BS EN 13280:2001 - Specification for glass fibre reinforced cisterns of one-piece and sectional construction, for the storage, above ground, of cold water
- BS EN 13397:2002 - Industrial valves. Diaphragm valves made of metallic materials
- BS EN 13709:2002 - Industrial valves. Steel globe and globe stop and check valves
- BS EN 13789:2002 - Industrial valves. Cast iron globe valves
- BS EN 13792:2002 - Colour coding of taps and valves for use in laboratories
- BS EN 13828:2003 - Building valves. Manually operated copper alloy and stainless steel ball valves for potable water supply in buildings. Tests and requirements
- BS EN 14154-1:2005 - Water meters. General requirements
- BS EN 80416-1:2002 - Basic principles for graphical symbols for use on equipment. Creation of symbol originals
- BS EN 80416-2:2001 - Basic principles for graphical symbols for use on equipment. Form and use of arrows
- BS EN 80416-3:2003 - Basic principles for graphical symbols for use on equipment. Guidelines for the application of graphical symbols
- BS EN 806-1:2000 - Specifications for installations inside buildings conveying water for human consumption. General
- BS EN 877:1999 - Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings. Requirements, test methods and quality assurance
- BS EN 969:1996 - Specification for ductile iron pipes, fittings, accessories and their joints for gas pipelines. Requirements and test methods
- BS EN ISO 1461:1999 - Hot dip galvanized coatings on fabricated iron and steel articles. Specifications and test methods
- BS EN ISO 8434-1:1998 - Metallic tube connections for fluid power and general use. 24° compression fittings

- BS EN ISO 9002:1994 - Quality systems. Model for quality assurance in production, installation and servicing. (Replaced by BS EN ISO 9001:2000 but remains current)
- BS ISO 9000-2:1997 - Quality management and quality assurance standards. Generic guidelines for the application of ISO 9001, ISO 9002 and ISO 9003
- BS EN ISO 15874-2:2003 - Plastics piping systems for hot and cold water installations. Polypropylene (PP). Pipes
- DD CEN/TS 14578:2003 - Plastics piping systems for water supply or drainage and sewerage. Glass-reinforced thermosetting plastics (GPR) based on unsaturated polyester resin (UP). Recommended practice for installation
- PD 970:2005 - Wrought steels for mechanical and allied engineering purposes. Requirements for carbon, carbon manganese and alloy hot worked or cold finished steels.

C Where reference is made to a British Standard (BS), a British Standard institution (BSI) recognised equivalent European Standard would also apply. Each type of equipment / material selected shall comply with the latest issue of the BS or European Standards.

D The installation shall also comply with the following:

- BBA British Board of Agrément Certificate, where applicable
- Plumbing Engineering Services Design Guide
- Current Building Regulations Approved Documents
- Water Supply (Water Fittings) Regulations.

E Ensure that the installation, equipment, materials, workmanship, testing and commissioning are in accordance with, and follow the recommendations of the water bylaws.

F Ensure that all materials are WRAS listed and approved for use in potable water systems.

G All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 97/23/EC, implemented in the UK through the Pressure Equipment Regulations 1999, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

G Check dimensions on site prior to ordering.

H Where relevant this document is to be read in conjunction with the following General Engineering clauses:

- For pipework installation refer to sections Y10, Y11, Y12, Y13
- For pumps section Y20
- For pipework cleaning and chemical treatment refer to section Y25
- For sound and vibration control measures refer to section Y45
- For thermal insulation section Y50
- For mechanical identification refer to section Y54
- For testing and commissioning refer to section Y51 and Y81
- For earthing and bonding section Y80
- For fixing to building fabric refer to section Y90
- For off site painting refer to section Y91

S10.3 Submittals

A Refer to Section A of this specification.

S10.9 Pipes and Fittings

A The cold water system pipes and fittings shall be installed in the positions as indicated on the drawings.

B All pipework should be installed, fixed, tested and commissioned to the manufacturer's recommendations.

S10.9.1 Stainless Steel Pipes and Fittings

A Cold water pipes and fittings shall be stainless steel manufactured from high grade austenitic stainless steel. For high pressure (up to 25 bar) domestic water applications use Type 316L (1.4404) as listed in BS EN 10088-1:2005. In marine or corrosive environments use grade 322. Pipes shall be straight, smooth, of true cylindrical bore and free from all flaws and imperfections.

B For pressures up to 16 bar, up to 108mm diameter, pipes and fittings can be jointed by a proprietary crimped press fit type of fitting, with appropriate sealing rings for potable water.

Alternative fittings:
15 to 50 TIG welded capillary fittings
65 – 200 PN40 flanges (BS EN 1092-1)
PN 25 for working pressures up to 17 bar
PN 40 for working pressures up to 25 bar.

C Joint rings shall be pre-cut and pre-drilled to suit the flange bolt centres
Screwed joints: Screwed joints are not permitted.

D Pipes crossing building expansion joints shall be provided with a flexible coupling either side of the joint.

E Tube: OD 21.3 to 219.1 (15 to 200) to BS EN 10216-5:2004, BS EN 10217-7:2005 or BS EN 10312:2002.

S10.9.2 Copper Pipes and Fittings

A Design conditions:

		Maximum temperature	30°C	65°C	110°C
Maximum pressure (bar gauge) for joints	compression or capillary with soft silver solder		16	10	6
	capillary, silver brazed or bronze welded		16	10	6

B Tube: Above ground: 15 to 159mm, copper tube BS EN 1057 R250 (equivalent to BS 2871 table X)
Below ground: 15 to 159mm, copper tube BS EN 1057 R250 (equivalent to BS 2871 table Y).

C Fittings: 15 to 159mm, either lead free capillary soldered or compression to BS EN 1254-1:1998 and BS EN 1254-2:1998 or for 15 to 54 mm at pressures up to 16 bar proprietary crimped press fit system with suitable sealing ring.
Fittings shall be marked with manufacturer's symbol to indicate lead free solder.

D Flanges: 15 to 159mm, bi-metal flange to BS EN 1092-3:
PN 10 for working pressures up to 6 bar.
PN 16 for working pressures up to 10 bar.

E Joints: 15 to 54mm, capillary, lead free soft solder or compression to BS EN 1254-1:1998 and BS EN 1254-2:1998.
Use capillary or welded joints in inaccessible locations.
Alternatively for sizes 15 to 54 mm proprietary crimped press fit system with suitable sealing ring can be used.
67mm and above, lead free bronze welding bi-metal flange to BS 1724.

F Flange joints: For sizes 67mm and above:
Joint rings shall be of brass construction, corrugated and of a diameter to lie within the circle of flange bolts as Taylor's.
Above 10 bar the rings shall be of the full face diameter of the flange.
Joint rings shall be pre-cut and where applicable pre-drilled to suit the flange bolt centres.
Joint rings containing any asbestos material are not permitted.

G Grooved joints: Victaulic grooved copper connection system may be used with hard drawn copper tube conforming to BS EN 1057, DN 54 diameter, roll grooved only with Victaulic tools designed specifically for grooving copper tubing.

Grooved copper couplings will consist of two ductile iron housings cast with offsetting, angle-pattern bolt pads coated with copper-coloured alkyd enamel. Gasket shall be pressure-responsive, synthetic rubber, secured together with plated steel bolts and nuts. Couplings will be manufactured to connect copper tubing sized tube and fittings. Flaring of tube and fitting ends to IPS dimensions is not permitted. Victaulic Style 606.

Grooved end Victaulic fittings will be ASTM B-75 alloy C12200, or B-152 alloy C11000 wrought copper or ASTM B-584 alloy C83600 (85-5-5-5) bronze sand castings with copper tubing sized grooved ends designed to accept Victaulic couplings. Flaring of tube and fitting ends to IPS dimensions is not permitted.

Grooved copper flange adapters will be cast of ductile iron coated with copper-colored enamel, flat faced, for engaging into roll grooved copper tube and fittings and bolting directly to pN10 flanged components. Victaulic Style 641.

Mechanical grooved joints shall only be installed by operatives trained by the coupling manufacturer in the use of grooving tools, application of groove, and installation of grooved joint products. The grooved coupling manufacturer's representative shall periodically visit the jobsite and review installation. Mechanical sub contractor shall remove and replace any joints deemed improperly installed.

S10.9.3 Plastics Pipes and Fittings

A Cold water pipes and fittings of plastics materials (PB, PP or PEX) or multi layer plastics composites shall be suitable for the pressures and must be WRAS approved materials and systems. Pipes shall be straight, smooth, of true cylindrical bore and free from all flaws.

B All pipework should be installed, fixed (with brackets at the appropriate spacing), tested and commissioned according to the manufacturer's recommendations. All intallers shall be fully trained and skilled with respect to fitting the particular system applied whether it be by fusion, electrofusion, fusion socket, compression fittings, push fit or solvent welding. Especial care must be taken and only the appropriate proprietary fittings used when changing from one pipework material to another.

C When bending pipes follow manufacturer's guidance with respect to minimum radius of bend and ensure there are no impressions on the pipe surface nor any compression damage on the inside of the bend.

D Be aware that, in general, plastics pipes or multi layer pipes with a metal layer are not electrically conductive The system must not be used for equipotential bonding or integrated into the earthing system.

E Certain plastics systems are sensitive to UV degradation and must be protected from sunlight both during storage and use.

F Pressure test and flush the pipework system according to manufacturer's recommendations. In addition check visibly every connection.

S11.1 General

A Supply, install, clean, test and commission the complete hot water system.

B Provide all equipment to meet the performance criteria as detailed in the schedules and drawings.

C Fabricate, assemble, test at works, deliver to site, install and commission all hot water heaters to provide hot water in full conformity with the drawings, specifications and recommendations by the equipment manufacturers.

D Consideration to water conservation issues should extend to current industry good practice.

S11.2 Quality Assurance

A Ensure that the design, construction, materials and finishes of all equipment are suitable for the location, climatic and operating conditions to which the installation will be exposed.

B Ensure that the whole installation complies with the relevant standards, including the following:

- BS 21:1985 - Specification for pipe threads for tubes and fittings where pressure-tight joints are made on the threads (metric dimensions). (Partially superseded by BS EN 10226-1:2004)
- BS 416-1:1990 - Discharge and ventilating pipes and fittings, sand-cast or spun in cast iron. Specification for spigot and socket systems
- BS 437:1978 - Specification for cast iron spigot and socket drain pipes and fittings
- BS 417-2:1987 - Specification for galvanized low carbon steel cisterns, cistern lids, tanks and cylinders. Metric units
- BS 476-7:1997 - Fire tests on building materials and structures. Method of test to determine the classification of the surface spread of flame of products
- BS 534:1990 - Specification for steel pipes, joints and specials for water and sewerage. (Replaced by BS EN 10224:2002 and BS EN 10311:2005 but remains current)
- BS 853-1:1996 - Specification for vessels for use in heating systems. Calorifiers and storage vessels for central heating and hot water supply
- BS 853-2:1996 - Specification for vessels for use in heating systems. Part Tubular heat exchangers and storage vessels for building and industrial services
- BS 1010-2:1973 - Specification for draw-off taps and stopvalves for water services (screw-down pattern). Draw-off taps and above-ground stopvalves
- BS 1196:1989 - Specification for clayware field drain pipes and junctions
- BS 1212-1:1990 - Float operated valves. Specification for piston type float valves (copper alloy body) (excluding floats)
- BS 1212-2:1990 - Float operated valves. Specification for diaphragm type float operated valves (copper alloy body) (excluding floats)
- BS 1212-3:1990 - Float operated valves. Specification for diaphragm type float operated valves (plastics bodied) for cold water services only (excluding floats)
- BS 1306:1975 - Specification for copper and copper alloy pressure piping systems

- BS 1566-1:2002 - Copper indirect cylinders for domestic purposes. Open vented copper cylinders. Requirements and test methods
- BS 1566-2:1984 - Copper indirect cylinders for domestic purposes. Specification for single feed indirect cylinders
- BS 1640-3:1968 - Specification for steel butt-welding pipe fittings for the petroleum industry. Wrought carbon and ferritic alloy steel fittings. Metric units
- BS 1640-4:1968 - Specification for steel butt-welding pipe fittings for the petroleum industry. Wrought and cast austenitic chromium-nickel steel fittings. Metric units
- BS 1710:1984 - Specification for identification of pipelines and services
- BS 1965-1:1963 - Specification for butt-welding pipe fittings for pressure purposes. Carbon steel. (Replaced by BS EN 10253-1:1999 but remains current)
- BS 2767:1991 - Specification for manually operated copper alloy valves for radiators
- BS 2879:1980 - Specification for draining taps (screw-down pattern)
- BS 3274:1960 - Specification for tubular heat exchangers for general purposes.
- BS 3505:1986 - Specification for unplasticised polyvinylchloride (PVC-U) pressure pipes for cold potable water. (Replaced by BS EN 1452-1:200, BS EN 1452-2:2000, BS EN 1452-3:2000, BS EN 1452-4:2000 and BS EN 1452-5:2000 but remains current)
- BS 3506:1969 - Specification for unplasticised PVC pipe for industrial uses
- BS 3799:1974 - Specification for steel pipe fittings, screwed and socket-welding for the petroleum industry
- BS 4346-1:1969 - Joints and fittings for use with unplasticised PVC pressure pipes. Injection moulded unplasticised PVC fittings for solvent welding for use with pressure pipes, including potable water supply. (Current, but replaced by parts 1 to 5 of BS EN 1452)
- BS 4346-2:1970 - Joints and fittings for use with unplasticised PVC pressure pipes. Mechanical joints and fittings, principally of unplasticised PVC. (Current, replaced by parts 1 to 5 of BS EN 1452)
- BS 4368-1:1998 - Metallic tube connectors for fluid power and general use. Split collet compression fittings
- BS 4508-1:1986 - Thermally insulated underground pipelines. Specification for steel cased systems with air gap
- BS 4514:2001 - Unplasticised PVC soil and ventilating pipes of 82.4mm minimum mean outside diameter, and fittings and accessories of 82.4mm and of other sizes. Specification
- BS 4660:2000 - Thermoplastics ancillary fittings of nominal sizes 110 and 160 for below ground gravity drainage and sewerage. (Partially replaced by BS EN 13598-1:2003)
- BS 4825-1:1991 - Stainless steel tubes and fittings for the food and other hygiene applications. Specification for tubes
- BS 4825-2:1991 - Stainless steel tubes and fittings for the food and other hygiene applications. Specification for bends and tees
- BS 4825-3:1991 - Stainless steel tubes and fittings for the food and other hygiene applications. Specification for clamp type couplings
- BS 4825-4:1991 - Stainless steel tubes and fittings for the food and other hygiene applications. Specification for threaded (IDF type) coupling
- BS 4825-5:1991 - Stainless steel tubes and fittings for the food and other hygiene applications. Specification for recessed ring joint type couplings
- BS 4962:1989 - Specification for plastics pipes and fittings for use as subsoil field drains
- BS 4991:1974 - Specification for propylene copolymer pressure pipe

- BS 5154:1991 - Specification for copper alloy globe, globe stop and check, check and gate valves. (Partially replaced by BS EN 12288:2003)
- BS 5158:1989 - Specification for cast iron plug valves
- BS 5159:1974 - Specification for cast iron and carbon steel ball valves for general purposes
- BS 5163-1:2004 - Valves for waterworks purposes. Predominantly key-operated cast iron gate valves. Code of practice
- BS 5254:1976 - Specification for polypropylene waste pipe and fittings (external diameter 34.6 mm, 41.0 mm and 54.1 mm). (Replaced by BS EN 1451-1:2000 but remains current)
- BS 5255:1989 - Specification for thermoplastics waste pipe and fittings. (Partially replaced by BS EN 1329-1:2000, BS EN 1451-1:2000, BS EN 1455-1:2000, BS EN 1519-1:2000, BS EN 1565-1:2000, BS EN 1566-1:2000 but remains current)
- BS 5353:1989 - Specification for steel plug valves
- BS 5391-1:1976 - Specification for acrylonitrile-butadiene-styrene (ABS) pressure pipe. Pipe for industrial uses
- BS 5392-1:1976 - Specification for acrylonitrile-butadiene-styrene (ABS) pressure pipe. Fittings for use with pipe for industrial uses
- BS 5409-1:1976 - Specification for nylon tubing. Fully plasticized nylon tubing types 11 and 12 for use primarily in pneumatic installations
- BS 5422:2001 - Method for specifying thermal insulating materials for pipes, tanks, vessels, ductwork and equipment operating within the temperature range -40°C to +700°C
- BS 5433:1976 - Specification for underground stopvalves for water services
- BS 5480:1990 - Specification for glass reinforced plastics (GRP) pipes, joints and fittings for use for water supply or sewerage
- BS 5481:1977 - Specification for unplasticised PVC pipe and fittings for gravity sewers. (Replaced by BS EN 1401-1:1998 but remains current)
- BS 5615:1985 - Specification for insulating jackets for domestic hot water storage cylinders
- BS 5911-1:2002 - Precast concrete pipes, fittings and ancillary products. Specification for unreinforced and reinforced concrete pipes (including jacking pipes) and fittings with flexible joints (complementary to BS EN 1916:2002)
- BS 5911-5:2004 - Precast concrete pipes, fittings and ancillary products. Specification for Pre-stressed non-pressure pipes and fittings with flexible joints
- BS 6144:1990 - Specification for expansion vessels using an internal diaphragm, for unvented hot water supply systems
- BS 6282-1:982 - Devices with moving parts for the prevention of contamination of water by backflow. Specification for check valves of nominal size up to and including DN 54
- BS 6282-2:1982 - Devices with moving parts for the prevention of contamination of water by backflow. Specification for terminal anti-vacuum valves of nominal size up to and including DN 54
- BS 6282-4:1982 - Devices with moving parts for the prevention of contamination of water by backflow. Specification for combined check and anti-vacuum valves of nominal size up to and including DN 42
- BS 6340-1:1983 - Shower units. Guide on choice of shower units and their components for use in private dwellings
- BS 6340-2:1983 - Shower units. Specification for the installation of shower units
- BS 6340-4:1984 - Shower units. Specification for shower heads and related equipment

- BS 6340-5:1983 - Shower units. Specification for prefabricated shower trays made from acrylic material. (Partially superseded by BS EN 251:2003)
- BS 6340-6:1983 - Shower units. Specification for prefabricated shower trays made from porcelain enamelled cast iron. (Partially superseded by BS EN 251:2003)
- BS 6340-7:1983 - Shower units. Specification for prefabricated shower trays made from vitreous enamelled sheet steel. (Partially superseded by BS EN 251:2003)
- BS 6340-8:1985 - Shower units. Specification for prefabricated shower trays made from glazed ceramic. (Partially superseded by BS EN 251:2003)
- BS 65:1991 - Specification for vitrified clay pipes, fittings and ducts, also flexible mechanical joints for use solely with surface water pipes and fittings
- BS 6572:1985 - Specification for blue polyethylene pipes up to nominal size 63 for below ground use for potable water. (Obsolete. Superseded by BS EN 12201-1:2003, BS EN 12201-2:2003 and BS EN 12201-5:2003 but remains current)
- BS 6700:1997 - Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their curtilages. (Partially superseded by BS EN 806-2:2005 and BS EN 806-3:2006)
- BS 6920-1:2000 - Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of the water. Specification
- BS 6920-2.1:2000 - Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water. Methods of test. Samples for testing
- BS 6920-2.2.1:2000 - Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water. Methods of test. Odour and flavour of water. General method of test
- BS 6920-2.2.2:2000 - Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water. Methods of test. Odour and flavour of water. Method of testing odours and flavours imparted to water by hoses and composite pipes and tubes
- BS 6920-2.2.3:2000 - Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water. Methods of test. Odour and flavour of water. Method of testing odours and flavours imparted to water by hoses for conveying water for food and drink preparation
- BS 6920-2.3:2000 - Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water. Methods of test. Appearance of water
- BS 6920-2.4:2000 - Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water. Methods of test. Growth of aquatic micro organisms test
- BS 6920-2.5:2000 - Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water. Methods of test. The extraction of substances that may be of concern to public health
- BS 6920-2.6:2000 - Suitability of non-metallic products for use in contact with water intended for human consumption with regard to their effect on the quality of water. Methods of test.
- BS 7074-1:1989 - Application, selection and installation of expansion vessels and ancillary equipment for sealed water systems. Code of practice for domestic heating and hot water supply

- BS 7074-2:1989 - Application, selection and installation of expansion vessels and ancillary equipment for sealed water systems. Code of practice for low and medium temperature hot water heating systems
- BS 7291-1:2006 - Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings. General requirements
- BS 7291-2:2006 - Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings. Specification for polybutylene (PB) pipes and associated fittings
- BS 7291-3:2006 - Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings. Specification for cross-linked polyethylene (PE-X) pipes and associated fittings
- BS 7291-4:1990 - Thermoplastics pipes and associated fittings for hot and cold water for domestic purposes and heating installations in buildings. Specification for chlorinated polyvinylchloride (PVC-C) pipes and associated fittings and solvent cement
- BS 7350:1990 - Specification for double regulating globe valves and flow measurement devices for heating and chilled water systems
- BS 7671 - Requirements for electrical installations. IET Wiring Regulations. Seventeenth edition
- BS 7697:1993 - Nominal voltages for low voltage public electricity supply systems
- BS EN 89:2000 - Gas-fired storage water heaters for the production of domestic hot water
- BS EN 295-1:1991 - Vitrified clay pipes and fittings and pipe joints for drains and sewers. Requirements
- BS EN 545:2002 - Ductile iron pipes, fittings, accessories and their joints for water pipelines. Requirements and test methods
- BS EN 593:2004 - Industrial valves. Metallic butterfly valves
- BS EN 598:1995 - Ductile iron pipes, fittings, accessories and their joints for sewerage applications. Requirements and test methods
- BS EN 639:1995 - Common requirements for concrete pressure pipes including joints and fittings
- BS EN 642:1995 - Pre-stressed concrete pressure pipes, cylinder and non-cylinder, including joints, fittings and specific requirement for Pre-stressing steel for pipes
- BS EN 806-2:2005 - Specifications for installations inside buildings conveying water for human consumption. Design
- BS EN 877:1999 - Cast iron pipes and fittings, their joints and accessories for the evacuation of water from buildings. Requirements, test methods and quality assurance
- BS EN 969:1996 - Specification for ductile iron pipes, fittings, accessories and their joints for gas pipelines. Requirements and test methods
- BS EN 1057:2006 - Copper and copper alloys. Seamless, round copper tubes for water and gas in sanitary and heating applications
- BS EN 1092-1:2002 - Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Steel flanges
- BS EN 1092-2:1997 - Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Cast iron flanges
- BS EN 1092-3:2003 - Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Copper alloy flanges
- BS EN 1092-4:2002 - Flanges and their joints. Circular flanges for pipes, valves, fittings and accessories, PN designated. Aluminium alloy flanges
- BS EN 1171:2002 - Industrial valves. Cast iron gate valves

- BS EN 1213:2000 - Building valves. Copper alloy stopvalves for potable water supply in buildings. Tests and requirements
- BS EN 1254-1:1998 - Copper and copper alloys. Plumbing fittings. Fittings with ends for capillary soldering or capillary brazing to copper tubes. (Replaces BS 864-2:1983 which remains current)
- BS EN 1254-2:1998 - Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with copper tubes
- BS EN 1254-3:1998 - Copper and copper alloys. Plumbing fittings. Fittings with compression ends for use with plastics pipes
- BS EN 1286:1999 - Sanitary tapware. Low pressure mechanical mixing valves. General technical specification
- BS EN 1287:1999 - Sanitary tapware. Low pressure thermostatic mixing valves. General technical specifications
- BS EN 1329-1:2000 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Unplasticised polyvinylchloride (PVC-U). Specifications for pipes, fittings and the system
- BS EN 1401-1:1998 - Plastics piping systems for non-pressure underground drainage and sewerage. Unplasticised polyvinylchloride (PVC-U). Part 1 Specifications for pipes, fittings and the system
- BS EN 1451-1:2000 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Polypropylene (PP). Specifications for pipes, fittings and the system
- BS EN 1452-1:2000 - Plastics piping systems for water supply. Unplasticised polyvinylchloride (PVC-U). General
- BS EN 1452-2:2000 - Plastics piping systems for water supply. Unplasticised polyvinylchloride (PVC-U). Pipes
- BS EN 1452-3:2000 - Plastics piping systems for water supply. Unplasticised polyvinylchloride (PVC-U). Fittings
- BS EN 1452-4:2000 - Plastics piping systems for water supply. Unplasticised polyvinylchloride (PVC-U). Valves and ancillary equipment
- BS EN 1452-5:2000 - Plastics piping systems for water supply. Unplasticised polyvinylchloride (PVC-U). Fitness for purpose of the system
- BS EN 1453-1:2000 - Plastics piping systems with structured-wall pipes for soil and waste discharge (low and high temperature) inside buildings. Unplasticised polyvinylchloride (PVC-U). Specifications for pipes and the system
- BS EN 1455-1:2000 - Plastics piping systems for soil and waste (low and high temperature) within the building structure. Acrylonitrile-butadiene-styrene (ABS). Specifications for pipes, fittings and the system
- BS EN 1519-1:2000 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Polyethylene (PE). Specifications for pipes, fittings and the system
- BS EN 1565-1:2000 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Styrene copolymer blends (SAN + PVC). Specifications for pipes, fittings and the system
- BS EN 1566-1:2000 - Plastics piping systems for soil and waste discharge (low and high temperature) within the building structure. Chlorinated polyvinylchloride (PVC-C). Specification for pipes, fittings and the system
- BS EN 1595:1997 - Pressure equipment made from borosilicate glass 3.3. General rules for design, manufacture and testing

- BS EN 1984:2000 - Industrial valves. Steel gate valves
- BS EN 10216-1:2002 - Seamless steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties
- BS EN 10216-2:2002 - Seamless steel tubes for pressure purposes. Technical delivery conditions. Non-alloy and alloy steel tubes with specified elevated temperature properties
- BS EN 10216-3:2002 - Seamless steel tubes for pressure purposes. Technical delivery conditions. Alloy fine grain steel tubes
- BS EN 10216-4:2002 - Seamless steel tubes for pressure purposes. Technical delivery conditions. Non-alloy and alloy steel tubes with specified low temperature properties
- BS EN 10217-1:2002 - Welded steel tubes for pressure purposes. Technical delivery conditions. Non-alloy steel tubes with specified room temperature properties
- BS EN 10217-2:2002 - Welded steel tubes for pressure purposes. Technical delivery conditions. Electric welded non-alloy and alloy steel tubes with specified elevated temperature properties
- BS EN 10217-3:2002 - Welded steel tubes for pressure purposes. Technical delivery conditions. Alloy fine grain steel tubes
- BS EN 10217-4:2002 - Welded steel tubes for pressure purposes. Technical delivery conditions. Electric welded non-alloy steel tubes with specified low temperature properties
- BS EN 10217-5:2002 - Welded steel tubes for pressure purposes. Technical delivery conditions. Submerged arc welded non-alloy and alloy steel tubes with specified elevated temperature properties
- BS EN 10217-6:2002 - Welded steel tubes for pressure purposes. Technical delivery conditions. Submerged arc welded non-alloy steel tubes with specified low temperature properties
- BS EN 10224:2002 - Non-alloy steel tubes and fittings for the conveyance of aqueous liquids including water for human consumption. Technical delivery conditions
- BS EN 10226-1:2004 - Pipe threads where pressure tight joints are made on the threads. Taper external threads and parallel internal threads. Dimensions, tolerances and designation
- BS EN 10241:2000 - Steel threaded pipe fittings
- BS EN 10255:2004 - Non-alloy steel tubes suitable for welding or threading. Technical delivery conditions
- BS EN 10312:2002 - Welded stainless steel tubes for the conveyance of aqueous liquids including water for human consumption. Technical delivery conditions
- BS EN 12327:2000 - Gas supply systems. Pressure testing, commissioning and decommissioning procedures. Functional requirements
- BS EN 12334:2001 - Industrial valves. Cast iron check valves
- BS EN 12449:1999 - Copper and copper alloys. Seamless, round tubes for general purposes
- BS EN 12450:1999 - Copper and copper alloys. Seamless, round copper capillary tubes
- BS EN 13792:2002 - Colour coding of taps and valves for use in laboratories
- BS EN 13828:2003 - Building valves. Manually operated copper alloy and stainless steel ball valves for potable water supply in buildings. Tests and requirements
- BS EN 60335-2-21:2003 - Specification for safety of household and similar electrical appliances. Particular requirements. Particular requirements for storage water heaters

- BS EN 60335-2-35:2002 - Specification for safety of household and similar electrical appliances. Particular requirements. Particular requirements for instantaneous water heaters
- BS EN 60335-2-73:2003 - Specification for safety of household and similar electrical appliances. Particular requirements for fixed immersion heaters
- BS EN ISO 8434-1:1998 - Metallic tube connections for fluid power and general use. 24° compression fittings
- BS EN ISO 9002:1994 - Quality systems. Model for quality assurance in production, installation and servicing. (Replaced by BS EN ISO 9001:2000 but remains current)
- BS EN ISO 15874-2:2003 - Plastics piping systems for hot and cold water installations. Polypropylene (PP). Pipes
- BS ISO 9000-2:1997 - Quality management and quality assurance standards. Generic guidelines for the application of ISO 9001, ISO 9002 and ISO 9003
- DD CEN/TS 14578:2003 - Plastics piping systems for water supply or drainage and sewerage. Glass-reinforced thermosetting plastics (GPR) based on unsaturated polyester resin (UP). Recommended practice for installation

C Where reference is made to a British Standard (BS), a British Standard institution (BSI) recognised equivalent European Standard would also apply. Each type of equipment / material selected shall comply with the latest issue of the BS or European Standards.

D The installation shall also comply with the following:
BBA British Board of Agrément Certificate, where applicable
Plumbing Engineering Services Design Guide
Current Building Regulations Approved Documents
Water Supply (Water Fittings) Regulations
HSE Legionnaires' disease - The Control of legionella bacteria in water systems (L8).

E Ensure that the installation, equipment, materials, workmanship, testing and commissioning are in accordance with, and follow the recommendations of the water bylaws.

F Ensure that all materials are WRAS listed and approved for use in potable water systems.

G All equipment and assemblies which fall within the scope of the Pressure Equipment Directive (PED) 97/23/EC, implemented in the UK through the Pressure Equipment Regulations 1999, must be tested by the manufacturers, and be certified as compliant with the Directive. Such compliance shall be evidenced by displaying the appropriate CE Mark on the equipment and assemblies.

H Check dimensions on site prior to ordering.

I Where relevant this document is to be read in conjunction with the following General Engineering clauses:

- For pipework installation refer to sections Y10, Y11, Y12, Y13
- For pumps section Y20
- For pipework cleaning and chemical treatment refer to section Y25
- For sound and vibration control measures refer to section Y45
- For thermal insulation section Y50
- For mechanical identification refer to section Y54
- For testing and commissioning refer to section Y51
- For earthing and bonding section Y80
- For fixing to building fabric refer to section Y90

- For off site painting refer to section Y91

S11.3 Submittals

A Refer to Section A of this specification.

S11.4 Electric Water Cylinders and Calorifiers

A Use:
- Direct unvented or
- Indirect unvented units as shown in the schedules.

B Hot water storage calorifiers shall be BBA, WRAS, BEAB, and CE approved. They shall comprise a stainless steel water container with internal air gap system. Containers shall be pressure tested to a minimum of 15 bar, batch tested to 30 bar and guaranteed for 25 years.

C Outer cases shall be constructed from corrosion proof materials. Thermal insulation shall consist of CFC/HCFC-free (ODP zero fire-retardant expanded polyurethane).

D Each system shall be complete with provision for expansion, combined pressure reducing strainer valve, check valve and cold water control valve rated at 3 bar.

E The heater shall be complete with a factory fitted temperature and pressure relief valve (set to operate at 5 bar and 90ºC) and manually resettable cutout for heating elements (set to operate at 85°C).

S11.4.1 Cylinder Fittings

A Each cylinder shall be fitted with the following:
- Pressure regulating valve (that also serves the cold outlets)
- Pressure / temperature relief valve thermometer
- Drain cock
- Strainer
- Anti-vacuum valve/check valve
- High limit thermostat (with manual reset), set to 90°C
- Low-level cut-out switch.

B Discharges from pressure relief valves shall be routed to discharge above local floor drains via a back inlet floor gulley connection or via a HepvO self sealing waste valve to foul water installed as recommended by manufacturer and in accordance with G3 of the Building Regulations.

C Each cylinder shall have connections for:
- Cold feed
- Primary HW flow and return.
-

S11.4.2 Immersion Heaters

A Heaters shall be replaceable embedded rod type element sheathed in corrosion resistant alloy.

B Provide a capillary thermostat externally adjustable from 40-70°C.

C Electrical supply for heaters shall be single phase 230V.

S11.8 Vented Hot Water Generators

A Hot water generators shall be copper shell hot water storage calorifiers.

B Each hot water generator shall be fitted with the following:
Pressure gauge
Temperature gauge
Safety valve
Anti-vacuum valve
High limit thermostat
Bursting disc
50mm thick outer insulation (minimum)
Steel outer jacket
Access manway (450mm wide)
Support legs / cradles
Finned heater battery
Destratification pump and link to time clock.

C Each hot water generator shall have connections for:
Cold feed
Primary LTHW flow and return
Secondary HW flow (and return if applicable)
Open vent
Drain valve.

S11.9 Unvented Hot Water Generators

A Hot water generators shall be copper shell hot water storage calorifiers.

B Each hot water generator shall be fitted with the following:
Pressure gauge
Temperature gauge
Safety valve
Anti-vacuum valve
High limit thermostat
Bursting disc
50mm thick outer insulation (minimum)
Steel outer jacket
Access manway (450mm wide)
Support legs / cradles
Finned heater battery
Destratification pump and link to time clock.

C Each hot water generator shall have connections for:
Cold feed

Primary LTHW flow and return
Secondary HW flow (and return if applicable)
Drain valve.

D Each system shall be complete with an expansion vessel, combined pressure-reducing valve with built in strainer, pressure relief valve (set to operate at 7 bar and 90ºC), discharge tundish, service valve and mounting brackets. Discharge from temperature and pressure relief valve shall be plumbed to discharge in a safe, visible manner.

S11.11 Two Pipe Hot Water Systems

A With pumped hot water return systems, two pumps should be supplied with one fitted and one bolted to the wall, for use as a spare. Valves and pressure gauges should be fitted as indicated on the standard installation detail with a single check valve on the cold feed and check valve within 300mm of the pump outlet.

S11.12 Plate Heat Exchangers

A Packaged Plate Heat Exchangers should be built around an epoxy coated chassis containing the heat exchanger, and associated pumps, valves and controls. The heat exchanger itself is to be constructed from a number of gasketed (EPDM) stainless steel (316) plates (unless for marine or aggressive water environments where 322 grade stainless steel plates should be used) . When Plate Heat Exchangers are to be used in combination with condensing boilers they should be able to operate with lower primary temperatures and achieve return temperatures in the mid 40s°C. Primary maximum operating pressure - 10 bar secondary maximum operating pressure - 6 bar. Maximum primary operating temperature 120°C.

B The unit should include a fully modulating, fast acting 3 port motorised control valve fitted to the primary circuit. This valve is to be modulated by an integral, purpose built PID controller, timer which senses the secondary water temperature and opens or closes the valve giving close control on heat input and providing accurate control of HWS temperature. The controller must also include alarms and have an LCD display to show the function and with menu driven operation/interrogation.

C The unit should include an integral pump for the primary water which is matched to the heat exchanger. Systems which utilise an existing primary feed pump, when connected to a packaged unit with its 3 port valve, will have an additional bypass.

D Primary and secondary connections are to be BSP threaded or flanged.

S11.13 Buffer Vessels

A Buffer vessels should be of stainless steel sized as shown in the drawings.

B Each hot water generator shall have connections for:

- Cold feed
- Primary LTHW flow and return
- Secondary HW flow (and return if applicable)
- Drain valve.

C Each vessel shall be fitted with the following:

- Pressure gauge

- Temperature gauge
- Safety valve
- Anti-vacuum valve
- High limit thermostat
- Bursting disc
- 50mm thick outer insulation (minimum)
- Steel outer jacket
- Access manway (450mm wide)
- Support legs / cradles.

D Each buffer vessel shall be complete with an expansion vessel, combined pressure-reducing valve with built in strainer, pressure relief valve (set to operate at 7 bar and 90°C), discharge tundish, service valve and mounting brackets. Discharge from temperature and pressure relief valve shall be plumbed to discharge in a safe, visible manner.

S11.15 Pipes and Fittings

A The hot water system pipes and fittings shall be installed in the positions as indicated on the drawings.

B All pipework should be installed, fixed, tested and commissioned to the manufacturer's recommendations.

S11.15.1 Stainless Steel Pipes and Fittings

A Cold water pipes and fittings shall be stainless steel manufactured from high grade austenitic stainless steel. For high pressure (up to 25 bar) domestic water applications use Type 316L (1.4404) as listed in BS EN 10088-1:2005. In marine or corrosive environments use grade 322. Pipes shall be straight, smooth, of true cylindrical bore and free from all flaws and imperfections.

B For pressures up to 16 bar, up to 108mm diameter, pipes and fittings can be jointed by a proprietary crimped press fit type of fitting, with appropriate sealing rings for potable water.

Alternative fittings:
15 to 50 TIG welded capillary fittings

65 – 200 PN40 flanges (BS EN 1092-1)

PN 25 for working pressures up to 17 bar

PN 40 for working pressures up to 25 bar.

C Joint rings shall be pre-cut and pre-drilled to suit the flange bolt centres

D Pipes crossing building expansion joints shall be provided with a flexible coupling either side of the joint.

E Tube: OD 21.3 to 219.1 (15 to 200) to BS EN 10216-5:2004, BS EN 10217-7:2005 or BS EN 10312:2002.

S11.15.2 Copper Pipes and Fittings

A Design conditions:

		Maximum temperature	30°C	65°C	110°C
Maximum pressure (bar gauge) for joints	compression or capillary with soft silver solder		16	10	6
	capillary, silver brazed or bronze welded		16	10	6

B Tube: Above ground: 15 to 159mm, copper tube BS EN 1057 R250 (equivalent to BS 2871 table X)
Below ground: 15 to 159mm, copper tube BS EN 1057 R250 (equivalent to BS 2871 table Y)

C Fittings: 15 to 159mm, either lead free capillary soldered or compression to BS EN 1254-1:1998 and BS EN 1254-2:1998 or for 15 to 54 mm at pressures up to 16 bar proprietary crimped press fit system with suitable sealing ring.

Fittings shall be marked with manufacturer's symbol to indicate lead free solder.

D Flanges: 15 to 159mm, bi-metal flange to BS EN 1092-3:
PN 10 for working pressures up to 6 bar.
PN 16 for working pressures up to 10 bar.

E Joints: 15 to 54mm, capillary, lead free soft solder or compression to BS EN 1254-1:1998 and BS EN 1254-2:1998.

Use capillary or welded joints in inaccessible locations.

Alternatively for sizes 15 to 54 mm proprietary crimped press fit system with suitable sealing ring can be used.

67mm and above, lead free bronze welding bi-metal flange to BS 1724.

F Flange joints: For sizes 67mm and above:

Joint rings shall be of brass construction, corrugated and of a diameter to lie within the circle of flange bolts as Taylor's.

Above 10 bar the rings shall be of the full face diameter of the flange.

Joint rings shall be pre-cut and where applicable pre-drilled to suit the flange bolt centres.

Joint rings containing any asbestos material are not permitted.

G Grooved joints: Victaulic grooved copper connection system may be used with hard drawn copper tube conforming to BS EN 1057, DN 54 diameter, roll grooved only with Victaulic tools designed specifically for grooving copper tubing.

Grooved copper couplings will consist of two ductile iron housings cast with offsetting, angle-pattern bolt pads coated with copper-coloured alkyd enamel. Gasket shall be pressure-responsive, synthetic rubber, secured together with plated steel bolts and nuts. Couplings will be manufactured to connect copper tubing sized tube and fittings. Flaring of tube and fitting ends to IPS dimensions is not permitted. Victaulic Style 606.

Grooved end Victaulic fittings will be ASTM B-75 alloy C12200, or B-152 alloy C11000 wrought copper or ASTM B-584 alloy C83600 (85-5-5-5) bronze sand castings with copper tubing sized grooved ends designed to accept Victaulic couplings. Flaring of tube and fitting ends to IPS dimensions is not permitted.

Grooved copper flange adapters will be cast of ductile iron coated with copper-colored enamel, flat faced, for engaging into roll grooved copper tube and fittings and bolting directly to pN10 flanged components. Victaulic Style 641.

Mechanical grooved joints shall only be installed by operatives trained by the coupling manufacturer in the use of grooving tools, application of groove, and installation of grooved joint products. The grooved coupling manufacturer's representative shall periodically visit the jobsite and review installation. Mechanical sub contractor shall remove and replace any joints deemed improperly installed.

S11.15.3 Plastics Pipes and Fittings

A Cold water pipes and fittings of plastics materials (PB, PP or PEX) or multi layer plastics composites shall be suitable for the pressures and must be WRAS approved materials and systems. Pipes shall be straight, smooth, of true cylindrical bore and free from all flaws.

B All pipework should be installed, fixed (with brackets at the appropriate spacing), tested and commissioned according to the manufacturer's recommendations. All installers shall be fully trained and skilled with respect to fitting the particular system applied whether it be by fusion, electrofusion, fusion socket, compression fittings, push fit or solvent welding. Especial care must be taken and only the appropriate proprietary fittings used when changing from one pipework material to another.

C When bending pipes follow manufacturer's guidance with respect to minimum radius of bend and ensure there are no impressions on the pipe surface nor any compression damage on the inside of the bend.

D Be aware that, in general, plastics pipes or multi layer pipes with a metal layer are not electrically conductive The system must not be used for equipotential bonding or integrated into the earthing system.

E Certain plastics systems are sensitive to UV degradation and must be protected from sunlight both during storage and use.

F Pressure test and flush the pipework system according to manufacturer's recommendations. In addition check visibly every connection.

T30.1 General

A This section covers low and medium temperature hot water (LTHW and MTHW) services and or distribution systems with working temperatures up to 120 °C and 10 bar gauge.

B All pipework shall be installed so as to allow for thermal expansion

C Where possible, avoid installing medium pressure mains in occupied spaces.

D All plant and equipment shall achieve specified duty when operating at altitudes between sea level and 150 metres above sea level at ambient temperatures of up to 40 °C with RH of 85%.

E Pipes and fittings stored on site or left disconnected shall have the ends effectively closed to prevent ingress of dirt etc.

F Where galvanising has become damage from screwing bending or other cause, the affected area shall be coated immediately with one coat primer and one coat galvanised paint.

T30.2 Quality Assurance

A Ensure that the design, construction, materials and finishes of all equipment are suitable for the location, climatic and operating conditions to which the installation will be exposed.

B Ensure that the whole installation complies with the relevant standards.

T30.3 Submittals

A Refer to Section A of this specification.

T30.4 Pipes and Fittings

T30.4.1 Steel Pipe and Fittings

A LTHW and MTHW pipework shall comply with BS EN 10255:2004 heavy grade (black finish) up to 125 mm nominal bore (140 mm OD) and with carbon steel to BS EN 10217-1:2002 Welded steel tubes or BS EN 10216-1:2002 Seamless steel tubes for pressure purposes for tube greater than 125 mm nominal bore (140 mm OD) Steel pipework shall be ungalvanised.

B Pipe joints shall be welded and shall comply with relevant BS and EN standards for specific sizes of pipe.

C Flanges shall be from forged steel and to BS EN 1092 complete with gaskets of materials suitable for temperature, pressure and operating condition to BS 6956 and BS 3063 as appropriate.

D Headers shall be flanged and complete with at least one spare set of valved and blanked connections.

T30.4.2 Installation Details

A Welding shall be in accordance with the HVCA Code of Practice TR/5. Welders shall hold current certificates by an approved inspection body. 10% of site welds on MTHW pipework shall be subject to non-destructive testing to BS 3923 as appropriate. Welding brackets direct to the structure shall not be permitted.

B Boiler flow and return headers shall be supported independently of the boilers themselves.

C On the system side of the isolating valve (fitted on flow) and flow balancing valves (fitted on return), circuit flows and returns from boiler headers shall each have sockets for thermometer and temperature sensors. Also drain points for circuit drain down.

D Unless stated elsewhere, branches shall be controlled and isolated by a double regulating valve (with pressure tappings for flow measurement) on the return and an isolating valve on the flow. Ensure joints and valves are accessible for maintenance purposes.

E Pipework shall follow the contour of walls with minimum 25 mm clearance (after insulation applied). Where installed in occupied spaces.

F Pipework opening entering and exiting buildings shall be sealed with silicon rubber, accompanied by a 6 mm mild steel blanking plate where openings are too large for silicon alone.

G Pipework systems shall be bonded to earth in accordance with IEE regulations.

T30.4.3 Pipeline Ancillaries

A Brackets shall be mild steel or malleable iron with ferrous fixings. Fixings shall be of proprietary type with a detachable clip, which may be removed without disturbing the fixing.

B Pipework shall be supported to permit free movement due to thermal expansion and contraction.

C Load bearing insulation shall be used in oversized brackets so the insulation is continuous and to avoid pipes sitting direct on metal brackets.

D Expansion and contraction shall generally be taken up with changes in direction or loops. Supports and guides shall be installed to ensure movement is taken up safely and without damaging the insulation. Where expansion joints are needed they shall be of the manufacturer's proprietary type (capable of not less than 3000 complete cycles), purpose made and fitted with guides, which are secured rigidly. The manufacturer shall inspect the installation prior to heat on.

E Joints shall not be permitted within a wall or floor thickness and shall be free from stresses due to expansion/contraction.

F Sleeves (fire rated to comply with building regulations in compartments) shall be provided through wall and floors and wall and ceiling plates where visible.

G Air vents shall be provided at all high points. They shall comprise either an air bottle (constructed from 300 mm long line size tube with cap) or auto air vent. Both to be piped safely to drain in a visible position with a globe valve and flange. Vents on MTHW systems shall be lockable with a warning notice. Automatic air vents shall not be employed on MTHW systems.

T30.6 Circulating Pumps

A Shall generally be electrically driven, direct drive centrifugal type, resiliently mounted and isolated from the pipework system. Circulators shall be mounted on concrete bases. All parts shall be of corrosion resistant material.

B Each pump shall be provided with isolating valves and pressure gauges on suction and discharge sides, strainers on suction side and check valves on discharge side. Tappings for BMS differential pressure sensors shall be provided between pump and isolating valves

T30.7 Valves and Ancillaries

T30.7.1 Valves and Cocks General

A Valves shall be easily accessible and fitted with spindle vertically upwards (in horizontal pipework).

B Up to 50 mm they shall be copper alloy or steel bodies, threaded. Above this shall be steel bodies, flanged.

C Valves connected to appliances shall have heat insulated hand wheels (on MTHW).

D All valves shall be labelled with a unique reference number on a steel or plastic plate.

E A durable, non-fading circuit diagram indicating position, function, size and reference number for each valve shall be mounted in each plantroom

F Valves shall be designed for the highest working pressure of the system.

T30.7.2 Isolating Valves

A Shall be either gate valves or butterfly valves suitable for the system operating temperature and pressure, threaded to BS 21/BS EN ISO 228 mated to a BS21 male pipe taper thread or flanged to BS EN 1092.

T30.7.3 Regulating Valves

A Shall comply with BS EN 13789 or BS 5154 (BS EN 12288) as appropriate.

T30.7.4 Gauges

A Shall be mounted on mild steel siphons with bronze isolating cocks.

B Pressure gauges shall have their scale marked in Bars from zero to 1.5 times operating pressure.

C Guages shall comply with BS EN 837-1 and be 150 mm diameter in steel cases, stove enamel finish.

T30.7.5 Check Valves

A Shall be either BS 1868 (steel) or BS 5154 (BS EN 12288) (gunmetal) screwed or flanged as for isolating valves above.

T30.7.6 Pressure Reducing Valves

A Shall be of the spring-loaded pilot-operated type. Up to 50 mm shall be threaded to BS 21/BS EN ISO 228 above this they shall be flanged to flanged to BS EN 1092 or BS 1560. Control of downstream pressure shall be to +/- 35 mbar. Pressure reducing valves shall be fitted with a downstream safety valve, pressure gauges and isolating valves up and downstream and a strainer upstream.

B Valves shall be lockable in any position in the range.

T30.7.7 Safety Valves

A Shall meet the BS for the boiler, calorifier or equipment to which they are connected and suitable for system conditions. They shall be totally enclosed spring loaded type with padlock. Discharge pipes shall terminate in safe visible positions.

T30.7.8 Pipeline Strainers

A Shall be to BS 21 to BS EN 1092-3 or BS EN 1254-2 as appropriate.

T30.8 Heating Emitters

A See specification section T21

B Emitters served by MTHW above 95 °C shall not be mounted lower than 2.0 metres or accessible by building occupants unless protected by approved screens.

T30.9 Calorifiers

A Storage calorifiers shall comply with BS 853 grade A or B as appropriate. Bodies shall be mild steel galvanised after manufacture (with tin coated tubes on secondary side) or copper.

B Non-storage calorifiers shall comply with BS 3274 type 2 or BS 853 grade A as appropriate. Bodies shall be cast iron or mild steel

C Calorifiers shall generally be complete with a safety valve (piped to discharge safely), pressure and temperature gauges on primary and secondary sides, tappings for temperature and high limit control sensors, a bursting disc, a drain cock.

D Heating surfaces shall be copper tubes, with provision for easy removal.

E Support for horizontal calorifiers shall be brick or concrete piers or steel cradles, vertical calorifiers shall be on a purpose made steel support frame.

T30.10 Cylinders

A Direct cylinders shall be galvanised mild steel and comply with BS 417, grade A or B as appropriate, or copper to BS 699 grade 1 or 2 as appropriate.

B Indirect cylinders shall be galvanised mild steel to BS 1565 class B or copper to BS 1566 Part 1 grade 2.

C Large cylinders and those for high pressure shall comply with BS 853.

D Support for horizontal cylinders shall be brick or concrete piers or steel cradles, vertical cylinders shall be on a purpose made steel support frame.

T30.11 Pressure Equipment Directive

A All equipment and assemblies connected in an MTHW system operating at or above 100 °C shall comply with the Pressure Equipment Directive and be evidenced as such by displaying the appropriate CE mark.

T30.12 Guards

A Fit guards in accordance with BS EN ISO 12100, so that it is impossible to touch a moving part.

B Provide cover plates so inspection and adjustment can be made. Cover plates to be held in position with spring clips.

T30.13 Thermal Insulation

A Shall comply with BS 5422 and BS 5970 as appropriate.

T30.14 Identification

A Pipe runs shall be colour coded after installation to meet the requirements of the current BS or EN standard.

B Laminated plates shall be fitted to all items of plant and equipment.

T30.15 Painting and Anti-Corrosion Treatment

A Internally mounted galvanised pipework shall be painted one coat primer and two coats of good quality paint to approved colour. Pipework shall be de-greased clean and dry before painting.

B All ferrous pipework and supports (not galvanised) shall receive one coat primer and two coats good quality paint to approved colour after erection on site.

T30.16 Fixing to Building Fabric

A All fixings shall be to the complete satisfaction of the architect and structural engineer.

T30.17 Safety of Installation

A Safety control components shall be fitted where there can be no doubt as to their efficacy.

B An automatic gas or oil shut off valve shall be provided on the fuel supply to the boilers, which will operate on a fire alarm or by fusible link located above the boiler.

C Lock-out control devices shall be guarded against unauthorised interference and shall need to be manually reset.

D Controls shall automatically recycle and restart if and when the relevant operational condition is restored to normal except where a safety device has triggered or lock-out has occurred.

E Control systems shall be arranged to recycle and have one attempt to start the MTHW boiler plant following a flame, pilot or ignition failure. If this fails controls will be arranged so that lock-out will occur.

F Safety devices shall be fitted to each boiler such that the primary fuel supply is shut off in the event of one or more of the following circumstances:

- Flame and/or pilot failure
- Failure to ignite the fuel within a certain time
- Low or no water flow
- Boiler high pressure.
- Failure of draft fan and/or automatic flue dampers
- Electrical fault (i.e. the firing control and safeties shall be fail safe)

T30.18 Draining and Flushing

A Pipework shall generally be graded to fall in direction of flow (minimum grade 1 in 300).

B Drainage points shall be provided at all low points comprising tee, isolating valve and hose union. Min diameter shall be 50mm or line size for main sizes below this. Also where pipes enter trenches or ducts 15mm drain points shall be provided above ground. On MTHW systems these shall be lockable with a warning notice provided.

C Full provisions for cleaning and flushing shall be provided in accordance with BSRIA commissioning codes. Blanked, valved flow and return connections shall be fitted in the boiler room for pre-commission flushing out of the system. These shall be at least 100mm or line size if mains are smaller.

T30.19 Chemical Treatment

A Provide a chemical solution injection system for pre commission cleaning and periodic dosing of anti corrosion and de-sludging chemicals. This shall comprise a valved water supply connection, a mixing tank, injection pumps, a dosing pot and interconnecting valves, pipework and fittings. Chemicals being injected into the system in the boiler room.

B Chemical injection shall be automatically controlled.

C Controls shall be provided for both manual and fully automatic operation of the treatment plant. Controls shall indicate alarm on water supply failure, power failure, low chemical level, failure to achieved specified quality.

D Be responsible for providing details of the source and character of the water supply to the plant room, and the water pressure at point of supply.

E Provision shall be made for the treatment of the system with suitable chemicals to provide corrosion protection and bacterial control. Appropriate and safe means of testing at intervals and further introduction of chemicals shall be provided. Treatment may be manual or automatic.

F Proposals for water pre-treatment and chemical injection are contained elsewhere. Check these for suitability of use with the water supply details identified above.

G Check and anti-vacuum valves and other provisions required by the water supply authority shall be provided to the mains supply, for protection from backflow.

H Line size valve connection shall be provided for initial filling of the system, separate from the treatment plant.

I Safety valves shall be discharged safely into the drainage system, with provision for effluent treatment as required by the local authority.

J Provision shall be made for safely taking water test samples from MTHW boiler plant, via a lockable isolating valve and a sample cooler (complying with BS 6068-6.7:1994, ISO 5667-7:1993)

K Two water test sample containers shall be provided within the boiler room.

L Safe storage of water treatment materials shall be provided. Note unless otherwise stated sufficient quantities of chemicals shall be provided for initial filling, re-filling, commissioning and operation at expected consumption rates for 12 months.

T30.20 Testing and Commissioning

A Provide all the plant and equipment, electricity and water for carrying out testing and commissioning including pressure gauges and temporary isolation, draining and safety valves. Pressure gauges shall possess current test certificates.

B Comply fully with the requirements of the BSRIA pre- commissioning checklist and CIBSE commissioning codes.

T30.21 Performance Testing

A Works pressure tests shall be carried out for pipe and fittings and test certificates shall be provided upon request.

B Site tests shall be carried out after installation or in stages as the erection proceeds to suit the requirements of the engineer. Test certificates shall be provided for all site testing.

C All welds shall be hammer tested for firmness.

D Allow for inspection of plant and equipment at manufacturers works by insurer and one other in accordance with regulations.

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